UNITED STATES ARMY IN WORLD WAR II

The Technical Services

THE SIGNAL CORPS: THE TEST

(December 1941 to July 1943)

by

George Raynor Thompson

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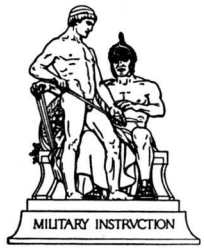

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History of

THE SIGNAL CORPS

The Emergency

The Test

The Outcome

. . . to Those Who Served

Foreword

The methods of modern warfare and its wide deployment of forces make effective communications one of the vital elements of victory. In the higher levels of command in the Army this is the responsibility of the Signal Corps. Actually, war laid far greater demands on Signal troops and equipment than the War Department had anticipated, and the rapid development of electronic devices continued to multiply these demands. For this reason, rather than through any fault of its own, the Signal Corps was perhaps the least ready of the technical services for the missions assigned to it after Pearl Harbor. That the Corps managed as well as it did to meet the demands of war was a tribute to the preparations described in the preceding volume of this subseries. The Corps' burgeoning activities during 1942 and the first half of 1943 are the theme of this second volume.

Based for the most part on War Department records, especially those of the Chief Signal Officer, the present history generally reflects his point of view. After March 1942 each of the technical services had its special problems within the fold of the Army Service Forces. Those of the Signal Corps were in some respects unique, and led to a partial decentralization of its functions from 1943 onward rather than to the centralized and autonomous control of Army communications that many Signal officers, including the Chief Signal Officer, wanted. The present volume shows how effectively, despite its organizational problems, the Corps managed in the period under review to prepare for its intricate and world-wide mission in the final war years.

ALBERT C. SMITH
Maj. Gen., U. S. A.
Chief of Military History

Washington, D. C.
3 December 1954

The Authors

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Dixie R. Harris received an A.B. degree from Ohio State University in 1933. After studying law for four years, she was admitted to the bar of Ohio in 1938. From 1942 to 1944 she was employed by the Signal Corps Publications Agency at Wright Field, Ohio. From 1945 to 1947 she was with the historical section of the Office of the Chief Signal Officer, and in 1949 she joined the staff of the Signal Corps section of the Office of the Chief of Military History. Since 1952 she has been assistant chief of the Signal Corps historical office.

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Preface

The scope of this, the second volume devoted to the history of the Signal Corps during World War II, covers the events of 1942 and the first six months of 1943. Like the first volume in the subseries, *The Emergency,* by Dr. Dulany Terrett, this book presents a broad, panoramic view of the progress and problems, the defeats and triumphs, of a technical service in wartime. Since the time span covers only eighteen months, it has been possible to examine certain operations in considerable detail. Such emphasis on particular matters should not be taken to mean that they are necessarily more important than others which are touched upon lightly or omitted altogether, but only that they are illustrative or typical of the three main streams of Signal Corps effort. Research and development, training, and supply each swelled so quickly to proportions so vast that they almost engulfed the Signal Corps in the first year of war. How the Corps met the test is the subject matter of this volume.

The treatment is in general chronological. The story opens with an account of the beginning, for the United States, of the war itself: those tense moments on the Hawaiian Island of Oahu when two young Signal Corps men at their radar picked up and tracked the Japanese bombers winging in to attack Pearl Harbor. Succeeding chapters carry the account forward on a broad front through the following months of severe shortages, worried production efforts, and feverish preparations for the first tests in combat with the enemy. They present the confusions and frustrations that attended the Army's call for signal specialists and items of signal equipment in incredible numbers. The story is told from the viewpoint of the Office of the Chief Signal Officer in Washington, where the important decisions were made that laid the groundwork for the eventually triumphant outcome. This viewpoint permits only side glances at Signal Corps activity in the theaters around the world until mid-1943, detailed theater accounts being reserved for the third and last volume in the Signal Corps' World War II subseries. Finally, this volume touches upon two problems not unlike those experienced by some other technical services: how the Signal Corps fared within the framework of the conglomerate Army Service Forces, and how a conflict between development and procurement, and between operations and both, reached a crisis. The book ends with this crisis brought into focus in a conflict which led to the retirement of the Chief Signal Officer, but which brought forth no solid solution.

This book is a product of truly collaborative effort. Four writers working together produced the first draft, often two or more having labored over the same chapter. The chronological arrangement is owed to Dr. Terrett, until mid-1952 the chief of the Signal Corps historical office when it was located in the Office of the Chief of Military History. The contents of the book are in general handled according to subject in time segments: first, through the early months of the war, then through the second half of 1942, and finally through the first half of 1943. Only one subject receives strictly topical treatment. It is Signal Corps photography, or the story of the Army Pictorial Service, which Chapter XIII covers for the entire 18-month period. The research and writing on the procurement and supply chapters are principally the work of Mrs. Harris, the training chapters the work of Miss Oakes, and the equipment studies the work of Dr. Thompson. The final reworking and revision of the first draft, together with much additional research and writing, were accomplished by Dr. Thompson and Mrs. Harris after this office was reorganized within the Signal Corps in August 1952.

The authors are indebted to the Historical Section which existed in the Signal Corps from 1943 to early 1947 and whose members compiled a number of useful monograph studies, recorded many interviews, and collected a considerable quantity of valuable historical files. A large debt is owed to Mrs. Helen Sawka for her faithful and meticulous care and accuracy in checking and typing the manuscript throughout its several drafts and revisions. The authors are grateful for the corrections and comments of the many Signal Corps officers and personnel who reviewed the manuscript. They recognize, too, the invaluable advice and suggestions of those in the Office of the Chief of Military History who supervised and edited the text, especially Lt. Col. Leo J. Meyer, the Deputy Chief Historian, Dr. Stetson Conn, his successor, and Miss Ruth Stout, the editor of the subseries. Many thanks are due likewise to others who aided the editorial process: Mr. David Jaffé, Mrs. Loretto Stevens, and the photographic editor, Maj. Arthur T. Lawry, who searched out and prepared the illustrations.

Washington, D. C.
3 December 1954

GEORGE RAYNOR THOMPSON
Chief, Historical Division Signal Corps

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All photographs in this volume are from U.S. Department of Defense files.

THE SIGNAL CORPS: THE TEST

CHAPTER I

December 1941

"This Is Not Drill"

At four o'clock on the morning of 7 December 1941, two U. S. Army signalmen switched on the radar at their station near the northernmost point of Oahu. They would be on duty until seven, when a truck would call to take them back to the post for breakfast. The rest of the day would be theirs, for it was Sunday, and the big SCR–270 radar would be closed down until the next early morning shift. Along with five other mobile stations spotted around the perimeter of the island until the permanent sites could be made ready, the Opana radar was intended to operate for two hours before dawn and one afterward, according to the latest operating schedule agreed upon under the past week's alert.[1]

Throughout the Hawaiian Department the alert had been ordered rather suddenly on Thanksgiving Day, and instructed all troops to be on guard against acts of sabotage. The *Honolulu Advertiser* had printed a story on the Saturday after Thanksgiving that had carried the headline "Japanese May Strike over Weekend," and certainly it was difficult not to see how ominous the international situation was; yet nothing had happened, after all, and the round-the-clock operating schedule which the alert had brought about had been relaxed. Another week of menacing headlines had reached a climax just the day before, on 6 December, with a warning, "Japanese Navy Moving South," on the first page of the *Advertiser*.[2] Many persons felt that it would be well, in view of the large population of Japanese origin in the Hawaiian Islands, to prepare for the possibility that a Japanese power drive into the rich Asiatic Indies might be accompanied by trouble stirred up locally.

The officers charged with aircraft warning saw no reason to anticipate trouble beyond that possibility. The operation of the radars and the control of the Signal Aircraft Warning Company, Hawaii (13 officers and 348 enlisted men) were currently responsibilities of the signal officer of the Hawaiian Department, although when the training phase was completed they were to be turned over to the Air Forces, which controlled the information center and the other elements comprising the aircraft

[1] *Pearl Harbor Attack: Hearings Before the Joint Committee on the Investigation of the Pearl Harbor Attack* (Washington, 1946), Pt. 18, pp. 3013–14. (Hereafter, Parts 1 through 39 will be referred to by the short title *Pearl Harbor Attack*. See Bibliographical Note.) Accounts of events in Washington, including War Department warning messages to the field commanders, may be found in this report. See also Mark Skinner Watson, *Chief of Staff: Prewar Plans and Preparations*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1950), especially pp. 494–520.

[2] *Pearl Harbor Attack*, Pt. 7, p. 3080.

warning system.[3] The alert which the commanding general, Lt. Gen. Walter C. Short, had ordered into effect upon receipt of secret messages from his superiors in the War Department was the lowest of three grades, an alert against sabotage. Accordingly, in order not to risk burning out the radars, for which there were few spare parts, the acting signal officer of the Hawaiian Department (in the absence of the signal officer, who was on a trip to the United States) had instituted a short but intensive schedule calling for radar search during the three hours considered to be the most dangerous each day. Moreover, the platoon lieutenant of the Signal Aircraft Warning Company, Hawaii, who had the Opana crew under his responsibility, had agreed that two men would be enough for the Sunday operation and had let the third, normally on the roster for that duty, off with a pass to Honolulu. Pvt. Joseph L. Lockard and Pvt. George A. Elliott drew the duty, went up to the station Saturday afternoon, and woke themselves up at four to begin their stint.

The radio aircraft-detection device, the SCR–270, was very new and very secret. It generated a powerful pulse of electricity which its antenna threw out into the surrounding sky, and it caught upon the luminous face of its oscilloscope the reflection of the interrupted electric beams in case anything got in the way. Some of these echoes were steadfast, caused by nearby cliffs and hills beyond which the radar was blind. Others were temporary—and these were the ones to watch for. They indicated and tracked airplanes in the sky reflecting the invisible beams of the radar transmitter.

For the entire three hours of their scheduled watch, Privates Lockard and Elliott saw nothing out of the ordinary. Elliott was new to the device, but it was as apparent to him as to Lockard that the oscilloscope showed a normal early dawn sky, with an occasional airplane from one of the military or naval fields on the island. At 0700 they prepared to close down. The truck was late. The radar hut was warmer than the out-of-doors and there were places to sit down, so Elliott urged that they keep the equipment on while they were waiting. He could then take advantage of a good opportunity to practice with it under Lockard's supervision. At 0702 an echo appeared on their oscilloscope such as neither of them had ever seen before. It was very large and luminous. They reasoned that something must be wrong with the equipment. Lockard checked it, found it in good working order, and observed that the echo was as large as ever. He took over the dial controls, and Elliott moved over to the plotting board. By their calculations, a large flight of airplanes was 132 miles off Kahuku Point and approaching at a speed of three miles a minute.

Because such a large formation was so unusual, Private Elliott suggested that they report it to the information center. After some discussion, Lockard agreed, and Elliott made the call at 0720.[4] At the informa-

[3] (1) History of Subsection G–2, HUSAFMIDPAC, United States Army Forces, Middle Pacific and Predecessor Commands, I, 1–2, 25. (Hereafter cited as Hist of Subsec G–2, HUSAFMIDPAC.) OCMH. (2) *Pearl Harbor Attack*, Pt. 31, APHB Exhibit 58, Report on the Establishment of AWS in Hawaii, with Incls 1–181. (3) Testimony of Maj Gen Howard C. Davidson, APHB, pp. 4125–51. MS File, Pearl Harbor, DRB AGO. (4) Sig AW Co, Hawaii, History of the Aircraft Warning System in Hawaii. AF Archives SIG–(HAWAII)–HI, 7896–54.

[4] (1) *Pearl Harbor Attack*, Pt. 22, p. 221, and Pt. 29, p. 2121ff; Pt. 27, pp. 517–26; Pt. 36, p. 561. (2) Testimony of Pvts George A. Elliott and Joseph L. Lockard, APHB, pp. 994–1014, 1014–34. MS File, Pearl Harbor, DRB AGO.

tion center at Fort Shafter, atop a small concrete building used as a signal warehouse, only Pvt. Joseph P. McDonald, 580th Aircraft Warning Company, Oahu, and a young Air Corps lieutenant, Kermit Tyler, were present in the building. The plotters had left at 0700 to enjoy their first off-duty day in a month. McDonald had been on duty at the private branch exchange switchboard since 1700 the previous evening, and was waiting out the last ten minutes until he, too, would leave at 0730. So far as he knew at the moment he was alone in the building. There was no one at the Navy position—no one had been appointed. Tyler would not have been in the center, either, except that he was new, and the air control officer had thought it a good idea for him to take a four-hour tour of duty to become acquainted with the routine. Thus it was only an accident that Lockard and Elliott happened to be on hand at the detector station after 0700, and part of no formal schedule that McDonald and Tyler happened to be on hand after that time at the information center.

When McDonald answered Elliott's call, Elliott told him that a large number of planes was coming in from the north, three points east, and asked him to get in touch with somebody who could do something about it. McDonald agreed, hung up, looked around and saw Lieutenant Tyler sitting at the plotting board. McDonald gave him the message. Tyler showed no interest. McDonald then called back the Opana unit, and got Lockard on the wire. By this time Lockard was excited, too. McDonald, leaving Lockard on the wire, went back and asked Tyler if he wouldn't please talk to the Opana men. Tyler did, spoke to Lockard, and said, in effect, "Forget it." Tyler had heard that a flight of Army bombers was coming in from the mainland that morning, and he had heard Hawaiian music played through the night over the radio, a common practice for providing a guide beam to incoming pilots flying in from the mainland. He assumed that the airplanes the radar was reporting were either the B–17's expected from the west coast, or bombers from Hickam Field, or Navy patrol planes.[5]

Back at the Opana station after talking with Tyler, Lockard wanted to shut the unit down, but Elliott insisted on following the flight. They followed its reflection to within twenty miles, where it was lost in a permanent echo created by the surrounding mountains. By then it was 0739.[6] A little later the truck came, and they started back to the camp at Lawailoa for breakfast. On the way, they met a truck headed away from camp, bearing the rest of the crew with all their field equipment. The driver for Lockard and Elliott blew the horn to signal the other truck to stop, but the driver paid no attention and kept on going.

The Japanese air attack on Pearl Harbor began at 0755, with almost simultaneous strikes at the Naval Air Station at Ford Island and at Hickam Field, followed by attacks on strategic points all over the island of Oahu. The residents of Oahu were accustomed to the sight and sound of bombs used in military practice maneuvers; they did not realize immediately that this time it was no practice drill. Some of the Signal Corps officers on the island were on duty; others were alerted by the first wave of bombings; still others knew nothing of it until notified officially.

[5] *Pearl Harbor Attack,* Pt. 27, p. 569, and Pt. 32, pp. 343–44. See also Pt. 10, pp. 5027–33; Pt. 27, pp. 520–22, 531–33; Pt. 29, pp. 2121–26.

[6] *Ibid.,* Pt. 21, Item 38, Original Radar Plot Opana Station 7 Dec 41.

Lt. Col. Carroll A. Powell, the Hawaiian Department signal officer, had just returned from a trip to the mainland. Lt. Col. Maurice P. Chadwick had been appointed only a month before as signal officer of the 25th Infantry Division, which was charged with the defense of the beaches, the harbor, and the city of Honolulu. He was in his quarters at Hickam Field when the first bomb dropped on the battleships in the harbor. A few minutes later Japanese planes winged in low over his house as they attacked the nearby hangars. Hastily the colonel piled mattresses around a steel dining table and gathered his children under its shelter. Then he hurried off to direct the communication activities of the signal company as the troops moved into position.[7]

The officer in charge of the wire construction section of the department signal office, 1st Lt. William Scandrett, was responsible for installing and maintaining all permanent wire communication systems throughout the islands—command and fire control cables, post base distribution facilities, and the trunking circuits from major installations. By one of the quirks of fate that determine the course of events, the Engineers had been remodeling the tunnels at the battle command post, and the Signal Corps had removed the switchboard and distribution cables to preserve them from the blasting and construction. Thus the command post was virtually without telephone communication when the Japanese struck. At once Scandrett's Signal Corps crews rushed to the command post and restored the switchboard and cables in record time.[8]

At Schofield Barracks, men from the communications section of the 98th Antiaircraft Regiment were frantically setting up switchboards and connecting telephones at the regimental command post at Wahiawa for the gun positions around Wheeler Field and Schofield Barracks. The communications lines had been strung to each gun position, and at the command post itself all the wires were in and tagged. But under the November alert the telephones and switchboards remained in the supply room at Schofield Barracks as a precaution against theft and sabotage. About 0830 2d Lt. Stephen G. Saltzman and S. Sgt. Lowell V. Klatt saw two pursuit planes pull out of a dive over Wheeler Field and head directly toward them. Each of the men seized an automatic rifle and began firing. One of the two planes, trapped by high tension wires, crashed on the far side of the command post building. Running around to look at it, the men felt worried—to use Saltzman's words—at seeing an American engine, an American propeller, and an American parachute. "And, well, that's about all there was to it"—except that Air Corps Intelligence later decided that the plane was Japanese—"and we went back and finished setting up our communications." [9] Within twenty-five minutes the equipment was connected. In fact, communications were set up hours before the guns were in place and ready to fire, in late afternoon.

Within a half hour after the first bombs fell in Hawaii, the Signal Aircraft Warning

[7] Interv, SigC Hist Sec with Col Chadwick (formerly Sig Officer, 25th Inf Div, Hawaiian Dept), 16 Oct 43. SigC Hist Sec File. (See Bibliographical Note.)

[8] Warrant Officer John E. Carney later received a Legion of Merit for his work that morning. Interv, SigC Hist Sec with Lt Col William Scandrett (formerly O/C Wire Const Sec, Hawaiian Dept Sig Off), 28 Jul 44.

[9] (1) *Pearl Harbor Attack*, Pt. 22, pp. 273–74, 278–79. (2) Hist of Subsec G–2, HUSAFMIDPAC, I, 48–49, citing Ltr, Hq 98th AA, Schofield Barracks, to CG 53d Brigade AA, Ft. Shafter, 15 Dec 41, sub: Narrative rpt of initial opn of 98th CA to meet Japanese attack on Oahu, 7 Dec 41.

Company, Hawaii, had manned all six radar stations and the information center.[10] About 1000 a bomb blast cut the telephone wires leading from the Waianae radar to the information center. The Waianae station commander at once sent a detail of his men to the nearest town where they confiscated a small 40-watt transmitter and antenna, together with the Japanese operator, who was prevailed upon to help install the set in the station. By 1100 the Waianae radar station was communicating with the information center by radio, thus establishing the first radio link in what became within the next few weeks an extensive aircraft warning radio net covering both Oahu and the principal islands nearby.[11]

The attacking Japanese planes withdrew to the northwest, the earliest returning to the carriers by 1030, the latest by 1330.[12] The Opana station, reopened after the first wave of Japanese planes attacked, tracked that flight or some other flight back from Oahu in the same northerly direction from 1002 to 1039. In the confusion and turmoil, amid numerous false reports from both civilian and military sources, the Navy sent its ships and planes out to search for the Japanese carriers, centering the search to the southwest. The Air Corps also sent planes in that direction. There was much bitterness afterward over the question of why there was no search to the north, and why the radar information of the outgoing flights, apparently headed back to rendezvous, was not given to the searchers at the time.[13] The reasons for this failure are much the same as those that underlay other mishaps of that day: the information center, and indeed the entire aircraft warning system, was still in a training status, and if any one in authority saw the radar plot, he was too inexperienced to realize its possible significance at the time.[14]

Except for one major cable put out of

[10] The six 270's were set up on Oahu at Kawailea, Waianae, Koko Head, Kaaawa, Ft. Shafter, and Opana. Hist of AWS Hawaii cited n. 3(4).

Signal AW Company, Hawaii, was the largest single Signal Corps unit in the territory on 7 December. The following is a strength report by units and stations on Oahu at that date:

	Enlisted	*Officer*
Total	1,283	38
Ft. Shafter		
9th Signal Service Co	327	1
Hickam Field		
12th Signal Plat AB	27	1
324th Signal Co Avn (later 400th SigC Avn)	73	4
407th Sig Co Avn	72	3
428th Sig Co Avn	73	3
Schofield Barracks		
24th Sig Co	133	4
25th Sig Co	136	5
Sig AW Co	348	13
Wheeler Field		
45th Sig Plat	23	1
307th Sig Co Avn	71	3

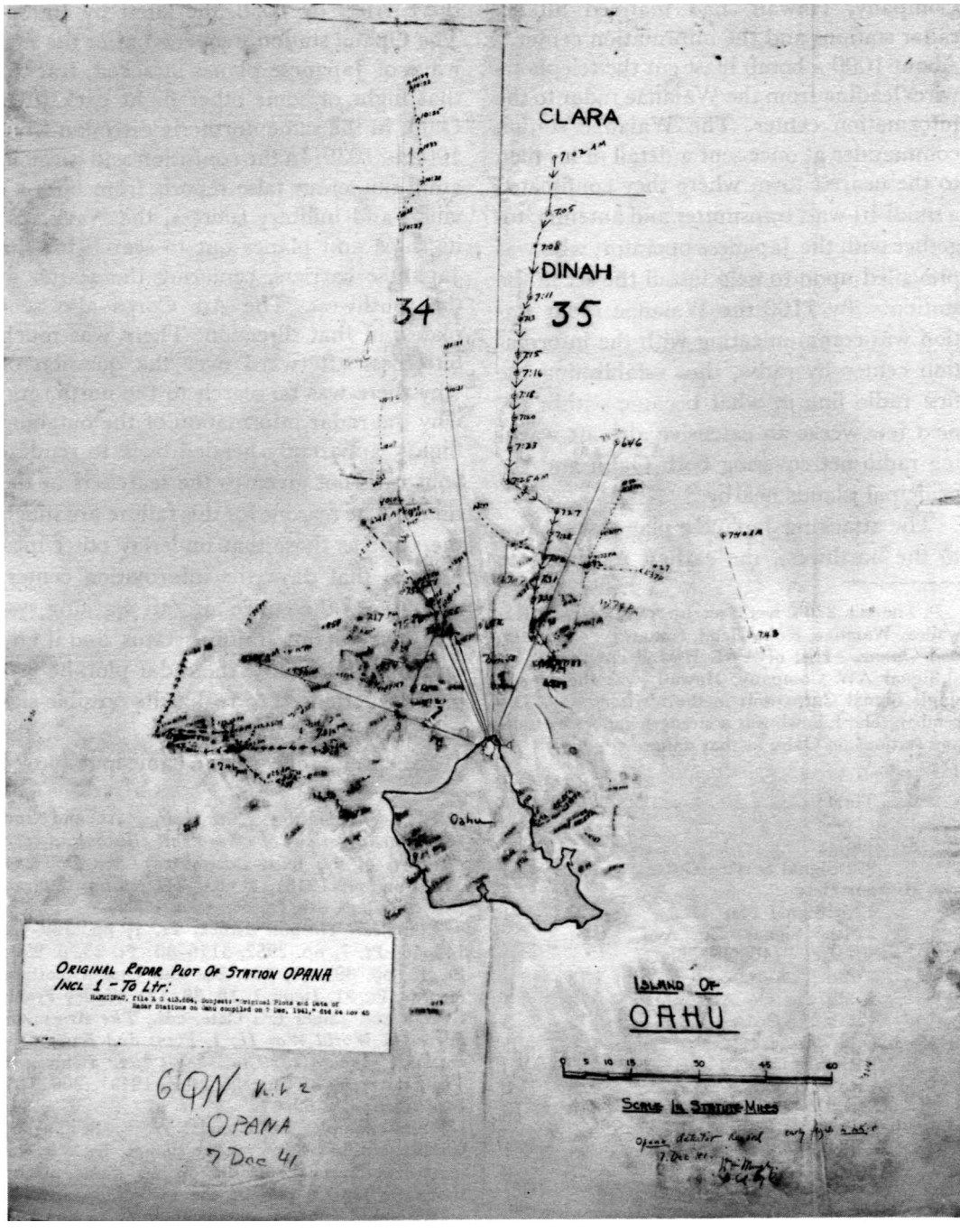
Source: Pearl Harbor Attack, Pt. 12, pp. 318–20.

[11] Hist of AWS Hawaii cited n. 3(4).

[12] Joint Committee, 79th Cong, 1st and 2nd Sess, *Investigation of the Pearl Harbor Attack* (Reports of the Joint Committee), Sen Doc 244 (Washington, 1946), p. 63. (Hereafter referred to by the short title *Investigation.*)

[13] (1) *Pearl Harbor Attack,* Pt. 1, pp. 139–42, 145–46; Pt. 7, pp. 2952, 3176–80; Pt. 23, p. 999; Pt. 32, pp. 394–95, 464. See also Opana plotting records, Pt. 21, Items 1, 18, 38. (2) Wesley Frank Craven and James Lea Cate, eds., *The Army Air Forces in World War II:* I, *Plans and Early Operations, January 1939 to August 1942* (Chicago: The University of Chicago Press, 1948), 200. (3) *Investigation,* p. 69.

[14] For example, Lt. Comdr. W. E. R. Taylor, USNR, testified later that, although he was the most experienced controller on the island at the time, the Opana plot of the incoming Japanese planes would not have meant anything to him had he seen it when it came in on the board. *Pearl Harbor Attack,* Pt. 23, pp. 757–58.



ORIGINAL RADAR PLOT OF STATION OPANA

commission at Hickam Field, the Japanese attack did little damage to signal installations. Soldiers and civilians working through the second phase of the bombings quickly patched all the important circuits in the Hickam cable. Two hours before midnight a third of the damaged Hickam Field circuits were back in the original route, and by two o'clock on the morning of 8 December the whole cable was restored.[15]

Word of the attack reached the Navy communications center in Washington at 1350 Sunday, Washington time, over the direct Boehme circuit from the Pearl Harbor radio station.[16] In an action message over the name of Admiral Husband E. Kimmel, the commander in chief of the Pacific Fleet, the broadcaster was saying "Air attack on Pearl Harbor. This is not drill." [17] Thus he was correcting the first incredulous reaction to the falling bombs.

As word spread through the military establishment in Washington, General George C. Marshall, the Chief of Staff, wanted to know why the warning message he had sought to send that morning had not arrived in time to avert disaster.[18] Atmospheric disturbances in the vicinities of San Francisco and Honolulu that morning had rendered the Army radio circuits unusable. For that reason, Lt. Col. Edward F. French, the Signal Corps officer in charge of the War Department Message Center, had turned to the commercial facilities of Western Union and the Radio Corporation of America (RCA).[19] When he had sent Marshall's message from the Center (at 0647 Hawaiian time) he had told Western Union that he desired an immediate report on its delivery. Now he perspired at the telephone trying to get it. "I was very much concerned; General Marshall was very much concerned; we wanted to know whose hands it got into. This went on late into the night; I personally talked to the signal office over there." [20] French was not able to talk to Colonel Powell, the Hawaiian Department signal officer, who was busy in the field, but he did talk to the Hawaiian operator, and told him that it was imperative to be able to tell Marshall who got that message.

It was not until the following day that Washington received a definite answer, and learned that the RCA office in Honolulu had delivered the message to the signal center at Fort Shafter in a routine manner. The warning message had arrived in Honolulu at 0733, twenty-two minutes before the attack, and a messenger boy on a motorcycle was carrying it out to the Army post when the bombs started falling. The boy delivered the message at Fort Shafter at 1145, long after the main attacking groups of Japanese planes had retired.[21] About an

[15] Interv, SigC Hist Sec with Capt Robert Danser (formerly O/C Switchboard Instl Sec, Hawaiian Dept Sig Off), 7 Oct 44.

[16] U.S. Office of Naval Opns, Office of the Chief of Naval Operations: Naval Communications (1947). First draft narrative, Hist Sec, Office CNC.

[17] (1) *Pearl Harbor Attack*, Pt. 10, p. 4737; Pt. 11, p. 5351; Pt. 23, pp. 608, 935. (2) Hist of Subsec G-2, HUSAFMIDPAC, I, 55.

[18] See account in Watson, *Chief of Staff*, and in *Pearl Harbor Attack*, Pt. 9, pp. 4517–19; Pt. 2, pp. 915–16 and 933; Pt. 3, pp. 1111–12.

[19] *Pearl Harbor Attack*, Pt. 22, pp. 237–39; Pt. 27, pp. 105–15.

[20] *Ibid.*, Pt. 23, pp. 1102–05.

[21] (1) Memo for Record, Col W. B. Smith, Secy General Staff, 15 Dec 41, p. 474 of Résumé of Papers in War Department Bearing Significantly on Events at Pearl Harbor, December 7, 1941, prepared by Current Group, OPD, WDGS, 11 Nov 44. Copy in OCMH. (2) According to the Honolulu office of RCA, the message arrived at Fort Shafter between 0900 and 0930, Honolulu time, and not 1145. The receipt for the message was

hour was spent in decoding it; it had to be processed through the cipher machine and then played back to make sure of its accuracy. At 1458 it was placed in the hands of the adjutant general of the department, who delivered it to General Short's aide, who gave it to Short at 1500. The warning was in Short's hands, then, 8 hours and 13 minutes after it had left the War Department Message Center, 7 hours and 5 minutes after the attack had begun.[22]

War in the Philippines

Meanwhile, farther west, the Philippines, a focus of Army and Navy power for forty years, came under attack.[23] The one o'clock warning message which General Marshall had sought to send to General Short in Hawaii had gone also to General Douglas MacArthur, commanding general of the United States Army Forces in the Far East (USAFFE). In fact, it had been transmitted, in the signal sense of the term, as number two in the series of four which went out to Panama, the Philippines, the Western Defense Command, and Hawaii. It had left the War Department Message Center at 1205, Washington time.[24] But before it reached the Philippines, word of the attack on Pearl Harbor had arrived more or less unofficially. About 0300 on 8 December (it was then 0830, 7 December, in Hawaii) a Navy radio operator picked up Admiral Kimmel's message to the fleet units at Pearl Harbor. About the same time a commercial radio station on Luzon picked up word of the attack.[25]

Thus the military forces in the Philippines were on combat alert several hours before sunrise and before hostile action occurred. With the Pacific Fleet crippled by the attack at Pearl Harbor, the prime target in the Philippines became the Far East Air Force (FEAF).[26] The Japanese could be expected to launch their initial attacks against the major airfields. Of these, Clark was the only big first-class airfield for B–17's in the islands.[27] Maj. Gen. Lewis H. Brereton, commander of FEAF, had established his headquarters at Neilson Field, which had been taken over from a commercial owner. Nichols Field was of less than top rank. A scattering of others, all the way down to Del Monte on Mindanao, were but emerging. Clark Field was the only one comparable to Hickam Field in Hawaii,

initialed by the receiving clerk, but not time-stamped, as was customary. The teletype circuit between the RCA office in Honolulu and the message center at Fort Shafter, which would have made messenger service unnecessary, was set up and mechanically completed on 6 December, but was not in operation pending final tests to be completed on Monday, 8 December. Ltr, W. A. Winterbottom, Vice Pres and Gen Manager, RCA Communications, Inc. [Honolulu], to David Sarnoff, Pres RCA, N. Y., 23 Dec 41; and Ltr, David Sarnoff to Col O. K. Sadtler, OCSigO, 23 Dec 41. SigC AC 381 Jap Attack. SigC Hist Sec File.

[22] *Pearl Harbor Attack*, Pt. 7, pp. 2930–40, 3163–64; Pt. 11, p. 5297; Pt. 22, pp. 46–47, 217–18; Pt. 23, pp. 1102–05.

[23] For a detailed account of prewar planning, the Japanese attack, and the siege of the Philippines, see Louis Morton, *The Fall of the Philippines*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1953).

[24] Résumé of Papers in War Department Bearing Significantly on Events at Pearl Harbor, December 7, 1941, p. 62.

[25] (1) Samuel Eliot Morison, *History of United States Naval Operations in World War II*, III, *The Rising Sun in the Pacific, 1931–April 1942* (Boston: Little, Brown and Company, 1948), 168–69. (2) Craven and Cate, *The Army Air Forces*, I, 203.

[26] Japanese Monograph 11, Philippine Air Operations Record, Phase One, *passim*. OCMH.

[27] Terrain Study 94, Philippine Series: Central Luzon, I, prepared by the Allied Geographical Sec, GHQ SWPA, 18 Oct 44. OCMH.

and there were no others like them in between.[28]

At Clark Field the Signal Corps had provided telephone and teletype connection with Neilson and Nichols. SCR–197's had recently arrived to give tactical radio communications to each of the fields.[29] The Philippine Long Distance Telephone Company brought commercial telephone in to Brereton's headquarters from all parts of Luzon, where local aircraft spotters had been appointed to telephone reports of what they saw. The spotters' reports, telephoned to the communication center at Neilson, were supposed to be relayed by teletype to Clark.[30]

In time, this primitive arrangement of spotters was expected to yield to the mechanized and infinitely more accurate reporting information supplied by the Army's new aircraft detection devices, the long-range radars SCR–270 and SCR–271. As yet, however, very few sets had been manufactured, and of those few only a half-dozen had been shipped to the Philippines under the strict priorities established by the War Department. Of the half-dozen, only one was set up and in satisfactory operating condition when war came.[31]

The Signal Company Aircraft Warning, Philippine Department, had arrived in Manila on 1 August 1941 with about 200 men, but with no aircraft warning equipment.[32] The first SCR–270 allotted to the Philippines arrived two months later, about 1 October. At once the men uncrated and assembled it. The SCR–270's were the mobile versions. They required less time to erect than did the fixed SCR–271's, but for all that they were massive and complicated mechanisms, and it was necessary to spend many hours testing and adjusting the sets at Fort William McKinley, and more hours instructing and training the men who operated them. No test equipment of any sort accompanied the set (or, indeed, any of the others which subsequently arrived). Fortunately, this first set gave so little trouble that Lt. C. J. Wimer and a detachment of thirty men shortly were able to take the radar to Iba, an airstrip on the coast about a hundred miles to the northwest of Clark Field. By the end of October the Iba radar was in operation. At about the same time,

[28] (1) Craven and Cate, *The Army Air Forces,* I, 175–93, *passim.* (2) Morton, *The Fall of the Philippines,* p. 43.

[29] A typographical error appears in the History of the Fifth Air Force (and Its Predecessors), Pt. 1, December 1941–August 1942, December 1941 installment, page 6, in the Air Historical Division File, and has been perpetuated in Craven and Cate, *The Army Air Forces,* I, *Pearl Harbor Attack,* and numerous other accounts using the History of the Fifth Air Force as source material. This source document states that each of the major airfields in the Philippines had "an SCR–297." Obviously, "SCR–297" should read "SCR–197." The SCR–197 was the standard point-to-point and ground-to-air radio which the Signal Corps furnished for such purposes at this period. No production radio ever bore the nomenclature "SCR–297"; the experimental navigation system bearing that nomenclature was incorporated into the shoran system in 1943. OCSigO Engineering and Tech Sv, History of Signal Corps Research and Development in World War II, Vol. II, Pt. 4, Proj. 208–A. SigC Hist Sec File.

[30] (1) Ltr, Col Alexander H. Campbell (formerly AWS officer, Hq FEAF) to Maj Gen Orlando Ward, Chief of Mil Hist, 4 Dec 51. OCMH. (2) Craven and Cate, *The Army Air Forces,* I, 175–93, *passim.* (3) Hist of Fifth Air Force, Pt. I, Dec 41–Aug 42, Dec 41 installment, *passim.* Air Hist Div File (Copy also in *Pearl Harbor Attack,* Pt. 11, pp. 5317–30.)

[31] History of Signal Corps Radar Units in the Philippine Islands, 1 Aug 41–6 May 42, *passim.* Folder, Radar-Philippine-Capt C. J. Wimer, SigC Hist Sec File. This history and the Report on Enemy Air Activities, cited in note 40 below, were compiled in 1946 by Capt. C. J. Wimer, a Signal Corps officer of the Signal Company Aircraft Warning, Philippine Department.

[32] History of Signal Corps Radar Units in the Philippine Islands, 1 Aug 41–6 May 42, p. 1.

Lt. Col. Alexander H. Campbell, the officer in charge of aircraft warning activities, set up a central plotting board at Neilson Field to co-ordinate the activities of all types of air warning.[33]

Within the next two weeks three more SCR–270 sets arrived at Manila, as well as two SCR–271's in crates. The 271's were the fixed radars, which had to be mounted on high towers. It took months to prepare the sites,[34] so for the time being the SCR–271's, still in their crates, were put into storage. Of the mobile sets, two appeared to test satisfactorily, but nothing the men could do would coax the third to operate efficiently. Within a few days Lieutenant Rodgers set out by boat for Paracale, Camerines Norte Province, Luzon, about 125 miles southeast of Manila on the coast of the Philippine Sea. He took with him one of the better mobile sets and one of the crated SCR–271's, planning to use the mobile set until the permanent site for the fixed radar could be made ready. Rodgers and his men got their 270 set up, and started preliminary test operation by 1 December.[35]

Meanwhile, Col. Spencer B. Akin had arrived in the Philippines to become General MacArthur's signal officer. Unlike the situation in Hawaii, where the aircraft warning company and the operation of the radars were Signal Corps responsibilities at the outbreak of war, in the Philippines the Air Forces controlled the entire air warning service. Although it was not one of his responsibilities, Colonel Akin felt impelled to recommend strongly that all radar sets and aircraft warning personnel allocated for the Philippines be shipped at once, without reference to the established priority schedules of shipment.[36] Doling out the remaining radars in the closing days of November Colonel Campbell sent Lieutenant Weden of the Signal Company Aircraft Warning to a site some forty-five miles south of Manila on Tagaytay Ridge. Weden drew the damaged set. Any hope that it might work better in this location soon faded; the set could not be made to operate satisfactorily, although it was still useful for training. About 3 December another Signal Corps officer, Lt. Robert H. Arnold, rushed the last remaining SCR–270 to Burgos Point on the extreme northern tip of Luzon. Arnold arrived at his location on the night of 7 December.[37] A few days earlier, the Marine Corps unit at Cavite had informed Colonel Campbell that it had just received a radar set, but that no one knew how to operate it. This was an SCR–268 radar, a short-range searchlight-control set developed for the Coast Artillery and not intended as an aircraft warning set, although it was sometimes used as such. A Signal Corps crew hurried to Cavite and helped the marines take the set to Nasugbu, below Corregidor, and on the southwest coast of Luzon.[38]

[33] *Ibid.*

[34] For Corps of Engineers difficulties and delays in readying sites, see Karl C. Dod and G. L. Marr, The Engineers in the War Against Japan, forthcoming volume in the series UNITED STATES ARMY IN WORLD WAR II, Ch. II.

[35] History of Signal Corps Radar Units in the Philippine Islands, 1 Aug 41–6 May 42, p. 1.

[36] Ltr, Maj Gen Spencer Akin, Ret., to SigC Hist Sec, 16 Apr 54. SigC Hist Sec File.

[37] After northern Luzon was overrun, Arnold destroyed his radar set, worked his way to the Ilocos Norte district, and joined the guerrillas. He commanded the 15th Infantry Regiment, USAFIP, N.L. (guerrilla), which captured the Gabu airfield and other important objectives in the 1945 return to the Philippines. R. W. Volckmann, Colonel, United States Army, *We Remained: Three Years Behind the Enemy Lines in the Philippines* (New York: W. W. Norton & Company, Inc., 1954), pp. 153–54, 200–202.

[38] History of Signal Corps Radar Units in the Philippine Islands, p. 2.

To sum up, then, this was the tally of aircraft warning radars in the Philippines on the morning of the Japanese attack: an SCR–270 at Paracale, with tuning and testing just being completed, and an SCR–271 in crates; a faulty SCR–270 at Tagaytay Ridge, still giving trouble but able to be used for training; an SCR–270 at Burgos Point, not yet assembled for operation; an SCR–268 at Nasugbu in the care of an untrained crew; one SCR–271 still in its crate in a Manila storeroom; and finally, at Iba, the one radar fully competent and able to perform its role.[39]

The prime purpose of the Iba radar installation, according to the young officer in charge of it, was to demonstrate to commanders and troops alike what radar was, what it could do, and how it operated.[40] A grimmer mission emerged in the closing days of November when Colonel Campbell ordered Lieutenant Wimer to go immediately on a 24-hour alert until further notice. On the nights of 3 and 4 December the Iba radar tracked unidentified aircraft north of Lingayen Gulf, and Wimer radioed the reports to Neilson Field. Single "hostile" planes had been sighted visually that week over Clark Field, as well, but attempts to intercept them had failed.[41]

Sometime in the early morning hours of 8 December (it was 7 December in Hawaii) the Iba radar plotted a formation of aircraft offshore over Lingayen Gulf, headed toward Corregidor. The Air Forces records put the time as within a half hour after the first unofficial word of Pearl Harbor reached the Philippines, and state that the planes were seventy-five miles offshore when detected. The Signal Corps officer in charge of the Iba radar remembers the time as before midnight, and the distance as 110 miles offshore. He states that the first news of the Pearl Harbor attack had not yet reached Iba.[42] The 3d Pursuit Squadron at Iba sent out planes for an interception. But the long-range radars of that period could not show the elevation of targets, and in the darkness the pilots did not know at what altitude to seek the enemy. Poor air-ground radio conditions prevented contact with the American planes, although the Iba station was keeping in touch with aircraft warning headquarters at Neilson, point by point. As the American pursuit planes neared the calculated point of interception about twenty miles west of Subic Bay, the radar tracks of both groups of planes merged, showing a successful interception. Actually, the pursuits did not see the Japanese air-

[39] *Ibid.* All sources available to date agree that the Iba radar was in operation, and several state that it was the only one. See, for example, Hist of Fifth Air Force, 24th Pursuit Gp; Lt. Gen. Lewis H. Brereton, *The Brereton Diaries, 3 October 1941–8 May 1945* (New York: William Morrow & Company, Inc, 1946), p. 65; Walter D. Edmonds, *They Fought With What They Had* (Boston: Little, Brown and Company, 1951), p. 59. On the evidence of Col. Alexander H. Campbell, aircraft warning officer of the V Interceptor Command, two sets, one at Iba and the other outside Manila, were in operation. Craven and Cate, *The Army Air Forces,* I, 186, and Morton, *The Fall of the Philippines,* p. 44, accept this view. From the Signal Corps point of view, no set could be considered "operational" unless it was fully tuned, aligned, and sited, and in the hands of a trained crew able to operate it. Similarly, the SLC set SCR–268 could not properly be regarded as an aircraft warning radar. By these standards, only the Iba radar could qualify.

[40] Report on Enemy Air Activities Over the Philippines up to and Including the First Day of War, as Observed by Signal Corps Radar. Folder, Radar-Philippine-Capt C. J. Wimer. SigC Hist Sec File.

[41] (1) *Ibid.* (2) Craven and Cate, *The Army Air Forces,* I, 191. (3) Hist of Fifth Air Force.

[42] (1) Report on Enemy Air Activities Over the Philippines. (2) Craven and Cate, *The Army Air Forces,* I, 203. (3) Hist of Fifth Air Force.

craft and apparently passed beneath them, missing them altogether as the Japanese turned and headed back out to sea.

This failure to come to grips with the enemy was the first of a series of tragic mischances which spelled disaster for the Far East Air Force. The events of the next few hours have become clouded by dispute and cannot be reported with accuracy.[43] At any rate it appears that the Japanese made several strikes at lesser targets before launching their main attack on Clark Field. All of the initial enemy flights were reported faithfully by the aircraft warning service, both through calls from aircraft spotters and through radar reports. The Iba radar began picking up enemy flights due north over Lingayen Gulf about 1120, at a distance of approximately 112 miles. During the next hour the Iba crewmen were frantically busy, checking and plotting enemy flights, radioing the reports to Neilson Field and to subsequent points along the enemy flight path until the planes were lost by interference from mountain echoes as the Japanese. flew down Lingayen valley. New flights were appearing before the old ones were out of sight, twelve of them in all, in waves of three flights each. The radar was still picking up new flights, still reporting them, when enemy bombers struck Iba at about 1220, silencing the station and completely destroying it.[44]

Waiting and watching in the Neilson headquarters communications center as the reports started coming in that morning were Col. Harold H. George, chief of staff of the V Interceptor Command; his executive officer, Capt. A. F. Sprague; his aircraft warning officer, Colonel Campbell; and Campbell's executive officer, Maj. Harold J. Coyle.[45] Listening to the reports coming in, Colonel George predicted that "the objective of this formidable formation is Clark Field." A message was prepared warning all units of the FEAF of the incoming flight. Sgt. Alfred H. Eckles, on duty with the FEAF headquarters communication detail, carried the message to the Neilson teletype operator. There he waited while he saw the message sent, and the acknowledgment of the Clark Field operator that it had been received by him. The time was about 1145.

For the next half hour or so, George, Campbell, Coyle, and Sprague watched the plotting board, where the indications of the approaching flight were being charted. Campbell was apprehensive; he kept asking the others to do something about it, but the air officers were waiting for the enemy to approach close enough to permit the most effective use of the outnumbered American defending aircraft. When they decided that the Japanese were within fifteen minutes' flying time of their target, Captain Sprague wrote a message. He showed it to George and Campbell. "What does the word 'Kickapoo' mean?" asked Campbell. They told him, "It means 'Go get 'em.'" Captain

[43] See account in Craven and Cate, *The Army Air Forces*, I, 203–13. To date the most exhaustive search of available records has been made by Morton, *The Fall of the Philippines*.

[44] Report on Enemy Air Activities Over the Philippines.

[45] The account given here was supplied by Colonel Campbell to Dr. Morton, who made the information available to the authors. It is based on Colonel Campbell's recollection of the day's events, documented by a page from his notebook which he prepared soon after the event, and which he kept with him during his confinement in prison camps. Ltr, Col Campbell to Gen Ward, 4 Dec 51, and Incl, page from Notebook of Col Alexander H. Campbell, Aircraft Warning Officer, USAFFE. OCMH. See also Morton, *The Fall of the Philippines*, pp. 85ff.

Sprague took the message into the teletype room for transmission.

At this point the record dissolves in a mass of contradictions. Most Air Forces accounts state that no warning message was received at Clark Field, and place the blame variously on "a communications breakdown," [46] "cutting of communications to Clark Field by saboteurs, and jamming of radio communications by radio interference," [47] and the allegation that "the radio operator had left his station to go to lunch," and that "radio reception was drowned by static which the Japanese probably caused by systematic jamming of the frequencies." [48] Colonel Campbell states that he and the others assumed that the "Go get 'em" message had been sent and received properly, since they had had perfect communication with Clark, and since neither Captain Sprague nor anyone else mentioned any difficulty at the time.[49] If the teletype circuit was out of order, there were direct radio circuits to Clark, as well as long-distance telephone and telegraph lines available in the Neilson headquarters, which could have been used. Campbell believes that "if the Bomber Command was not notified [as its former commander, Brig. Gen. Eugene L. Eubank, insists] internal administration was at fault." [50]

Whatever the facts, the strike at Clark Field, plus the other lesser attacks during the day, rendered the Far East Air Force ineffective as an offensive force. There remained no more than seventeen of the original thirty-five B–17's, the long-distance bombers which it had been hoped could alter the entire strategy of defense in the area. The military forces in the Philippines must revert to the prewar concept, and resist as long as it was humanly possible to do so.

The First Month of War in the Field

The reverberations of Pearl Harbor brought additional duties to the Signal Corps organization in Hawaii. The biggest single item of Signal Corps responsibility was radar: to get sets in place, get them operating and co-ordinated with the information center and an effective interceptor system. In the first hours after the attack, the Air Corps had taken over responsibility for continuous operation of the aircraft warning service. Crews of the Signal Aircraft Warning Company, Hawaii, went on 24-hour duty, working in three shifts: 4 hours of operation, then 4 hours of guard duty, then 4 hours off, then repeating the cycle. Thanks to the Japanese attack, Colonel Powell, the department signal officer, could get equipment, men, and military powers as never before. He no longer had to contend with the peacetime obstacles which had hindered his efforts to put up the several SCR–271 long-range fixed radar stations allotted to him. The station at Red Hill, Haleakala, Maui, had been slated for completion on 8 December. The attack on 7 December intervened, but the project was rushed to completion a few days later. At Kokee, on Kauai, where heavy rains had held up installation of a communications cable late in November, the entire station was completed a few days after the attack,

[46] Hist of Fifth Air Force, especially 24th Pursuit Group account.

[47] *Ibid.*, Maj William P. Fisher, Rpt of Philippine and Java Opns.

[48] Morton, *The Fall of the Philippines*, p. 85.

[49] *Ibid*, p. 85, n. 36. The three officers with Campbell that morning were all killed not long after: Colonel George in Australia; Colonel Coyle in Davao; Captain Sprague in the Netherlands Indies.

[50] Ltr cited n. 45.

and its radar went into operation early in January. [51]

The installation of the fixed 271 stations with their towers atop mountain peaks had been thought to be of primary importance because current opinion among radar engineers held that for the best long-range detection, a radar must be located as high as possible. Fortunately, the mobile SCR–270's proved quite good enough for long-range detection, even at lower sites, as the radar at Opana had demonstrated on 7 December. As Signal Corps units acquired more men and equipment, they quickly put up other radars and extended communication nets. Immediately after the attack, they installed two more radars on Oahu. One at Puu Manawahua was borrowed from the Marine Corps; the other was a Navy set, salvaged from the battleship *California* and set up in the hills behind Fort Shafter. On 18 December the Lexington Signal Depot shipped two SCR–270's and these Colonel Powell put on Maui and Kauai when they arrived. Next, an SCR–271, complete with three gasoline power units, communication radio equipment, and other attachments, which had been in San Francisco labeled for Alaska, went to Hawaii instead. Three other sets due for delivery in January and originally intended for installation on the continental coasts were similarly diverted, and a mobile information center from Drew Field was shipped by rail and the first available water transportation. Unfortunately the difficulties of shipping so delayed the equipment that it did not arrive in port in Honolulu until 28 March 1942. In the meantime the temporary information center carried on as best it could, in the quarters it had occupied for training before the Pearl Harbor attack, and with such makeshift equipment as it could beg, borrow, or steal.[52]

All sections of the Hawaiian Department Signal Office under Colonel Powell worked around the clock for several weeks following the attack. For about a week, the civilian employees of the Signal Office lived right on the job. After that they were permitted to go home each night, but many preferred the safety of the signal area to the unknown hazards of the streets outside. The stringent blackout, with armed volunteer guards patrolling the streets, presented its own dangers. There were stories of trigger-happy guards, and of unauthorized lights shot out or smashed with gun butts. Before long, life settled down to a fairly even tempo, although the amount of signal construction sharply increased.[53]

Communications among the islands, provided by a system which was partly Army, partly Mutual Telephone Company, had been unsatisfactory. To the islands of Kauai, Maui, Molokai, and Hawaii, there was also a radiotelephone service. Powell took over all the amateur radio stations on the islands immediately after the attack.[54]

The limited telephone facilities at once clogged with a rush of civilian and military calls. The situation, in particular the traffic on the interisland lines, seriously endangered the Army's and Navy's means of com-

[51] APHB Investigation Exhibit 58, Report on the Establishment of an AWS in Hawaii. MS File, Pearl Harbor, DRB AGO. For a full account of efforts to establish long-range radar in prewar Hawaii, see Dulany Terrett, *The Signal Corps: The Emergency (To December 1941)*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1956), pp. 301ff.

[52] (1) *Ibid.* (2) Hist of AWS Hawaii cited n. 3(4). Within a year of Pearl Harbor, the Signal Aircraft Warning Company, Hawaii, expanded into a regiment, eventually to be redesignated the 515th Signal Aircraft Warning Regiment.

[53] Intervs, SigC Hist Sec with Capt Danser, 7 Oct 44, and with Col Scandrett, 28 Jul 44.

[54] *Pearl Harbor Attack,* Pt. 22, pp. 237–49.

munication, especially since it seemed possible that the islands might be blockaded. Some means of control had to be found. Two days after the attack, General Short gave Powell supervision over the local activity of the Mutual Telephone Company in order to limit business to essentials if necessary (it turned out unnecessary) and in order to distribute the limited stock of commercial telephone equipment where it was most needed. Another task added to Powell's growing burdens was the unwanted but inevitable business of censoring telephone traffic.[55]

On Oahu a network complex of cable supplemented by much field wire served both tactical and administrative needs.[56] Eventually, after 7 December, cable replaced much of the field wire, the latter being retained only where bad terrain made trenching difficult. The network operated through a series of huts located in each of the sectors into which the island of Oahu was divided. These huts contained BD–74 switchboards through which, if one cable became inoperative, another could be connected to reach the desired destination by an alternate route.[57]

In the Philippines, communications were sorely taxed. At the outbreak of war, Colonel Akin was the signal officer of USAFFE. His assistant, executive, and radio communications officer was Col. Theodore T. "Tiger" Teague, a man who, Maj. Gen. Jonathan M. Wainwright declared, "could make any kind of radio work." [58] In the next seventeen days after 8 December, Akin and Teague arranged the orderly transfer of communications as the forward echelon of Headquarters, USAFFE, prepared to withdraw from Manila to Corregidor. Akin would accompany MacArthur, Teague would remain in the rear echelon with General Wainwright.

Akin and Teague could not count on replenishment of supplies from the United States; they would have to improvise. True, USAFFE had a signal depot, taken over from the Philippine Department, and wire, cable, and radio communications were ostensibly available. So long as the atmosphere of a peacetime Army installation endured, the signal service was adequate, but, like all the other services of the Army, it faltered under the pressures of war. The depot, located in the port area of Manila, became a regular target, and its supplies had to be removed to a less conspicuous building on the outskirts of the city.[59] Headquarters telephone service to the three subordinate elements—the South Luzon Force, the North Luzon Force, and the USAFFE reserve—was almost immediately imperiled,

[55] (1) Office of Internal Security, T. H., Wartime Security Controls in Hawaii, 1941–1943, Pt. 2. OCMH. (2) Hist of Signal Sec, Appended to Hist of Subsec G–2, HUSAFMIDPAC, I, Pt. 2, Sec. X, pp. 1–2.

[56] Ltr, SigO Hawaiian Dept, to CSigO, 11 Aug 41, sub: Const and maint of telephone systems. SigC 676.1 Gen 12.

[57] Dr. Donald O. Wagner, Army Command and Administrative Network, 1941–1945: Pt. 1, The Pacific. SigC historical monograph E–6, pp. 13–14. SigC Hist Sec File. (For a discussion and list of the Signal Corps historical monographs, see Bibliographical Note.)

[58] General Jonathan M. Wainwright, *General Wainwright's Story, the Account of Four Years of Humiliating Defeat, Surrender, and Captivity* (Garden City: Doubleday & Company, Inc., 1946), p. 261.

[59] Report of Operations of USAFFE and USFIP in the Philippine Islands, 1941–1942, Annex XVII: Col Theodore T. Teague, Report of Operations, Signal Corps, United States Army, 8 December 1941–6 May 1942. 26447 98–USF 1–0.3, DRB AGO. Copy in OCMH. The account which follows is based on this document, supplemented by MS comment by Colonel Teague, contained in a series of letters to Dulany Terrett, from 24 September 1949 to 14 April 1950. SigC Hist Sec File.

even though the Philippine Commonwealth Telephone Company, which owned the facilities and employed the operators, gave the Army priority service.

The control station for the Army's tactical radio network occupied a room inside the old wall of Manila, at the Santa Lucia gate, but could not occupy it for long after the invasion. On the day before Christmas, when General MacArthur and his staff left Manila for Corregidor, Teague sent one of his assistants along to set up another temporary control station there. During Christmas week, the new station went up despite unceasing heavy air attacks, and one by one the subordinate stations signed out from the old control station and into the new net on Corregidor. On 1 January 1942 Teague signed off the Manila station permanently, dismantled it, and shipped the equipment by water to Corregidor.

The administrative radio network was also vulnerable. Its transmitter stood near the signal depot and was therefore near the first bombings. Its control room station had to be shifted to an old building, which later crumbled under attack, and then into a vaulted room in the fortress, which still could not save it. So swift was the Japanese advance that the network's subordinate stations in the north and south, Camp John Hay at Baguio, Mountain Province, on Luzon, and Pettit Barracks in Zamboanga on Mindanao, signed out within three weeks. It was obvious that soon the Manila station, too, would be silenced, and that only the one at Fort Mills on Corregidor would remain.

Although the two ten-kilowatt installations of the Corregidor station made it the strongest in the network, the increasing traffic soon showed that it was hardly qualified to be the sole eastbound channel between Corregidor and the War Department. It was designed to work with Fort Shafter, on Oahu, which in turn relayed to the Presidio in San Francisco. Knowing the system to be slow and inadequate for the demands suddenly placed upon it, Akin, now a brigadier general, got authority to lease the Mackay Radio high-speed machine-operated channel between Manila and San Francisco, and to operate it with Signal Corps personnel. For a time while USAFFE still occupied Manila, traffic to the United States improved; then the Mackay facilities, too, had to be destroyed to keep them from the enemy. The War Department had continued in any case to send all of its messages to USAFFE over the Army channel.

Communications to the northwest, southwest, and south had suddenly and simultaneously increased in importance, for the British, Dutch, and Australian Allies were isolated along with American forces in the Far East. For two weeks, an excellent RCA high-speed channel provided the connection with the British in Hong Kong and, by relay, with the Straits Settlements and Singapore. As the only fully mechanized means of communication in the Manila region, where any operators, let alone skilled ones, were hard to get and almost impossible to replace, the RCA facility was thankfully put into use. Then Hong Kong surrendered, and another outlet was lost. For keeping in touch with the Netherlands Indies, the theater rented Globe Radio facilities. They were less satisfactory, because the Bandoeng, Java, station, although operating with adequate power, was not to be counted upon to adhere to broadcasting and receiving schedules. Most hopefully of all, the signal office set up a radiotelegraph channel between Manila and Darwin, Australia. This channel was cru-

cial; in those early stages the Americans in the Philippines were hoping to hold out until reinforcements assembled to the south. But this circuit, too, was a disappointment and frustration. The USAFFE signal stations were aggrieved at the Australian use of student operators at Darwin, who were almost impossible to "read"—as if, it was said afterward, "the fact that there was a war in progress and that they and we were combatants and allies [was] merely a topic of academic interest." [60]

Meanwhile, the troops were withdrawing to the Bataan peninsula and to Corregidor. Colonel Teague, as signal officer of the rear echelon of the staff, remained behind for a week with a skeleton crew of signalmen to assist in destroying the radio stations still in operation. Day by day during that week, the men worked at their melancholy duty. In the closing days of December, Colonel Teague ordered the receiving equipment of the Manila station dismantled to save it from the enemy. The fixed transmitting equipment and antenna were blown up to keep them from falling into the hands of the Japanese. On 26 December the plant of the Press Radio Company, both transmitting and receiving, was demolished; on 27 December crews dismantled the interisland radio equipment of the Philippine Commonwealth Telephone Company, crating it and shipping it to Corregidor; on 28 December they destroyed the Manila radio broadcast station; on 29 December the Mackay station; on 30 December that of the Globe Radio Company; and on 31 December the RCA station. On New Year's Eve, trucks carrying troops and supplies headed from the capital to Bataan, and Teague with others crossed to Corregidor from a flaming port at 0330. Signal Corps communications now withdrew to the "Rock" to carry on the fight.

Meanwhile, in the gloomy succession of defeats, disaster came to tiny Wake Island and its small American garrison, which included a handful of Signal Corps men. Only the month before, Capt. Henry S. Wilson with "five cream [of the] crop radio people" from the 407th Signal Company, Aviation, in Hawaii had been sent to Wake Island in order to establish an Army Airways Communications System station there for the Air Corps.[61] Previously Air Corps messages handled by the Navy had sometimes been delayed as long as twenty-four hours and the local Pan-American station had not been able to operate the homing beam successfully. Both circumstances had seriously interfered with the prompt routing of airplanes to the Philippine Islands. The Signal Corps detachment, two days after its arrival, had put into operation an SCR–197 radio truck and trailer which the Navy had transported to the island.

[60] Similarly, Sgt Eustace M. Messer, one of the signalmen on Corregidor, recorded bitterly that WTA's most vital outlet—the channel to Darwin, thence by relay to Melbourne, Honolulu, and home—was somewhat lightly regarded by the Darwin operators "who would not keep schedules and made no apparent effort to indicate that they were taking the war seriously. To us," said Messer, "those schedules were serious. We could not inform them that we were undergoing constant bomb raids and that we were also being shelled by ten-inch mortars." Keeping the antennas up in order to meet agreed-on transmission schedules was formidable business. Interv, SigC Hist Sec with Sergeant Messer (formerly radio operator in the P. I.), 17 May 44.

[61] The 407th Signal Company, Aviation, had been activated as the 328th Signal Company Aviation on 5 October 1940 at Fort Shafter, T. H. It had installed and maintained communications for Headquarters, Hawaiian Air Force, at Fort Shafter and later at Hickam Field. On 1 October 1941 the 328th Signal Company, Aviation, was redesignated the 407th Signal Company, Aviation.

On Sunday morning, 7 December, Wilson was expecting a flight of planes from Hawaii. On awakening he picked up his telephone to check with the sergeant on duty in the radio station, as was his custom. Immediately, the sergeant pulled his radio receiver close to the telephone mouthpiece and Wilson heard the radioed dah dits coming in from Fort Shafter, "This is the real thing! No mistake!" Wilson recognized Lt. Col. Clay I. Hoppough's "fist" as he pounded out the alarm again and again.[62] In the next few hours of preparation the men moved the radio truck into the brush near the half-finished powder magazine. In the meantime Sergeant Rex had tried to warn the garrisons in Darwin, Australia, and in Port Moresby, New Guinea, that the Japanese had launched a war, but they would not believe him.

A few minutes before noon the war broke over Wake Island. On the tail of a rain squall a wave of Japanese bombers glided in, engines cut off, undetected. The island had no radar; clouds obscured the raiders. "They just opened their bomb bays and laid their eggs in my face," Wilson recalled in describing the attack. Then they circled and came back to machine gun. Two bullets penetrated the walls of the SCR–197 trailer and a thick safe (borrowed from the marines), went on through the radio receiving position, but failed to wreck the set. Both the marines' radio station, near the original location of the Army's installation, and the Pan-American radio station were destroyed.[63] In that first raid the Japanese transformed the three islands of the atoll into a bomb-pitted shambles, and for the next few days they repeated their attacks. Daily they strafed the position of the Signal Corps radio station, and each night the men changed its location.

On 11 December the Japanese took Guam. On 12 December they landed on southern Luzon. At about the same time the enemy attempted a landing on Wake, but the small force successfully repulsed this initial effort. That night the signalmen dragged the transmitter out of the radio truck and moved it into the concrete magazine, with the help of a civilian contractor's employees who had been caught on the island. They bolstered the hasty installation with spare bits of equipment salvaged from the Pan-American radio station. They further protected the shelter both by reinforcing it with concrete bars intended for structural work and by piling about eight feet of dirt on top, covering the whole with brush. A day later the naval commander moved his command post into the radio shelter. By this time all naval communication installations had been demolished, except a small transmitter limited in range to about 100 miles. By now the six Signal Corps men constituting the Army Airways Communications System detachment provided the only communication with the outside world. They installed and operated line communication for the Navy as well. During the constant raids they were out under fire chasing down breaks in telephone lines and in receiver positions. Finally, the end came on 22 December when the enemy landed, overwhelmed the small force despite strong resistance, captured the island and bagged the Navy and Marine forces there, together with the little Signal Corps unit. By Christmas Eve the Americans on Wake

[62] Each radio operator, transmitting in Morse code by means of a hand-key, develops a characteristic rhythm and manner, known as his fist, by which listeners can identify the sender.

[63] The commercial employees of Pan-American took off an hour later on a Clipper, which had arrived the day before. It had been hit but not badly harmed.

MAJ. GEN. DAWSON OLMSTEAD ARRIVING AT PANAMA. *From left: Lt. Col. Harry L. Bennett, Brig. Gen. Harry C. Ingles, Lt. Gen. Frank M. Andrews, General Olmstead, and Col. Carroll O. Bickelhaupt.*

lay entirely at the mercy of the Japanese, who used the communications wire lying about to bind their captives.[64]

The closing days of December brought only a sharpening of the bleak pattern of defeat. On Christmas Day Hong Kong fell. The next day the capital of the Philippines was declared an open city, and General MacArthur prepared to withdraw his troops to Bataan. By the end of the month, Corregidor was undergoing its ordeal of heavy bombing. The Japanese entered Manila on the second day of the new year, and newspaper headlines bespoke the coming loss of the islands. Against this grim background, the Signal Corps entered its second month of war, not yet ready, not yet equipped with enough of anything.

[64] (1) History of the 407th Signal Company, Aviation (formerly 328th Signal Company, Aviation), Seventh Air Force. AF Archives SIG–407–HI, 5074–9. (2) Interv, SigC Hist Sec with Maj Henry S. Wilson, n.d. (3) James P. S. Devereux, *The Story of Wake Island* (Philadelphia: J. B. Lippincott Company, 1947), *passim.*

The Impact of War in the Office of the Chief Signal Officer

The opening of hostilities found the Chief Signal Officer, Maj. Gen. Dawson Olmstead, in the Caribbean. He had left Washington on 2 December, heading into what appeared to be one of the most likely storm centers, with intent to appraise, stimulate, and strengthen the Signal Corps installations there. While word of the attack spread through Washington by radio and telephone that Sunday afternoon, Signal Corps of-

ficers not already on duty hurried to their desks.[65] There were scores of emergency actions to be put into effect at once as the Signal Corps went on a full war basis.

In Quarry Heights in the Canal Zone, General Olmstead was inspecting defense installations in the company of Maj. Gen. Frank M. Andrews, commanding general of the Caribbean Defense Command, and his signal officer, Brig. Gen. Harry C. Ingles, when word came of the Japanese attack.[66] For the next few days Olmstead remained in the Caribbean, making note of the most urgent needs for communication troops and equipment.

When he returned to Washington on 16 December, he at once found himself in the center of enormous pressures generated by the sudden onset of conflict: pressures which assumed an infinite variety of forms. The communications industry clamored for instructions and help. Swarms of small manufacturers of electronic items descended upon the Office of the Chief Signal Officer, wrote letters, sent telegrams, and asked their congressmen for assistance. Hollywood, too, sent messages and assurances. Many high-ranking officials in the huge moving picture industry held Signal Corps reserve commissions. With Army photographic needs in mind, they sought ways of assuring their personnel of most useful placement, and at the same time aiding in the war effort. Amateur radio operators wanted assignments. The Federal Communications Commission, intimately concerned with matters of frequencies and radio broadcasting and monitoring in general, needed conferences to map out areas of authority. Other agencies and war boards had to be consulted. The matter of priorities for materials and tools was urgent. There were budgets to prepare, appropriations to distribute, new troop allotments to parcel out.

There was the matter of lend-lease to consider. Equipment which had been rather too confidently allotted to other nations now was ardently desired for this country's use and defense. Following the attack on Pearl Harbor, orders sent out by the War and Navy Departments virtually stopped all lend-lease shipments. Trains were sidetracked, ships held at docks, and manufacturers were instructed to hold shipments from their factories. The Chief Signal Officer wired the Philadelphia and Lexington Signal Depots to stop all shipments of lend-lease materials, and to attempt to call back all equipment then en route, while a rapid survey took place to determine whether any lend-lease supplies should be diverted to American forces on the west coast, Hawaii, and in the Far East. Consequently, some matériel intended for lend-lease countries was sent to American forces, such as 1,100 miles of Signal Corps wire W–110–B diverted from the British and sent to American military units, mostly in the Pacific, but the balance was released to move as planned. Shipments actually were delayed only a few days. The Axis had propagandized that lend-lease would cease entirely as soon as the United States needed all its resources for self-defense. But in his report to Congress on 12 December, the President

[65] Log entries for 7–8 Dec 41. Deputy CSigO folder, pp. 171a–71b, SigC Hist Sec File. (See Bibliographical Note.)

[66] (1) Interv, SigC Hist Sec with Brig Gen Carroll O. Bickelhaupt, SigC Res, Vice-President AT&T Co., 16 Feb 50. (2) Memo, CSigO for all Brs and Divs OCSigO, 22 Dec 41, sub: Inspec trip by CSigO to Caribbean Defense Comd, 4–17 Dec 41. SigC OT 320.3 AWS.

removed all fear that lend-lease might not continue.[67]

Most of all, the demand for equipment was bitter, pressing, and confused. Olmstead was beset on all sides: from Brig. Gen. Simon B. Buckner, Jr., in Alaska and Lt. Gen. John L. DeWitt of the Western Defense Command, whose long-standing and vociferous complaints concerning the inadequacy of defenses in their areas now seemed wholly justified; from Maj. Gen. Henry H. Arnold of the Army Air Forces whose needs were obviously urgent; from the General Staff; from the Allied missions in this country. From every outpost requests poured in for more air warning equipment, higher powered transmitters, and radios better suited to the locality. Commanders overseas became more critical of what they had, and more impatient at delays or omissions in filling requisitions. Often the items they asked for had not gone into production.

Basically, all demands centered around the three essential ingredients for the brew of war: money, men, and materials. Money, it could be assumed, would be forthcoming in adequate supply. But funds alone could not be converted immediately into fully trained and fully equipped armies. All the advance planning had been predicated upon a theoretical mobilization day (M Day) which would permit an orderly progression from a state of peace to a state of war. But M Day had remained unidentified, and the events of war now differed from the plans. Necessities which might have been satisfied months hence overwhelmed the military establishment with the most immediate urgency. Like its units overseas, the Signal Corps headquarters organization would have to improvise. It would have to stretch the supply of materials and men on hand far beyond the limits of desirability.

Acquiring Manpower

Pearl Harbor set off tremendous demands for manpower, both civilian and military, which the Signal Corps could not hope to meet until training facilities and allotments were greatly increased. On 7 December just over 3,000 officers and 47,000 enlisted men comprised the Corps' total strength.[68] By 10 December revised authorizations for Signal Corps personnel for duty with the Army Air Forces alone called for 3,664 officers and 63,505 enlisted men.[69] Filling the authorizations was another matter. On 7 December nearly every Signal Corps reserve officer was already on duty or under orders to report for duty. In its senior Reserve Officers' Training Corps units, the Signal Corps had far too few basic and advanced students, and had to face the fact that of those few, some would take commissions in other branches of the Army.[70]

The need for radar men had been given the sharpest sort of underscoring by the events of Pearl Harbor. Yet in the highly specialized courses for radar specialists and

[67] (1) International Div ASF, A Guide to International Supply, p. 12; (2) Msgs, Actg CSigO to Philadelphia and Lexington SigC Depots, 9 Dec 41; (3) Ltr, CSigO to O/C Lexington SigC Depot, 13 Dec 41, sub: Temporary storage of defense aid material; (4) Msg, Maj A. E. Brundage, OCSigO Lend-Lease Off, to Philadelphia SigC Proc Dist, 17 Dec 41. SigC 475.7 Lend-Lease 4, 16 Dec 41–10 Jan 42. (5) Richard M. Leighton and Robert W. Coakley, *Global Logistics and Strategy, 1940–1943*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1956), p. 247.

[68] CSigO, Annual Report, 1942, p. 114. The Annual Reports of the Chief Signal Officer for the years 1942–46 exist in a few typed copies only, in the files of the Office of the Chief Signal Officer.

[69] Summary of Authorizations, revised 10 Dec 41. SigC SPSTP 5, PMP 1942.

[70] (1) *Historical Sketch of the Signal Corps (1860–1941)*, Eastern SigC Schools Pamphlet 32 (Ft. Monmouth, N. J., 1942), p. 127. (2) Ltr, CSigO to TAG, 24 Jan 42, sub: Expansion of ROTC units. SigC 326.2 ROTC Gen.

technicians in the Aircraft Warning Department at the Signal Corps School at Fort Monmouth, only 169 officers and enlisted men were on the rolls. About one hundred Signal Corps officers were taking advanced electronics courses at Harvard University and at the Massachusetts Institute of Technology, and between two and three hundred more specially selected, recently commissioned young engineers and physicists were studying radar in the British Isles as members of the Electronics Training Group.

The supply of trained aircraft warning specialists was pitifully inadequate, despite the fact that no other training activity had received so much critical attention in the past six months. The Air Defense Board's report, issued in the previous September, had recommended expansion of the signal aircraft warning service by 2,200 officers and 40,200 men, the first sizable increment to be added in October.[71] The War Department had responded to the recommendation on 13 November by asking Congress for funds to supply 900 officers and 17,000 men, with the first increment to be added in December.

Meanwhile, the supply of trained men had melted away. Throughout the summer of 1941, Air Forces and Coast Artillery quotas in the Signal Corps School Aircraft Warning Department had remained unfilled, class after class.[72] From existing Aircraft Warning Service (AWS) units the Signal Corps drew men to form cadres for new units in this country and at overseas bases. Indeed, by October the I Intercepter Command had lost almost all of its signal personnel by transfer to form cadres for the II, III, and IV Interceptor Commands, and to provide the entire quota of aircraft warning personnel for Iceland and Greenland.[73] That same month the commanding general of the Caribbean Defense Command asked for AWS troops for Panama and Puerto Rico. To furnish them would take all the remaining men, and the Signal Corps had been counting on them to help train the expected 17,000 novices.

Joining forces, the Signal Corps, the Army Air Forces, and the Air Force Combat Command united in an urgent plea to the General Staff not to wait until the small "breeding stock" of trained AWS specialists in the United States was entirely depleted, but rather to expand the Aircraft Warning Service immediately by 320 officers and 5,000 enlisted men, charging them off against the 17,000 in the expansion program when it should be approved.[74] The 5,000 men to be furnished could come, they argued, from replacement training centers other than the Signal Corps center. This would be necessary because the total estimated output of the Signal Corps Replacement Training Center for November and December would be only 3,220, and of these 1,320 would be required for replacements for task forces, overseas garrisons, base forces, and overhead for schools and replacement training centers, which

[71] (1) Terrett, *The Emergency*, p. 287. (2) Memo, Col Otis K. Sadtler, SigC, for Gen Bryden, 5 Dec 41, sub: Expansion of AWS. SigC 322 Sig AW Cos, 1940–43.

[72] Terrett, *The Emergency*, p. 288.

[73] Memo, CSigO for Chief of Opns Br OCSigO, 23 Oct 41, sub: Rpt of deficiencies in equip, pers, and tng of com units of U.S. Army. SigC OT 322 Gen.

Com is used throughout this volume as the abbreviation for both *communication* and *communications* in accordance with Army practice during the war period, although Signal Corps men used the abbreviation *comm.*

[74] Memo, AAA A–1 for CofS, n. d., sub: Immediate rqmts for AWS troops. SigC 322 Sig AW Cos, 1940–43.

current personnel policy required to be maintained at full strength.[75]

The air staff had prepared the action memorandum on 6 November, but on 5 December an air staff officer reported that it had still not reached the desk of the Chief of Staff. It was "bogged down in a mass of conferences and trivial non-concurrences in the G–1, G–3, and G–4 divisions of the General Staff." [76] To consider the nonconcurrences and get the paper cleared would take another month because of the approaching holidays, he thought, and he suggested an alternate plan which could be accomplished at once because the necessary staff approvals were already in hand. It involved the use of Fort Dix, New Jersey, and Drew Field, Florida, as training centers for the desired 5,000 men, the Signal Corps to furnish cadres of trained men from its existing aircraft warning companies to form new ones.

It was this plan that won approval in the first frantic hours after word of the Pearl Harbor disaster reached Washington. Early Sunday evening, Lt. Col. Orin J. Bushey, Army Air Forces staff A–1, called Maj. Raymond C. Maude in the Signal Corps' Air Communications Division to tell him that the Chief of Staff had given Bushey authority to put the plan into operation at once. It called for 5,000 men for the eastern and southern coastal frontiers, 3,300 of them to go to Fort Dix to be trained in the I Interceptor Command, and 1,700 to Drew Field for the III Interceptor Command. Colonel Bushey asked Maude whether the Signal Corps could furnish the 300 officers needed. At a conference with the air staff the next day, Lt. Col. Frank C. Meade, head of the Air Communications Division, promised the full number at once. Before the conference ended, G–3 had authorized an additional 5,000 men for the other coastal frontier: 2,200 to be divided between the Portland Air Base, Oregon, and Fort Lawton, Washington, for the II Interceptor Command, and 2,800 to be assigned to Camp Haan, California, for the IV Interceptor Command. Ten of the Signal Corps officers went to Panama on 20 December; 55 to Fort Dix, 25 to Mitchel Field, and 60 to Drew Field on 10 December; while 60 reported to Seattle and 90 to Riverside, California, on 12 December.[77]

These 10,000 men so hastily allotted on the morrow of Pearl Harbor to man Aircraft Warning Service units had had none of the radar training that the Signal Corps gave at Fort Monmouth. For the trainees who went to Fort Dix, the I Interceptor Command was already operating an aircraft warning school of sorts. For those going to the Pacific coast, there were no training facilities in operation as yet. For others going to Drew Field, the III Interceptor Command planned, but did not yet have, another training school.

At Drew Field, four aircraft warning companies, the 530th, 307th, 317th, and

[75] Incl, Memo, Brig Gen Harry L. Twaddle, ACofS, for CSigO, 19 Nov 41, sub: Immediate rqmts for AWS, and 1st Ind, Lt Col Henry L. P. King, OCSigO, for ACofS G–3, 22 Nov 41, with OCSigO R&W Action 1, Air Communications Division (Air Com Div) to Plans Sec, 25 Nov 41. SigC 322 Sig AW Cos, 1940–43.

[76] Incl (c), Memo (initialed "R. P. C." A–1) for Chief of Air Staff, 5 Dec 41, sub: Status of AW action by the air staff, with OCSigO R&W Action 1, Opns Br to Air Com Div, 13 Dec 41, sub: Immediate rqmts for AWS troops. SigC 322 Sig AW Cos, 1940–43.

[77] (1) OCSigO Air Com Div Off Résumé, n. d. [7 Jan 42], attached to Memo, Col Meade for O/C Opns Br, 8 Jan 42, sub: Prog rpt for week ending 8 Jan 42. SigC C&E folder Air Com Div. (2) OCSigO R&W Action 1, Air Com Div to Mil Pers Div, 10 Dec 41, sub: Augmentation AWS continental U.S. SigC 402 Pers-Gen Air.

331st, plus a signal headquarters and headquarters company, were in existence on 7 December. It had been expected that these units would form the nucleus of the projected III Interceptor Command school. But within a week, 1,700 infantrymen had arrived from Camp Wheeler, Georgia, to be taught radio operation "without advance notice or instructions as to their disposition." To provide shelter, authorities hastily erected a tent city, made up of Army tents supplemented by a circus tent from Ringling Brothers' winter quarters in Sarasota, Florida. On 16 December classes for information center technicians, radio operators, and administrative clerks began. The rainy season was well advanced. Classes of forty men each marched about in quest of comparatively dry spots in which to study. A pile of tent sidings was likely to provide the only sitting-down space. Instructors shouted above the noise of diesels that were plowing up the mud preparatory to building operations. The teacher shortage was so acute that several students who had been teachers in civil life were pressed into service as instructors, although they knew nothing about the subjects they taught and had to learn as they went along, hoping to keep a jump ahead of their classes. The calls for aircraft warning personnel were so pressing that radio operators were partially trained in fourteen days and sent overseas immediately, a practice which all training officers deplored. But it had to be done.[78]

There were urgent calls for enlisted specialists in other categories. Jamaica in the British West Indies, for example, had more radio sets on hand than it had men to operate them.[79] On 11 December the Signal Corps broadcast an urgent appeal to all corps area commanders, asking them to enlist without delay an unlimited number of amateur and commercial radio operators for the Signal Corps. A recognized license was accepted in lieu of a proficiency test, and the men were rushed to the nearest reception center for transfer to the Signal Corps Replacement Training Center.[80]

The Signal Corps had been adding civilian workers at the rate of about 1,000 per month during the last half of 1941.[81] In the last three weeks of December, it added 1,000 per week, more than doubling the midyear figure and bringing the total to about 13,500.[82] This meant that at least every other worker was a "new" employee, with less than six months' experience. Such an influx could not be assimilated without a certain amount of confusion, especially within the headquarters offices, where practically all sections were understaffed. Prospective civilian employees had to be interviewed, processed through Civil Service, and then trained to the particular work of the office which employed them. Consequently the original staff, both officer and civilian, worked all hours trying to keep abreast of current rush jobs while interviewing, training, and finding space for new employees. Interviews had to be sandwiched in between long distance calls and conferences; new employees meant more

[78] (1) Interv, SigC Hist Sec with Lt Col Frank E. Herrelko, Air Corps, 11 Mar 47. (2) History of 2d Training Battalion (formerly 588th Signal Aircraft Warning Battalion), Third Air Force, Oct 43, Apps. I, II, III. AF Archives Sig-2-HI.

[79] Ltr, CSigO to Chief of Inf, 15 Jan 42, sub: Sig com Jamaica, BWI. SigC OC 381 1942.

[80] TWX, AG to CG's All Corps Areas, 10 Dec 41. AG 351 (12-9-41) ER-A. SigC 341 Gen Recruiting No. 2, Apr 41-Dec 41.

[81] On 30 June 1941, the figure stood at 5,753; 1 August, 6,902; 7 December, about 10,000. (1) CSigO, Annual Report, 1942, p. 127. (2) Signal Corps Information Letters, No. 2 (January, 1942), p. 12, and No. 3 (February, 1942), p. 9.

[82] CSigO, Annual Report, 1942, p. 127.

desks; more desks called for more space. In most instances desks had to be crowded into the original office space in the old Munitions Building on Constitution Avenue and in sundry other buildings scattered around Washington.

Even with enough money to hire the civilians needed, it was not always possible to find employees possessing the desired qualifications. Private industry, the armed services, and government agencies and bureaus were competing fiercely for qualified employees, while Civil Service procedures in the first weeks of war still used peacetime wage standards and job descriptions that were somewhat unrealistic in the light of the sudden emergency. The need for more workers was most evident in the Signal Corps' procurement activities, which increased manyfold.

The Procurement Division in the Office of the Chief Signal Officer, barely able to support the increasingly heavy work load during the fall of 1941, was literally overwhelmed during the first weeks of war. For example, its Inspection Section was just being organized. In December it comprised but two men: Maj. John Shuler, the officer in charge, nominally transferred from the Purchase Section in October but still obliged to spend most of his time on Purchase Section work, and one reserve officer, 1st Lt. William H. Caruthers, Jr. Shuler knew his section was being organized to provide staff supervision over the hundreds of inspectors who were already operating in procurement districts and the thousands of additional ones who would be needed for a full-scale procurement program, but he had received no specific directive outlining his functions and duties, and he had as yet only one small office for the staff he hoped to get. One problem, he knew, was the scarcity of qualified men in the field. The inspection training program initiated in Philadelphia before the outbreak of the war and an additional one begun in Chicago shortly afterward could not fill the requirements. In December there were some 800 inspectors in the field, of whom about 260 were in the Chicago Procurement District, and the rest in the Philadephia Procurement District. They were working long hours of overtime without pay before 7 December; afterward, they worked even longer hours. At the same time, Selective Service was subtracting from the numbers on hand and drawing potential inspectors away from the first training course.[83]

The Production Expediting Section under Maj. Carrington H. Stone furnished another example of turmoil within the Procurement Division. Since November the section had fallen under the scrutiny of Wallace Clark and Company, management engineers whom General Olmstead had hired to survey his organization and make recommendations to increase general efficiency and to ease expansion for war. Two days before the attack on Pearl Harbor, Wallace Clark had proposed reorganizing the entire system of operation within the Expediting Section. The recommendations were mandatory, and the work involved had to be accomplished concurrently with the

[83] SigC 314.7, Inspec Sec, Daily Hist Data, 15 Oct 6–Dec 41; 12 Dec 41–24 Jan 42. Signal Corps historical data sheets were maintained by all sections of the Procurement Division, Office of the Chief Signal Officer; all bear the Dewey classification number 314.7. Folders referred to in this chapter are: Procurement Division, Inspection Section, 15 October 1941–6 December 1941, and 12 December 1941–24 January 1942; Procurement Division, Production Expediting Section, 5 December 1941–21 December 1941; Procurement Division, O/C, 11 December 1941. Hereafter these will be referred to as Daily Data (with appropriate section and date of report).

mounting daily schedules, despite the shortage of workers.[84]

Expediters were expected to be professional breakers of bottlenecks, whatever the nature of the stoppage, and in the first weeks of war the staff in the headquarters section had to eliminate numerous peacetime procedures which slowed up production and procurement. For example, complaints from the depots that radio parts were missing among the elements sent them for assembly brought to light one of the difficulties of the current method of procuring radio sets. During the prewar period, Signal Corps contracting officers placed separate contracts for individual components of radio sets, thus distributing work among more manufacturers. Final assembly of the sets took place at the Signal Corps depots. This system had worked well enough when the volume of procurement was moderate. But with the sudden upward sweep of requirements for radio in late 1941, the contracting officers in the rush of their work tended to overlook some of the components when they placed contracts. Soon after Pearl Harbor, depot crews trying to assemble sets for overseas shipment discovered parts missing: anything from nuts and screws to antennas. In the belief that an incomplete set was better than none, and might be used in some fashion, the depots had been distributing a number of imperfect sets, to the outrage of overseas units that received them. Expediters arranged that henceforth assembly should be delegated to the manufacturer of the largest component, who would assemble complete sets, obtaining the minor components by his own purchase or manufacture, or from a Signal Corps depot. Thus, for example, with the widely used short-range radio set SCR–284, the depots would provide the manufacturer, Crosley, with the headphones, microphones, and antennas, so that the sets could be shipped complete from the Crosley plant.[85]

Field installations everywhere needed additional civilian workers, and the Secretary of War granted blanket authority to employ any civilians required. The Civilian Personnel Branch of the Office of the Chief Signal Officer stepped up its recruiting efforts to meet the increasing demands from the corps areas, exempted posts, and stations.[86] Requests poured in for civilians to fill special posts outside the continental limits of the United States. Puerto Rico needed radio mechanics. Panama wanted large numbers of radio engineers, telephone installers, and telephone engineers. To meet the request, Civilian Personnel arranged with the American Telephone and Telegraph Company to borrow some of the company's cable splicers for temporary duty in Panama. In the Canal area, a desperately needed radar SCR–271 waited for trained engineers to install it. Signal Corps was asked to recruit civilians with all haste, and send them along by the first available air transportation.[87]

Accelerating Production

Such signal equipment as was available had to be allotted carefully to those who needed it most. The Signal Corps cupboard, although not completely bare, was not well stocked. The final report of the Army Service Forces states that on 7 December 1941 the Signal Corps had less than 10,000 usable ground and vehicular radio sets, less

[84] Daily Data, Prod Exped Sec, 5, 8 Dec 41.

[85] *Ibid*, 21 Dec 41.

[86] OCSigO Civ Pers Br Diary, 9 Dec 41. SigC Hist Sec File.

[87] *Ibid.*, 14, 19 Dec 41. The treatment of Signal Corps personnel and training activities is continued in Chapter II, below.

than 6,000 aircraft radio sets, and less than 500 radar sets "available," but does not state whether the equipment was available in depots, or was in the hands of troops.[88] Certainly insofar as radar sets were concerned, deliveries of commercial models had not begun until February 1941, and altogether only 491 sets had been delivered by the end of the year.[89] These had gone immediately to aircraft warning troops and to training schools as soon as they came off the production line.[90] Practically none of them remained in depots for distribution. But even had the Signal Corps possessed equipment and supplies in abundance, the Army did not have enough ships available to carry all the kinds of military items needed when war struck,[91] and signal equipment carried a lower priority than ordnance items. Finally, there were not enough escort vessels to afford effective protection in hostile waters—and suddenly all the waters were hostile.

During this first month of war all movement was to the west. As quickly as cargo space could be assigned and escort vessels provided, Signal Corps units and equipment moved out of California ports. Some ships that had left before 7 December for the Philippines were caught by the war en route, and were diverted to Australia. The Army transport *Meigs,* for example, had headed out of San Francisco for Manila at the end of October, with some Signal Corps men and equipment aboard. After a stop at Honolulu, she was on her way, and crossing the international date line when her radio received news of Pearl Harbor. Diverted from Manila, she went on by way of Fiji to Darwin, Australia, only to be bombed and sunk in the harbor there.[92]

On the whole, loss of signal equipment in transit across the Pacific was unexpectedly light during the early weeks of the war. Of the approximately 18 transport vessels which war caught at some point in the Pacific between the west coast of the United States and the Philippines bearing troops and supplies to MacArthur, two, both of which were unescorted freighters, were sunk in the course of the journey. Only one of the two, the *Malama,* sunk about 600 miles from Tahiti on 1 January, was known to have signal equipment aboard. It had only twenty-five tons of Signal Corps cargo. About seven ships turned back after 7 December. The remainder were diverted in midocean to Australia. The Navy transport *Republic,* flagship of a convoy which had formed just west of Honolulu on 29 November and which was diverted, after Pearl Harbor, from Manila to Brisbane, had aboard the 36th Signal Platoon and its

[88] *Logistics in World War II, Final Report of the Army Service Forces, 1 July 1949* (Washington, 1947), Chart 2, Logistic Situation, December 1941, pp. 16–17.

[89] (1) Capt Harry M. Davis, Signal Corps Development of U.S. Army Radar Equipment, Pt. II, 1937–1941, SigC historical monograph A–2, p. 116; and Pt. III, Long Range Radar, SCR–270–271; SigC historical monograph A–3, pp. 47–48. SigC Hist Sec File. (2) OUSW, Weekly Statistical Report, Sec. II, Air Signal, Nos. 5–28, 2 Aug 41–10 Jan 42. Until 9 March 1942 these reports were issued by the Statistical Branch, OUSW. From 9 March to 9 April they were issued by the Office of Statistical Services, Headquarters, Services of Supply. From 9 April 1942 they were known as the Weekly Statistical Summary rather than as the Weekly Statistical Report. Hereafter referred to as Weekly Stat Rpt.

[90] *Pearl Harbor Attack,* Pt. 27, pp. 353–59.

[91] Leighton and Coakley, *Global Logistics and Strategy, 1940–1943,* pp. 202–212, *passim.*

[92] (1) Incl 2 with Ltr, CG Hq USASOS, APO 501, 17 May 44, to CG USAFFE, sub: Radio operators, statement of S. Sgt Maurice L. Monson, detailed 832 Sig Sv Co. Unit Histories: 431st Sig Heavy Const Bn. (2) Interv, SigC Hist Sec with Sergeant Monson (formerly chief radio operator USAT *Meigs*), 14 May 44.

organizational equipment. This convoy, carrying the first American forces to Australia, reached Brisbane on 22 December.[93]

The shortage of signal equipment was so critical and the competition for supplies so bitter that on 23 December General Olmstead issued a plea to all segments of the Army to conserve signal supplies and to practice the strictest economy, particularly during training and maneuvers. Use only qualified men familiar with signal equipment to act on surveys, and on inventory and inspection reports, the Chief Signal Officer urged. Waste nothing; remove and repair all serviceable parts of discarded signal equipment for use in training. Units which had been supplied with nonstandard types of equipment should not turn it in, he warned, no matter what the tables of basic allowances said. Rather, they should repair equipment and continue it in service until it was possible to supply the newer types authorized in the tables.[94]

There were obstinate blocks to be overcome before the goal of quantity production, great enough to fill all requirements, could be achieved. The immediate demands for equipment constituted only part of the total requirements. Requirements, in the peacetime definition, were "the computed needs in supplies and equipment of all kinds necessary to meet a military plan established by the War Department." [95] In the first weeks of war the definition lost meaning. Which plan, whose needs, what computations were to have precedence? For example, in May 1941 the Signal Corps planning staff had estimated that requirements for wire W–110–B would be 412,000 miles for the first year after M Day. But in the three weeks after the attack on Pearl Harbor, "actual" requirements as computed by commanders in the field and staff planners rose to 832,000 miles. At the same time, requirements for five-pair cable increased thirteenfold above 1940 estimates.[96]

Actually, requirements could not be expected to be firmly fixed at this early date. One thing was clear enough: whatever the final figures might be, they would exceed the existing capacity of the communications industry to produce. The Signal Corps had devoted much effort to prewar planning for industrial expansion, and most of it was sound enough so that given time it would cover the enormous requirements of global war. But without funds or authority to translate plans into action, little could be done except to blueprint the objectives. Thus only one of the numerous proposed plans to expand the communications industry had been launched before the opening of hostilities. Only 15 out of 180 radio manufacturers in the country had produced any military radios for the Signal Corps before 7 December; of the 15, only 5 had built separate plants for their military work and were producing sets acceptable by military

[93] (1) A. J. Bingham, Reinforcement of the Philippines (1947), pp. 9–11; (2) List of Transport Vessels at Sea, Pacific Ocean, 7 December 1941; (3) Memo, ACofS G–4, WDGS, for TAG, 21 Jan 42, sub: Request for info as to whereabouts of vessels. AG 565 (1-19-42) Msc (G–4/33861). OCT Hist Sec File.

[94] Memo, CSigO for TAG, 23 Dec 41, sub: Conservation of SigC equip and supplies. SigC 400 Gen 5.

[95] André E. Gerard, The Story of Supply in the Signal Corps in World War II (1945), Pt. I, Requirements, SigC historical monograph B–1, p. 2. SigC Hist Sec File. For a general discussion of Army requirements see Chapter III of R. Elberton Smith, Army Procurement and Economic Mobilization, a volume in preparation for the series UNITED STATES ARMY IN WORLD WAR II.

[96] L. H. Drake and F. W. Thomas, Prod Div, Philadelphia SigC Proc Dist, Industrial Summary: Signal Corps Procurement of Wire and Cable, 15 Jan 46, pp. 42–45. SigC Hist Sec File.

standards.[97] Obviously expansion of manufacturing facilities was going to be a basic problem. In the first week of war the need for a much larger electron tube industry was evident, and representatives of the Army, the Navy, and the Office of Production Management met to devise an expansion program of $14,000,000 affecting eleven companies making transmitting, cathode ray, and special purpose tubes.[98]

On the day after the Pearl Harbor attack, the Signal Corps' Production Expediting Section drafted a letter which it sent out to contractors on 9 December. The letter asked for immediate reply by wire detailing what might be needed to attain the maximum possible production, right up to the limit of twenty-four hours a day, seven days a week. "What are your limitations respecting raw materials, skilled labor, plant facilities and machines?" the Signal Corps wanted to know.[99] On 20 December the Signal Corps wired officials of the General Electric Company, Bendix Radio Corporation, Westinghouse Electric Manufacturing Company, Radio Corporation of America Manufacturing Company, Aircraft Radio Corporation, and Western Electric Company inviting them to meet with certain officers of the Signal Corps at the Philadelphia Signal Corps Procurement District on the afternoon of 23 December to discuss procurement plans and facilities.[100] These were the industrialists upon whom the Signal Corps would depend for the major share of its wartime procurement. They would bear the initial strain of the procurement crisis. They must lend their industrial know-how to train smaller firms in mass production methods. Those among them who were already producing signal equipment must redouble their efforts, take on new contracts, and speed up deliveries.

Neither contracting nor delivery was progressing well. Some critical items for which money had been allotted under the fiscal year 1941 procurement program had not been contracted for; in particular 1,500 SCR–288's, substitute short-range radio sets for ground troops, who needed them badly, and 20 SCR–251 sets, instrument blind-landing equipment for the Air Forces. In fact, less than half of the $498,311,000 appropriated for critical items of signal equipment on the regular and first supplemental fiscal year 1942 expenditure programs had been awarded.

Deliveries especially were discouraging. Under the procurement programs for fiscal years 1940 and 1941, the week ending 6 December showed that of the 54 important signal items contracted for, 33, or a total of 61 percent, were behind schedule. Delinquencies included 14 types of ground radio totaling 4,542 sets. Contracts for radio sets SCR–536, the handie-talkie used by airborne and parachute troops, called for delivery of 1,000 sets in November, but none were delivered. Deliveries of short-range portable sets SCR–194 and SCR–195 were delinquent by 2,500 sets. Six items for the Air Forces—frequency meter sets SCR–211, marker beacon receiving equipment RC–43, microphone T–30, radio compass SCR–269, and aircraft liaison and command radios SCR–187 and SCR–274—also were behind schedule, but fortunately none

[97] J. A. Everitt and others, Industrial Planning Br, Philadelphia SigC Proc Dist, Industrial Summary: Signal Corps Procurement of Radio and Radar Equipment, 1 Jul 46, p. 25. SigC Hist Sec File.

[98] The Industrial College of the Armed Forces, Economic Mobilization Course, Prod Div, Rpt of Subcommittee 36, Electronics Production Problems (1 Nov 46), Bk. 12, p. 5.

[99] Daily Data, O/C, 11 Dec 41.

[100] Msg, CSigO to Officials of General Electric *et al.*, 20 Dec 41. SigC 400.12 Gen 8.

of the delinquencies were serious enough to interfere with the delivery of aircraft.[101] In the three weeks remaining in December after Pearl Harbor, contracting speeded up appreciably, but delivery lagged behind. By the end of the year, 16 types of ground sets had fallen behind schedule for a total of 5,812 units, as had six critical types of aircraft signal equipment.[102] At that rate, it would take years to complete the equipment orders, yet the stupendous production program required completion in from 12 to 18 months.

Most dire of all shortages were those pertaining to radar. Shortages of materials and tools had delayed production; until July 1941, aircraft detector equipment (which became known as radar in 1942) had a preference rating no higher than A–1–B.[103] In December 1941 radar was to American industry a new and uncharted realm, and only two or three of the largest companies had ventured into it. Only three types had been delivered in any quantity: the SCR–268, searchlight control (SLC) radar, and two early warning (EW) radars, the mobile SCR–270 and the fixed SCR–271. The SCR–268 was especially important because it could provide approximate target height data. Enough of them could relieve the serious shortage of optical height finders for fire control, and also provide a stopgap for the Air Corps' need for ground-controlled interception radars. On 16 December the Signal Corps contracted for 600 additional sets at a cost of $33,000,000 from supplemental funds.[104]

Meanwhile, the Under Secretary of War was urging his supply chiefs to redouble their efforts to push production. Speed, not cost, should be the main consideration, he added. New facilities for production had to be found and provided with contracts, while all existing contracts should be reviewed with the purpose of stepping up deliveries. A three-shift production schedule ought to be applied everywhere. Construction orders should be given War Department producers, and new contractors should be given letters of intent, later to be replaced by formal contracts, in order that the firms could proceed at full speed pending the availability of additional funds.[105]

All peacetime planning had looked toward prompt decentralization of military procurement and the easing of shackling legal restrictions. With the first War Powers Act, 18 December 1941, Congress granted to the President sweeping powers to expedite the war effort, including the authority to release government procurement of military equipment and supplies from certain restrictive legislation.[106] Executive Order 9001, 27 December, delegated this authority to the Under Secretaries of War and Navy, who in turn could delegate it to their various supply chiefs. The supply chiefs could then give their district procurement officers a great deal more freedom of action.

Anticipating these measures, on 17 December the Under Secretary of War had already issued to his supply chiefs General Directive 81, allowing them to award contracts for supplies and construction without advertising and waiting for bids, and even without obtaining the Under Secretary's

[101] Weekly Stat Rpt No. 24, 13 Dec 41, pp. 1–2.

[102] Weekly Stat Rpt No. 28, 10 Jan 42, p. 2.

[103] *Pearl Harbor Attack*, Pt. 27, pp. 353–59.

[104] 1st Ind, Brig Gen Brehon Somervell, G–4 WDGS, on Ltr, TAG to CSigO, 16 Dec 41, sub: SLC equip with 1 Incl. G–4/33736 OCS 16701–17500 No. 8.

[105] Memo, USW for CSigO *et al.*, 29 Dec 41, sub: Broadening the base of defense prod. SigC 400.13 Gen 24.

[106] First War Powers Act, 1941, P. L. 354, 77th Cong, 1st Sess, Ch. 593.

approval, although this last would be required for any contract involving five million dollars or more. Moreover, the Office of Production Management would have to clear any contract involving one million or more. The Under Secretary left it to his supply chiefs to determine any further safeguards and to fix the extent of decentralization, saying, "It is desired in the interest of speed that authority for placing orders be decentralized to your field agencies to the greatest extent compatible with efficiency and proper safeguarding of the public interest."

General Olmstead at once drew up his plan for procurement, which was approved by the Under Secretary of War on 3 January 1942. The plan embodied five major points. First, all major purchases would be made through the Signal Corps' procurement districts and laboratories, with contracting officers authorized to negotiate purchases and make awards in any amount less than $1,000,000 without reference to the Office of the Chief Signal Officer. Second, contracting officers would be appointed for all corps areas, departments, and mobile forces. Third, depots were authorized to buy specified stock items without reference to the Chief Signal Officer. Fourth, laboratories were freed from the restrictions hampering the purchase of experimental equipment and authorized to purchase it in any amount less than $1,000,000 without reference to the Chief Signal Officer. The fifth provision gave the Chief Signal Officer a means of exercising control over procurement by providing for specific procurement instructions to be issued to the procuring agency.[107]

These measures could not sweep away all legal and procedural barriers to speedy procurement. Further liberalization would be necessary in the months to follow: more extensive use of informal rather than time-consuming formal contracts, formulation of specific procedures, and standardization of contractual clauses covering advance payments, renegotiation, subcontracting, patents, and the like. These could be handled largely within the framework of the policy laid down by General Olmstead, and through subsequent War Department procurement circulars.[108]

Thus, in the first three weeks of war, the Signal Corps along with the other services of the Army took vigorous action toward solving the insistent calls for men and equipment. The actions were basic, but their results would not be apparent quickly. Months would pass before progress at home could be reflected at the fighting front.

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[107] Memo, CSigO for USW, 22 Dec 41, sub: Decentralization of proc, and 1st Ind, OUSW to CSigO, 3 Jan 42. SigC 400.12 Gen 8.

[108] See Chapter VI, below, for Signal Corps Procurement activities during the early months of 1942.

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CHAPTER II

The Call for Troops (January–February 1942)

The Source of the Demand

By the beginning of 1942 the shock of Pearl Harbor had given way to planning for a long war, but expansion plans for the Army were still very narrow. The thinking on which the plans were based, particularly with respect to the probable magnitude of an all-out war effort, was still to a large extent based on World War I experience. At all levels, efforts were organized with a view toward peacetime economy rather than wartime effectiveness. When war came, there was no recourse but to make day-by-day decisions and to dole out the Army's manpower, a few men here and a few there. All had to be soldiers, and some had to be made into technicians as rapidly as possible.

To the Signal Corps that meant signal specialists, and men trained in even the prosaic communications skills were too few to supply the needs. An Infantry division alone included 1,500 communications men, who represented about one-tenth of the division strength.[1] Although not all of these would be Signal Corps men, all had to be given communications training. Moreover, it was becoming apparent that the Signal Corps would be required to function not only as a military communications operating agency spread out over the earth, with auxiliary duties involving tremendous intelligence, photographic, and training responsibilities, but also as a large business establishment.

When the new year began, the military strength of the Signal Corps—3,119 officers (256 officers in the Office of the Chief Signal Officer) and 48,344 enlisted men—was scattered throughout the continental United States; in the Caribbean Defense Command, where about one third of the overseas units had been sent to strengthen the Panama Canal defenses; in Greenland; Iceland; Newfoundland; Bermuda; in the Hawaiian and Philippine Departments; and in Alaska. The civilian strength was 13,504, including 1,694 overseas and 1,886 in the office of the Chief Signal Officer.[2] The Alaska Communication System (ACS), which began the year with a military strength of 428 and a civilian strength of 171, probably enjoyed a higher proportion of thoroughly competent enlisted technicians than did any other Signal Corps activity. Since October 1941, when the War Department had authorized the 1st Signal Service

[1] *Biennial Report of the Chief of Staff of the United States Army, July 1, 1941 to June 30, 1943 to the Secretary of War* (Washington, 1943), p. 30n.

[2] (1) Statistics, a volume in preparation for the series UNITED STATES ARMY IN WORLD WAR II. MS in OCMH. (2) Signal Corps Information Letter, No. 3 (February, 1942), p. 9.

Company to increase its strength, ACS had been carefully selecting the additional men; about half were fully or partially qualified radio operators, the remainder touch typists who had satisfactorily passed the radio operators' aptitude test.[3] The mainstays of the company were men with long experience and excellent records of service in Alaska.

With this nucleus and in this geographical pattern, the Signal Corps now had to fill out vastly in numbers and spread out vastly in place. Some of the expansion necessary had already occurred, as these numbers and locations showed. The very opening hours of war, however, had created vacuums all over the world, which sucked in troops the instant they could be dispatched from the United States. American soldiers went out eastward to Iceland and westward to Australia. The Signal Corps units with these early task forces were hurried to overseas bases and combat zones, where the generally inexperienced men who comprised the units came up against unusual demands for individual skill and stamina. And nowhere, as judged by war standards, was there more than a token signal force.

The Limitations Imposed by Tables of Organization

The tools with which an arm or service shapes its units and fits them into the Army's structure are (1) its troop program, that is, the troop basis, which forecasts the number and kind of units to be in active service within a general time limitation; and (2) its tables of organization, T/O's, which ordain the composition of the units. The T/O signal units were as standardized as the multiplication table and pyramided up to the top echelon of the troop basis structure with little variation in size or composition.

The outbreak of war had found the planning divisions in the Office of the Chief Signal Officer trying vigorously to disrupt the neat structure. Not rigidity but flexibility and elasticity in organization and strength were essential to economy in the use of manpower, and never had there been a time when the Signal Corps had not had to economize in men. The war had already thrown a spotlight upon new military conditions and methods which differed greatly from those known earlier. Further, climate and terrain were obviously going to affect operations a great deal. In a place where good radio transmission could be attained only through the use of a rhombic antenna array, five men would be needed to install the equipment. If the situation were such that a wire strung between two trees would suffice, it could be set up by one man, who might be, as well as not, the driver of one of the unit's trucks. In some areas, a unit might have all the advantages of modern communications systems in the vicinity. In others, it might find it necessary to transport a 2,000-pound transmitter in pieces, back-packed over miles of rough terrain, to set up the only communications station for hundreds of miles around. Uniform, inelastic T/O units could not be expected to function equally well in all such widely varying situations.

Obviously it was desirable to tailor units to fit the situation. But the process of setting up tables of organization or of changing those already in effect was laborious and protracted. First, the Signal Corps made a

[3] First Draft, Alaskan Communication System History (1945), pp. 173, 175. (See Bibliographical Note.) Bound MS copy in SigC Hist Sec File.

detailed breakdown of the duties of each man in the proposed unit and determined the grades and ratings it considered applicable. Then, by way of The Adjutant General, the proposed table went to the War Department General Staff—to G–1, to G–3, and to the War Plans Division (after 9 March 1942, to comparable divisions of the Services of Supply before it reached the General Staff). There the requirements unit studied the table under the guidance of Signal Corps officers, who had direct knowledge of the equipment the unit would use; the training unit scanned the table from its own viewpoint; then the operations unit considered it. If all went well, approval was forthcoming. But at any stage in its progress, the proposed table might be sent back to the Signal Corps for revision, after which it would have to start all over again.[4]

Finally fixed, the table of organization was likely to become a white elephant, ponderous and sacred. Newer equipment might change the basic duties of at least some members of the team, or changed tactics might make more or fewer men desirable. But the table of organization remained fixed. Therefore, the Signal Corps often resorted to organization charts or special tables as it set up new units which necessarily would be more or less experimental.[5] Yet these had no standing in troop bases, the determinants of training capacity.

The 1941 Troop Basis in effect at the outbreak of war embodied a troop program which accorded with the prevailing defense plan for mobilizing only the four field armies. It authorized the Signal Corps 1 signal service regiment; 5 aircraft warning regiments; 19 battalions (2 armored, 4 aircraft warning, and 1 for each army and corps); a headquarters and headquarters company for each of the 4 interceptor commands; 2 signal troops, 29 platoons, air base; 32 division signal companies, 5 of them armored; and 79 other companies of various sorts, of which 48 pertained directly to the air arm and the remainder were depot, repair, operations, photographic, pigeon, construction, radio intelligence, and service companies.[6]

The 1942 troop unit basis for mobilization and training, issued in January, embodied the 1941 faults of rigidity and meagerness.[7] For the ground forces, it did include more of the needed nondivisional units than had the 1941 basis; yet it remained very weak, particularly in construction units. Reports from the field following the 1941 maneuvers had consistently urged that the number of construction units in a battalion be doubled or tripled. General Olmstead had held out strongly for two companies, with additional construction units in the General Headquarters U. S. Army reserve, where they would be available to reinforce corps and army units as required. As issued, however, the 1942 Troop Basis included neither.[8] But the most astonishing deficiency of the program

[4] By early February recommendations for revision of practically all Signal Corps tables of organization had either been made or were in process. Signal Corps Information Letter, No. 3 (Feb 42), p. 39.

[5] Conf in OCSigO, 13 Aug 42, attended by representatives of OCSigO and Psychological Warfare Br, MIS. SigC 011–S Psychological Warfare Br.

[6] Troop Unit Basis of the Signal Corps as of 28 December 1941 (continental limits of the United States). SigC 320.2 Gen 12, Oct–Dec 41.

[7] Ltr, O/C War Plans Div OCSigO to All Brs and Divs OCSigO, 24 Jan 42, sub: Troop unit basis for mob and tng, 1942. SigC 381 Gen (LG 381).

[8] Memo, Olmstead for Maj Gen George V. Strong, 24 Mar 42, sub: Orgn of Sig bn for an army corps. SigC 320.3 T/O's 1940–43.

was its failure to include any troops at all for the air arm. Toward the augmentation of Signal Corps overhead (i. e., the administrative positions in the War Department, in field offices, and in other installations exempt from corps area control), this 1942 Troop Basis also reckoned on the scheduled expansion of the ground forces alone, taking no account of the work which the Signal Corps would perform for the Army Air Forces (AAF).[9]

There were other weaknesses in the 1942 mobilization plan. From the time of its publication, revisions were frequent. It ceased to be a forecast; in fact, it fell behind. Activation schedules out-distanced the parent plan, which served only weakly as a training objective, being no better than any other plan of that time. In some ways its existence actually was a drawback, because the General Staff adhered to it in limiting training capacity, yet often had to ignore it when compelled to activate new units. Therefore, commitments for signal units exceeded the troop basis, were out of step, irregular, and un-co-ordinated. Men in training, expecting to be assigned months hence to units allowed under the troop basis, had to be assigned hurriedly, their training cut short, to meet task force activations or other urgent calls.

It was well into January before Major Maude, in the Signal Corps' Air Communications Division, succeeded in getting from G–3 a list of Signal Corps units authorized for the Aircraft Warning Service, which would serve as a troop basis of sorts for that service. The list included 7 signal headquarters and headquarters companies for AWS interceptor commands; 23 signal aircraft warning regiments; 19 signal aircraft warning battalions, separate; 19 signal aircraft warning reporting companies, frontier; 69 signal platoons, air base; 80 signal platoons, air depot group; 7 signal companies, depot, aviation.[10] This belated AWS troop basis added enormously to the technical manpower requirements of the 1942 mobilization plan; and yet there remained, still unknown, the requirements for technicians and specialists to man Signal Corps units serving the AAF as well as the AWS. Such additional Signal Corps units—and they numbered scores—grew without a broad plan.[11] Tentative authorizations in effect immediately after Pearl Harbor had called for 67,000 officers and enlisted men to be procured and trained by the Signal Corps within a year for the Air Forces as a whole.[12] The lack of a firm troop basis for the air arm and the inadequacy of tables of organization for the ground forces handicapped orderly planning. But even had satisfactory tables of organization covering all units been in effect, there would still have been the enormous task of converting civilian recruits into military technicians within a compressed length of time.

The Protective Mobilization Plan had called for one million men by M Day plus 120, all from the Regular Army, the National Guard, and the Reserve, and all with some measure of military training. Actually, Army strength, including Selective Service men who had expected to return to civilian pursuits at the end of one year of service, had passed the million mark in March 1941,

[9] Memo, ACofS G–1 for CSigO, 17 Sep 41, sub: Augmented PMP 1942. SigC LG–381.

[10] OCSigO R&W Action 1, Air Com Div to Mil Pers Div OCSigO, 17 Jan 42, sub: Distr of electronics officers. SigC 320.2 Activation of Units (MT–20) Jan–Jun 42.

[11] There was no firm troop basis for signal units for the AAF until 1943.

[12] Summary of Authorizations, revised to 10 Dec 41. SigC SPSTP 5, PMP 1942.

nine months before the declaration of war. It continued steadily to increase. Augmentations of the Protective Mobilization Plan were to have brought the Signal Corps to a strength of 62,500 by M Day plus 360. Signal Corps strength passed that mark and rose to 75,391 during February 1942.[13]

Plans for Getting Enlisted Men

"Good radio men are more precious than nuggets in this Army. They are diamonds, rated No. 1 on the list of 181 shortages." [14] The process of sorting out such treasures or of polishing potential gems remained one of the most baffling of the Signal Corps' many problems. There were only two ways to get skilled signal soldiers. Either the Signal Corps had to find men already trained in communication techniques and put them into uniform, or, failing that, it had to take soldiers potentially capable of absorbing such training and teach them what they needed to know.

The first possibility offered little hope. In October 1941 the War Department had directed the reception centers to send to the Signal Corps any draftees who had formerly been employed in the engineering and plant departments of commercial telephone and telegraph companies. On 8 December the order had been repeated. But these men were few, and the Signal Corps actually received no more than about one out of each six inducted.[15]

In another effort to get men already trained in communications duties, the War Department had directed reception centers to allocate all branch immaterial recruits who were radio engineers, electrical engineers, or geophysicists, in the proportion of 65 percent to the Signal Corps, 25 percent to the Coast Artillery Corps, and 10 percent to the Army Air Forces. Few men of this caliber were reaching the reception centers because before they were drafted as enlisted men they were offered commissons or were snapped up by essential industry.[16] If they were about to be drafted, they could take advantage of the voluntary enlistments still being offered by the Navy, the Marine Corps, and the Army Air Forces. Thus, many men whose abilities were in demand could choose the branch of the armed forces in which they wanted to serve. Even the Signal Corps' own civilian employees often found other fields greener. In consequence, the Signal Corps' Army Command and Administrative Network (ACAN) system suffered when many of its civilian operators and maintenance men, whose skills were vital, volunteered for other services or transferred into industry. In an attempt to hold them ACAN obtained 400 specialist grades to offer in exchange for enlistment in the Signal Corps. But even this inducement was to have little effect. By 10 April 1942, the limit set for enlistment under the authority, fewer than 70 had taken advantage of the offer.[17]

[13] (1) *Biennial Report of the Chief of Staff*, 1941–43, p. 64. (2) *Annual Report of the Secretary of the Army, 1948*, p. 292.

[14] Walter V. Bingham and James Rorty, "How the Army Sorts Its Manpower," *Harper's Magazine*, 185:1108 (September, 1942), 435.

[15] (1) Memo, Pers Div G–1 for CSigO, 8 Dec 41; (2) Tab III of Tab D, Incl to Memo, Chief of Mil Pers Div OCSigO for Deputy CSigO, 23 Oct 42, sub: Pers rqmts. SigC 320.22 Enlisted Strength MT–25.

[16] (1) AG Ltr to CG First Corps Area *et al.*, 31 Dec 41, sub: Assignment of selectees. AG 341 (12–18–41) EC–A. (2) Ltr, CSigO to CG SOS, 11 Nov 42, sub: Qualified enlisted pers for SigC. SigC MP 320.22 Requisitions Enlisted Men.

[17] (1) Ltr, TAG to CSigO, 13 Jan 42, sub: Enlistment and promotion of certain SigC civ employees; (2) Ltr, Col King, Chief of Mil Pers Div OCSigO to Mil Pers Div SOS, 15 Oct 42, same sub. SigC 220.1 (Gen) Appointments 1, 1940–43.

Not even the members of the Army Amateur Radio System (AARS), established by the Signal Corps in the 1920's to supplement its own operating strength in an emergency, could be counted on. The amateurs were also excellent operators and maintenance men; most of them built their own sets. But they, too, were in high demand and unfortunately no provision had been made for channeling into the Signal Corps such members as might be subject to military service. When the government closed all amateur stations on 8 December 1941, the Signal Corps lost touch with the group which it had organized and trained in military communications procedures. Of those who entered the Army not all served in the Signal Corps, and there was no way of counting the number who did. Thus the AARS plan, which had served adequately in peacetime emergencies, such as floods and tornadoes, fell short of its full purpose in war.[18]

The Signal Corps had another prewar design for obtaining experienced technicians, the Affiliated Plan, wherein the telephone and motion picture industries and the pigeon fanciers' associations had cooperated toward putting skilled men into Signal Corps units. But the Affiliated Plan was not broad enough. Although it drew directly upon the main sources of wire and photographic specialists and pigeon experts, it included no sources of radio skills. Also, by its nature it could not be expected to meet heavy current demands for very large numbers of technicians. It did not provide for the organization of entire troop units from the personnel of the sponsoring agencies, as had been done in World War I under a similar plan. The World War I plan had provided badly needed telegraph battalions. But the concentration of many skilled men in them reduced the number of specialists available to other Signal Corps units. Moreover, the sudden withdrawal of large blocks of men from the private companies had tended to disrupt civilian communications. More wisely, the new Affiliated Plan now gradually withdrew individual officers and enlisted specialists from sponsoring civilian concerns in order to form cadres for a large number of units, which filled up their ranks from reception and replacement training centers. At the time of Pearl Harbor, a ground force signal battalion of 20 officers and 542 enlisted men was entitled to an affiliated cadre of 11 officers and 13 noncommissioned officers and technicians of the fourth and fifth grades, if the unit had been sponsored as an affiliated organization. The strength of cadres varied with the types of units and, indeed, between units of the same type.[19]

The 1942 requirements under the Affiliated Plan called for 189 officers and 1,314 enlisted men to fill positions both in the Office of the Chief Signal Officer and in troop units. This number the Bell System signified its willingness to provide. In addition to the units which the original plan listed, the Secretary of War had authorized the affiliation of eighteen more, for ten of which commercial sponsors had yet to be

[18] FCC Order, 8 December 1941, closed all amateur stations, although in the month following Pearl Harbor about 1,500 amateur stations were reopened for civilian defense service. These were finally closed on 9 January 1942. FCC–DCB order, 9 Jan 42.

[19] (1) Donald S. Bridgman, "Skilled Manpower for the Signal Corps," *Bell Telephone Magazine*, XXII (1943), 166. (2) Ruth F. Sadler, History of the Signal Corps Affiliated Plan (August, 1944), SigC historical monograph C–4, Exhibit F. SigC Hist Sec File.

found.[20] In February the War Department authorized the affiliation of still more units, such, for example, as the first affiliated Signal Photographic Companies, the 164th and 165th, which the Research Council of the Academy of Motion Picture Arts and Sciences sponsored.[21] The first affiliated cadre called to active duty as a unit was that for the 99th Signal Battalion. The men reported at Fort Monmouth on 28 February, and within three weeks were on their way to the west coast where the 99th would be activated.[22]

Thus, though nearly one third of all the Signal Corps troop units to be activated during the war would be known as affiliated units, the affiliated leaven within them would represent only 1.7 percent of Signal Corps peak strength. Over nine tenths of this small percentage of affiliated officers and men would be wire specialists; fewer than one tenth would be photographic technicians; and scarcely one out of each hundred would be a pigeon specialist.[23]

Since all these plans proved ineffective toward recruiting ready-made specialists in large numbers, a second possibility had to be explored. If the Signal Corps could not get specialists ready to hand, it would have to take untrained men and make them specialists. That meant, first of all, getting men capable of absorbing the technical training the Signal Corps would give them, then months of preparation before they could become effective signal soldiers.

Conscription was bringing in a widening stream of recruits, but the upsurge in numbers was falsely encouraging. The Signal Corps was receiving too many men not qualified to pursue the courses it offered, too few who were. In normal times the Army had required a recruit to have at least a high school education before enlisting in the Signal Corps. But from the arrival of almost the first Selective Service increments, Signal Corps officers in the field had protested that many were below that standard. On the eve of war, five days before the Japanese attack, Col. Otis K. Sadtler, Chief of the Operations Branch, had pleaded with G–1 to instruct reception centers to send the Signal Corps only such men as were qualified to pursue technical study, contending that "given a man of adequate intelligence, the Signal Corps can train him." [24] But all the arms and services were screaming the same plea and Sadtler's request fell on deafened ears. Moreover, requisitions called for radio technicians at the rate of three and four times the number contemplated in current training quotas. Of all the warborn demands upon the Signal Corps' meager supply of manpower, none were more immediate and pressing than those of the Army Air Forces, particularly

[20] (1) Ltr, Col Sadtler, OCSigO, to Col Carroll O. Bickelhaupt, AT&T Co, 11 Dec 41; (2) Ltr, OCSigO to TAG, 11 Dec 41, sub: Affiliated positions in SigC orgns, and 1st Ind, TAG to CSigO, 30 Dec 41; (3) Ltr, Keith McHugh, vice-president AT&T Co, to Olmstead, 29 Dec 42. SigC 381 Affiliated Units, Dec 42.

[21] Motion picture studios, even those not connected with the academy, were eligible to nominate candidates for the affiliated positions which the academy sponsored. (1) Ltr, CSigO to TAG, 18 Feb 42, sub: Affiliated positions in SigC orgns; (2) Ltr, CSigO to TAG, 26 Feb 42, sub: Sponsorship of affiliated SigC orgns. SigC 381 Affiliated Units, Feb 42. (3) Ltr, TAG to CSigO, 28 Feb 42, sub: Affiliated SigC orgns. AG 320.2 (2-4-42) MR–M–AAF.

[22] Capt Frederick Reinstein, Signal Corps Training in World War II: Background and First Six Months of War, 1917–1942 (1944), SigC historical monograph C–1, p. 162. SigC Hist Sec File.

[23] Sadler, Hist of Signal Corps Affiliated Plan, Exhibit G.

[24] (1) Ltr, CO 310th Sig Co Avn to Sig Officer Northwest Air Dist, 1 Feb 41. SigC 201 Clarke, Carter W. (2) Memo, Sadtler for ACofS G–1, 2 Dec 41. SigC 352.12 (Psychological Tests).

for aircraft warning troops. Not only in the United States but in every other area of conflict there was a demand for radar men.

In February, the chief of the Military Personnel Division, Col. Henry L. Page King, repeated Sadtler's December plea for better "basics." The AAF had just indicated informally that it would need some 53,000 men for the Aircraft Warning Service alone, and King asked specifically for 2,000 enlisted men from the top intelligence group for aircraft warning duty. G–1, besieged on all sides by similar demands, again sought to give equal consideration to "the need for men of high intelligence in each branch of the service" and declined to limit Signal Corps assignments to even Class IV and better. Class IV stood just above the bottom of the five grades of military aptitude in which the Army classified its men according to the Army General Classification Test (AGCT).[25] A grade of 100 was taken to be the median. Yet among the men arriving at replacement training centers were many whose AGCT scores fell far below 100, as well as some who had to be taught to read and write. It would take an inordinate amount of time to make even simple technicians of such men, if it could be done at all. Even then they might still lack resourcefulness and skill. Initiative and mental stamina were of prime importance to Signal Corps men and to the success of their missions, as units and small teams were frequently thrown on their own resources in areas remote from the main body of the troops they served.

The Signal Corps felt that because of these considerations and because of the general difficulty of the subject of electronics, it ought to get men whose education and aptitude placed them in Class I of the AGCT, or in the upper half of Class II. In arguing successfully for assignment of at least 75 percent of its recruits from among men rating 100 or more in the tests, the AAF had advanced as a reason its extensive use of radio.[26] Yet the Signal Corps, engaged to a far greater extent in work on a wider variety of more complicated items of radio equipment, got men of lower ability.

The repeated rebuffs which the Signal Corps met as it sought to get better men to train brought forth one plan after another for General Staff consideration. Three days before the reorganization of 9 March 1942, while the technical services could still deal directly with the source of allotments of manpower and training capacity, Colonel King went to G–1 again with what was to be his most effective appeal. He had been impressed by the fact that although military training facilities could not be expanded fast enough, civilian institutions, which the war was emptying of students, did have space. He therefore requested authority to recruit men in the Enlisted Reserve Corps (ERC) for preservice training in the civilian schools. To his pleasure, G–1 approved his request and the War Department issued implementing orders.[27]

The approval of Colonel King's plan enabled the Chief Signal Officer to change

[25] (1) Memo, King for ACofS G–1, 10 Feb 42, and 1st Memo Ind, ACofS G–1 for CSigO, 12 Feb. 42. SigC 352.12 (Psychological Tests). (2) Robert R. Palmer, Bell I. Wiley, and William R. Keast, *The Procurement and Training of Ground Combat Troops,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1948), p. 6.

[26] Memo, ACofAS for CofS, 24 Jan 42, sub: Intel tests for Air Corps enlisted men prior to entry into the sv. 13190, OCS 12001 to 14000.

[27] (1) Memo, King for ACofS G–1, 6 Mar 42; (2) AG Ltr, 15 Mar 42, sub: Enlistment in ERC. SigC MT 353 Staff Study ERC Tng MT–164, Mar–Oct 42.

requirements at his discretion, to set quotas for the various schools, to change them at need, and to establish new courses as he saw fit. The plan directed corps area recruiting offices to test all applicants and to send those qualified to the nearest civilian school. Tuition for a period not to exceed six months was payable either from funds allocated to the U. S. Office of Education or from money under the control of the Chief Signal Officer. If a student had enrolled in a course prior to enlistment and had paid all or part of his tuition, he was to be reimbursed upon enlistment in the ERC. He would be deferred from active duty until completion of the course. Then he would be called to active duty and sent to a Signal Corps replacement training center or assigned to a Signal Corps unit. In either event, these men selected to meet the Signal Corps' specifications would possess not only the mental qualities the Signal Corps sought but a measure of communications skill as well.

The significance of King's plan lay not only in the fact that it was bigger than it appeared to be but also in the fact that the Signal Corps would have unusual independence in administering it. Signal Corps personnel and training officials were jubilant; previously they had estimated a shortage of 7,200 technicians in eight vital categories by the end of June. Moreover, procurement schedules called for the delivery of 369,694 radio sets of various kinds by the same time—841,560 by the end of 1942. This created a need for almost 15,000 maintenance men by the end of June, and for more than 50,000 six months later. About half the maintenance men would have to be soldiers; half might be civilians.[28] The enlisted reservists could be trained along with the civilian technicians under the preservice civilian training program. Also, the civilian recruiting publicity could now be focused on persuading men to enlist in the ERC for preinduction training.

Indeed, the recruiting campaign was also operating to bring men into the Army directly for Signal Corps duty. The communications industry had a personal stake in seeing that members of its craft subject to conscription were placed in appropriate Army positions. The industry therefore showed a keen interest in recruiting. Large communications companies, Westinghouse, Radio Corporation of America, and General Electric, searched their application files for prospects for the Signal Corps. The civilian communications profession understood, as the layman and many a nontechnical Army officer did not, the prodigious demands imposed by the Army's modern signal systems. Engineering societies sought candidates within their membership. Radio studios made their facilities available for the Army to broadcast appeals. Prominent actors and others in the public eye placed before the people the urgent need for military and civilian communications men of all kinds, and for men qualified to study the specialized subjects, whether at secondary or college level. Newspapers and magazines devoted space to the Signal Corps, its functions, its manpower needs. The radio amateurs' magazine, *QST*, appealed to licensed radio operators to join the Signal Corps, "the only branch of the Army in which by showing your amateur or commercial radio operator's license you may be assured of assignment to radio work." The editors added a timely caution, however, that not all recruiting officers understood this. An article in *QST* seeking civilian me-

[28] Table of Personnel Requirements for Maintenance, prepared 30 March 1942 from Current Schedules. SigC MT-353 Staff Study ERC Tng MT-164.

chanics for the Caribbean area told readers, "If you are looking for a late winter West Indies cruise, here it is." The needs of the Aircraft Radio Laboratory for engineering and subprofessional skills received publicity. Radar service received attention in semitechical articles, news items, and cartoons. "He's a Radar Man" was the caption under a cartoon depicting an enlisted man strutting between two high-ranking officers. Manufacturing companies lent their advertisements to the enlistment needs of the Signal Corps. The civilian commercial schools which conducted preservice war training advertised their courses widely if not always wisely.[29]

It was bad enough, the Signal Corps felt, that so many of its plans to acquire suitable men went awry. It was worse to know that many of the technicians and specialists whom it had taught were sent out to be wasted on duties which demanded either more or less skill than they had acquired. The Signal Corps taught the men, but G–1, War Department General Staff, filled the requisitions for them. Therefore, many requisitions were badly met by the assignment of simple technicians, who had received only general instruction in the replacement training centers.

Hence, a company commander who had asked for highly trained radio repairmen and repeatermen might find he had received only linemen and truck drivers. Much less often, the reverse occurred, and a skilled radio operator arrived to fill an opening for an automobile mechanic.[30] Either way, the commander was quite certain to consider the man poorly trained for the job he held. The heart of the trouble was the circumstance that many commanders were unfamiliar with the fact that signalmen came in many categories and that each was intended for a specific purpose. A commander might, for example, ask simply for a radio operator, when if what he wanted was a fixed station operator he ought to have a skilled man and not simply one who could send or receive only fifteen words a minute.

As a remedy, the Chief Signal Officer had initiated a campaign for educating commanders in the relationship between signal specialties and signal equipment. From time to time he had issued lists designed to aid them in requisitioning the specialist they wanted; and the Signal Corps also obtained permission from the War Department to substitute other men when those in the categories called for were not available. By the time the war was halfway over, these innovations were so well thought of that the Services of Supply introduced the same procedures into the Signal Corps' sister services.[31] But in the early months of 1942 the gap between the supply of enlisted technicians and the demand for them had not been bridged. In March G–1 was still assigning men—at times not even good substitutes—to apply on requisitions received a month before Pearl Harbor.

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[29] (1) *QST* (February, 1942), pp. 42, 75; (March, 1942), pp. 25, 78; (April, 1942), p. 25. (2) *Radio News* (June, 1942), p. 13. (3) Memo, Maj John A. Holman for Lt Col Will V. Parker, O/C Plant Div OCSigO, 23 Jan 42. SigC 322.08 PEA 1, Jul 40–Dec 42.

[30] Capt Wilson G. Burden, Signal Corps Enlisted Administration (1945), App. IX. SigC Hist Sec File.

[31] (1) Memo, ACofS G–3 for TAG, 26 Nov 41, sub: Editing of SigC replacement requisitions. OCS G–3/45082. (2) Ltr, CSigO to Fld Sig Officers, 3 Jun 42, sub: Requisitions for SigC specs on SigC RTC. SigC SPSMP 221 Specs. (3) AG Memo W 615–67–43, 7 Sep 43, sub: Requisitions for replacement of enlisted men. (4) WD Cir 149, 15 Apr 44.

Plans for Getting Officers

The 3,000 officers whom the Signal Corps had on active duty when war struck included most of its reserve, 40 called to duty under the Affiliated Plan, 335 newly commissioned from its first officer candidate class, and some 300 Electronics Training Group (ETG) officers in schools in the United Kingdom.[32]

The officer corps was weak in leaders and woefully weak in technical leaders. Although the Reserve Corps lists still contained the names of some World War I officers, many would no longer be able to qualify physically for active duty, and only a few of those eligible remained in an inactive status. The Reserve Officers Training Corps would yield a few officers each year, but only a few until the ROTC program should be revised to war scale; the United States Military Academy, only a handful. The Affiliated Plan would provide some under the schedule for spaced withdrawal from industry. The Officer Candidate School (OCS), drawing its students from Army ranks (often taking badly needed Signal Corps enlisted technicians), would provide monthly increments of nontechnical officers under the existing capacity of 500 students. About 200 more second lieutenants would be commissioned from civil life for the Electronics Training Group under the standing authorization. From all sources within and without the Army, only 5,735 officers would become available to the Signal Corps by the end of 1942. This number, even when measured against the short yardstick of that day, fell 1,407 below estimated requirements, with the real needs of the future as yet to be revealed.

[32] For the background of the ETG officer program, see Terrett, *The Emergency*, pp. 288–91.

The Regular Army officers of the Signal Corps approximated only a cadre for an officer corps. The 225 on duty with troops filled only 4.34 percent of troop demands for Signal Corps officers, as compared to the 7.27 percent average for all ground arms less the Signal Corps. For all other purposes the Corps had only about 100 Regular Army officers. To obtain Regular Army parity with the other arms, the Signal Corps asked for 142 additional Regular Army officers. Instead of authorizing that number, the General Staff approved an increase of 50, of whom 25 were to be from the Infantry, 15 from the Cavalry, and 5 each from the Field Artillery and Coast Artillery Corps.[33]

Had all of these new officers been signal specialists, there would still have been a very thin line of Regular Army officers to lend their experience to the inexperienced new officers. Fortunately, the largest concentration of Signal Corps Regular Army officers was in the grade of lieutenant colonel. Ninety officers had attained this permanent rank. All had fairly broad experience, and would have from five to fifteen years to serve before reaching the normal retirement age. This one grade group therefore provided officers to fill some of the most important positions in the Signal Corps during the war. Among them were Crawford, Sadtler, Milliken, Ingles, Mitchell, Farmer, Code, Moran, Rumbough, Stoner, Rives, Arnold, Lawton, King, Gardner, Watson, Matejka, Reeder, Black, Back, and others who served in key field and administrative

[33] (1) Incl, Tab A, with Memo, Chief of Mil Pers Br OCSigO for Deputy CSigO, 23 Oct 42, sub: Pers rqmts. SigC 320.22 Enlisted Strength (MT–25). (2) Memo, CSigO for ACofS G–1, 12 Dec 41, and 1st Ind, TAG, 24 Dec 42. (3) Memo, ACofS, 22 Jan 42, sub: Officer pers for SigC, with approval by SW, 30 Jan 42. G–1/13864–672, OCS 20605–39 to 20697–15.

assignments. These and the few other Regular Army and reserve officers of field grade carried the chief responsibility of placing the Signal Corps on a war footing. The machinery in motion to increase the Corps' commissioned strength would, in the main, bring in only company grade officers, many of them on the bottom rung as second lieutenants.

To avoid the shortage which it was estimated would exist by the end of 1942, Colonel King asked the General Staff soon after Pearl Harbor for authority to commission 1,407 qualified men directly from civil life, as the quickest way to get officers technically qualified for Signal Corps duty. The War Department authorized the direct commissioning of another 500 only, all for the Electronics Training Group, but did raise the capacity of the Officer Candidate School from 500 to 2,000.[34] By January 1942 requirements shot far ahead of the December estimates. Eight thousand company officers alone would be needed. According to G–3's unofficial troop basis for the AAF, that arm would itself need 1,667 officers with an electronics education and would have to have them before the end of 1942. A month later this estimate was boosted to 2,400 and the deadline moved to the end of September.[35] For many months to come the need for greater numbers of officers would persist and persist urgently.

Meanwhile, the Signal Corps found it difficult to locate men in civil life who were qualified to meet its exacting standards for electronics officers. There were too few men of appropriate caliber engaged in communications pursuits to supervise civilian and military communications networks of the normal kind under the increased demands of war. Beyond these needs were the requirements in a little known and far more complex field where highly secret military developments had barely charted the course that the enormous aircraft warning operation would follow. The techniques involved, new to the Army, had no commercial application; the equipment no commercial counterpart. Consequently, no military or civilian sources of skill had been built up. Yet a degree in electrical engineering or physics was an essential preliminary for a potential Aircraft Warning Service officer. By this time, most of the students about to graduate in electrical engineering were already committed to industry or to one of the other services. The Signal Corps did, however, obtain permission to take students in either their junior or senior years into the ERC, and upon their graduation to commission them in the Army of the United States.[36]

Courses in very high frequency subjects (called ultrahigh at that date) were essential as a foundation for advanced Army training in electronics. But such courses were being taught in only a few electrical engineering schools and in those schools they had been taught only in the past ten years

[34] (1) Ltr, CSigO to TAG, 15 Dec 41, and 1st Ind, TAG to CSigO, 8 Jan 42, sub: Pers rqmts. AG 210.1 SigC (12-15-41) BE–A. (2) Memo, King for Deputy CSigO, 23 Oct 42, sub: Pers rqmts, and Incls Tabs A to D inclusive. SigC 320.22 Enlisted Strength, Oct 42 (MT–25).

[35] (1) OCSigO R&W Action 1, Maj Maude to Mil Pers Div SigC, 17 Jan 42, sub: Distr of electronics officers. SigC 320.2 Activation of Units (MT–20) Jan–Jun 42. (2) Memo, ACofS G–1 for CofS, 17 Feb 42, sub: Commissioning of electronics students in SigC. G–1/8165–935, OCS 20605–39 to 20697–15.

[36] (1) Memo, Capt H. K. Horning for Chief of Opns Br OCSigO, 4 Feb 42, sub: Weekly Rpt, 26 Jan–1 Feb 42. SigC 319.1 Weekly Proj Rpts, Opns Br. (2) CSigO, Annual Report, 1943, pp. 116–17. (3) OCSigO R&W Action 3, Capt J. S. Vaughan, Mil Pers Div, to Chief of Opns Br, 5 Mar 42. SigC 353 Gen Feb 42–Aug 42, MT–40.

or less. Of the 21,000 men estimated to have graduated in electrical engineering in the decade preceding 1942, only a small proportion had taken the new courses. This unknown fraction constituted the nation's main supply of manpower for the commercial and military research in electronics, for the production of equipment, and—this being the vital necessity to the Army—for the intelligent use of radar in the war.[37]

In selecting the first 500 officers for the Electronics Training Group, the Personnel Division reviewed and replied to an estimated 10,000 applications, coming in at the rate of about 50 a day, in order to find some 1,500 that warranted serious consideration. Of these, 600 applicants lacked an adequate technical education, 112 were physically disqualified, and 276 eventually declined the appointments tendered them.[38] By January 1942, seven months after the War Department had authorized the first 500 appointments, the Signal Corps had been unable to commission the full number. In February the War Department was forced to relax the requirements, extending the original limitation (ages 21 to 36, unmarried, and without dependents) to ages 18 to 46, regardless of marital status or dependents.[39] Even then many of the applicants accepted had to be given preliminary instruction before pursuing the advanced electronics courses.

While the Personnel Division struggled to bring in officer timber from the civilian forests without, the sources within the Army and the Signal Corps itself slowly yielded further numbers. On 13 January a call went out for the few Signal reserve officers remaining on an inactive status.[40] The War Department released some officers from its Reserve pool, whence the Signal Corps obtained a number of very well qualified specialists.[41] The 173 graduates of the second officer candidate class received commissions as second lieutenants in January. Later in the month the Secretary of War again raised the capacity of the school, this time to 3,000, and opened officer candidate schools of all arms to qualified soldiers who would be not under 18 nor over 45 years old upon graduation, and who would have had not less than three months of continuous service on beginning the course or six months of cumulative service within the year immediately preceding enrollment.[42] This eased the situation slightly but the amount of technical training these officers would receive in OCS would not in itself qualify them as communications specialists. Therefore the shortage in this category persisted.

The Chief Signal Officer considered it essential that all Signal Corps officers assigned to tactical Signal Corps units be technically qualified signal communications specialists. Late in January he repeated a recommendation he had made before Pearl Harbor that educational standards for entering the Signal Corps Officer Candidate

[37] (1) Memo cited n. 35(2). (2) Memo, William Hotchkiss for Dir Gen Davis (Army Spec Corps), 8 Jul 42, sub: Needs of Army svs for officers both in AUS and ASC. SigC 210.2 ASC.

[38] Memo, King for Chief of Opns Br OCSigO, 20 Feb 42. SigC 201 Code, James A.

[39] (1) Ltr, CSigO to TAG, 15 Dec 41, sub: Appointment of 2d lts, and 1st Ind, TAG to CSigO, 8 Jan 42. AG 210.1 SigC (12-15-41) BE–A. (2) AG Ltr, 17 Feb 42, sub: Appointment of 2d lts, AWS. SigC 210.1 SigC (2-12-42).

[40] AG Ltr, 13 Jan 42, sub: Res officers for assignment to SigC pool. AG 210.313 Sig Res (1-1-42) RO.

[41] Signal Corps Information Letter, No. 3 (Feb 42), p. 56.

[42] Memo, CSigO for ACofS G–1, 15 Jan 42, sub: Officer candidates. SigC 210.632 Ft. Monmouth 5, 1941, 4-30-43.

School be revised to require an engineering degree or its equivalent in experience.[43]

Having exhausted every immediate source of officer material, the Signal Corps now urged the expansion of the existing ROTC units and the establishment of still others. When war began, 1,450 basic and 350 advanced students were enrolled in the 11 Signal Corps units at good engineering schools throughout the country.[44] Although they constituted a deferred class under the Selective Service Act, the Signal Corps would not get all these officers. In 1941 only 147, fewer than half the students in the advanced units, had been commissioned or certified for commissioning.

King estimated that the Signal Corps would now need 800 second lieutenants yearly from the ROTC, not counting combat losses. To provide a margin for these, he added 25 percent and arrived at 1,000 as the goal. If the 1941 experience were typical, in order to get 1,000 he would have to assume a pool of twice as many. He therefore asked for an annual quota of 2,000 ROTC advanced students. Two thousand students in the senior year was a figure implying an equal number in each of the three preceding years, so that the ultimate quota arrived at was 6,000 basic students for Signal Corps ROTC training, as well as the 2,000 advanced. Four thousand of the 6,000 basic students and 1,500 of the 2,000 advanced would have to be trained in new ROTC units.[45]

The General Staff viewed the proposal with disfavor. The Signal Corps wanted ROTC officers because it saw in them a source of skilled technical officers, adequately trained in their specialities through good university courses. At the institutions having ROTC units, the courses in military science were an integral part of the educational program. The ROTC graduates were, in general, interested in things military. When commissioned, they were ready almost immediately to step into technical positions or to pursue advanced electronics study, as the average officer candidate was not. Yet G–1 opposed them on the ground that they were not sufficiently trained as leaders. The ground forces felt that three months of officer candidate school training turned out far superior officers. This concept imposed upon the Signal Corps the characteristics of the nontechnical bulk of the Army, wherein general leadership was of more value than specialization, which was the core of communications competence.[46]

Meanwhile, some minor concessions were granted during the first two months of 1942 to strengthen the intake from the ROTC. In order to keep the existing units effectively filled, the professors of military science and tactics at the various universities received authority to reject any student who could not pass the physical examination which the Officers' Reserve Corps required.[47] A few

[43] Memo, CSigO for ACofS G–3, 27 Jan 42. SigC EO 4–9 No. 2, Equip and Movement Orders, North African Theater, 1942–43 (60.2 Liberia-Air).

[44] The schools were the Massachusetts Institute of Technology, Cornell University, the Carnegie Institute of Technology, the Georgia School of Technology, Ohio State University, the Universities of Michigan, Wisconsin, Illinois, Minnesota, and California, and the Agricultural and Mechanical College of Texas. The ROTC unit at Illinois also offered an advanced course in cryptanalysis. OCSigO MT Div, Unit Tng Subsec Diary, 12 Feb 42. SigC Hist Sec File.

[45] Ltr, CSigO to TAG, 24 Jan 42, sub: Expansion of SigC ROTC units. SigC 320.22 Enlisted Strength, Oct 42 (MT–25).

[46] Incl, Tab D, with Memo, King for Deputy CSigO, 23 Oct 42, sub: Pers rqmts. SigC 320.22 Rqmts Enlisted Men, MP to Dec 42.

[47] WD Cir 18, Sec. II, 22 Jan 42.

weeks later the War Department approved with reservations a Signal Corps request that ROTC graduates completing ultra-high frequency courses be given an opportunity to enter the Signal Corps even if the unit in which they had been trained was not a signal unit. But there remained in effect the prewar ruling that limited the Signal Corps to not more than 10 percent of all ROTC graduates and specifically prohibited to it any men trained in Ordnance, Engineer, Chemical Warfare, and Quartermaster Corps units.[48]

Yet another stubborn problem arose in the form of efficient assignment of officers, or something approaching appropriate placing of them. Although a board had been set up at Fort Monmouth in January 1942, both to observe the student officers there and to classify them carefully with a view to the best possible use of them, the effort was largely guesswork because there was no classification pattern to follow.[49] Neither could unit commanders submit an intelligent request for an officer without going into considerable detail as to the work he would be expected to perform. The obvious solution was to develop and adopt a system for officers such as the one that already existed for enlisted specialists. It must be broad enough to take in officers for tactical units, for replacement training centers, for schools and laboratories, and for other Signal Corps activities like procurement and distribution.[50] Some flexibility was achieved in February when the War Department increased the size of the Signal Corps' officer pool. Hitherto, the figure had been set at 500 for the Signal Corps School and 150 for the replacement training centers at Fort Monmouth and at Camp Crowder. Now it rose to 1,650, without restriction as to grade, and permitted the assignment of pool officers of all arms, including the Signal Corps, to administrative positions as well as to troops.[51]

By the end of February 1942, Signal Corps officers on assignments (excluding those in schools) numbered 5,247. About one in five was on duty with the Air Corps. Of the remainder, 252 were overseas; 765 served with troop units within the continental United States; 355 were assigned to corps area commands; and 2,852 were in War Department overhead positions. Over half the Signal Corps' officers were engaged in administrative duties.[52] Every month's total showed that the number of officers was increasing. There were far more each month than there had been the month before. Yet the war had so widened in area and so mounted in intensity that the calls from every quarter grew more numerous and more urgent than they had ever been. Thus, paradoxically, the shortage of officers remained acute, however fast the production lines turned them out.

[48] (1) Memo, ACofS G–1 for CofS, 17 Feb 42, sub: Commissioning of electronics students in SigC; (2) AG Ltr, 5 Sep 41, sub: Instructions governing commissions of ROTC graduates in arms and svs other than those in which trained. AG 210.1 ORC (7-18-41).

[49] Ltr, CSigO to Comdt SigC School, 29 Jan 42, sub: Bd of officers for replacement pool. SigC Ft. Monmouth 1, Jan–May 42.

[50] (1) SigC Bd Case 470. (2) WD Cir 301, 5 Sep 42, sub: SigC job specifications and specification serial nos. SigC 230 Classification of SigC Officers.

[51] AG Ltr, 20 Feb 42, sub: Officer filler and loss replacements. AG 320.2 (2-14-42) OP-A-M.

[52] (1) SigC File Mil Pers Info as of 28 Feb 42, *passim*. SigC SPSTP 14. (2) Incl, Tab A, with Memo, King for Deputy CSigO, 23 Oct 42, sub: Pers rqmts. SigC 320.22 Enlisted Strength, Oct 42 (MT–25).

Getting Civilians

With the onset of war, the Signal Corps for the first time in a quarter of a century had enough money to hire all of the civilian workers it wanted, together with blanket authority from the War Department to employ them without prior approval.[53] In common with other branches of the armed forces, with the rest of the government, and with the great hives of industry which were being federally subsidized, the Signal Corps began to hire multitudes of men and women, not solely to cope with multiplying work loads but also to attempt to compensate for downward trends in office skills. Roughly guessing that it would take two unskilled employees to do the work of one who was experienced, and taking into account the time lag between a requisition and its approval, Signal Corps administrators gave free rein to imagination; and personnel estimates zoomed.

The Military Personnel Division presented a more or less typical picture. When Colonel King had left it in 1938, there had been a staff of 1 officer and 3 civilians. Returning in October 1941, he had found 8 officers and 31 civilians. A tenfold expansion seemed enormous, but it was not enough after Pearl Harbor. In January 1942 King asked for 191 more civilians, ranging in grade from CAF–2 to a hitherto unthought of CAF–12. Because the Civil Service Commission endeavored to control the overgrading of positions, he had to justify the higher grades by increasing the number of office units and thereby indicating the need for greater numbers of supervisors. Even before he got the additional 191, he had to follow that request with another for 564, and then still another for 661, so fast were things growing.[54]

In the rest of the Office of the Chief Signal Officer and in every field installation, stenographers, clerks, and specialists of various sorts were being similarly employed—often in greater numbers than could be assimilated. Interviews were perfunctory, assignment was undiscriminating, and supervisors were not always competent to set tasks and to measure performance. Efficient workers tired of mediocre jobs. Less efficient workers held on to jobs too big for them. To provide an agency to take a personal interest in newcomers, particularly the hundreds of young women who were away from their homes for the first time, a Counseling and Recreation Section was added to the Civilian Personnel Branch.[55]

Malassignment was sometimes ludicrous. A clerk, for example, charged with the task of passing upon applicants for the Electronics Training Group did not know enough about college courses to identify those leading to degrees in electrical engineering and consequently accepted veterinary and law students along with the prospective engineers.[56] The promotion of clerks to minor supervisory positions caused dissatisfaction. Today's new employee became tomorrow's supervisor, sometimes when his lack of training or experience for the job was all too obvious to those working under him.

[53] Signal Corps Information Letter No. 2 (1 January 1942), p. 19.

[54] (1) Capt Wilson G. Burden, Signal Corps Military Personnel Branch, Functions and Operations, *passim*. OCSigO Career Mgmt Br File. (2) Memo, Chief of Mil Pers Br for Chief of Sig Opns Sv, OCSigO, 2 Apr 43, sub: Size of Mil Pers Br OCSigO; (3) OCSigO R&W Exec Officer to Dir of Sig Troops Div, 30 Mar 43, sub: Officer positions in OCSigO. SigC SPSMP 320.2.

[55] CSigO, Annual Report, 1942, p. 136.

[56] Maj John F. Bullock, Direct Commissioning of Signal Corps Officers (1945), p. 15. OCSigO Career Mgmt Br File.

Proselytizing between divisions and supervisors was common. Within the next year, the turnover reached 60, 70, 80, and sometimes 100 percent.[57]

Like the Regular Army, the permanent civilian force was very small, even in the early months of 1942, and in comparative size it continued to dwindle until almost submerged under the influx. Thus the administrative complex turned topsy-turvy, with many a greenhorn directing employees who had been trained for years in Signal Corps procedures. In February, with experienced supervisors scarce, organizational changes common, and office procedures a mystery to the newly arriving personnel, Col. Charles E. Saltzman of the Executive Control Division suggested—without much effect—a redistribution so that each division might have knowledgeable persons in at least a few key positions. He also proposed the assignment of a civilian assistant to each major subdivision of the Chief's Office, to follow administrative problems through, "wherever the ramifications of their investigation take them, until a satisfactory solution to the assigned task has been arrived at." [58] Such a force of trouble shooters, disengaged from the paper work under which most administrators were buried, might have accomplished a great saving.

Daily it was becoming more apparent that quality and not quantity was the key to efficiency, and the civilian as well as military personnel would have to be trained for the tasks awaiting them. This fact was notably clear in the hiring of civilian technicians. The understanding of radar equipment, to cite but a single example, certainly required specific knowledge which was not possessed by most men, nor even by some radio engineers.[59] In the case of skilled workers, it was certainly not true that bucketfuls of money would solve the hiring problem.

At the beginning of 1942, the Signal Corps had 966 engineers and 690 subprofessional employees. The estimated need by the end of the year was for 4,580 engineers and 1,866 subprofessional workers, with an additional 20,000 enrolled in radio repair and other subprofessional courses in civilian institutions.[60] Milliken, Lattin, Heath, Lanahan, Rooks, and Maude, when considering the specific problem of how many to hire for maintaining radar detector equipment, compromised at one technician for each 50 sets, which would require the employment of 5,000 civilian maintenance men by the end of June and 5,740 within the next fiscal year. This was all a guess, of course, because radar maintenance had never been required before. But the Western Defense Command, with 88 sets, had only one maintenance man, and the repair work was not getting done. Obviously more men were needed. As for the overseas demand, all that the Signal Corps could do was to delegate authority to department signal officers to employ as many maintenance men as they wanted—if they could find them.[61]

[57] Civilian Personnel Survey of Signal Troops Division, OCSigO, 16 Jan 43. SigC Hist Sec File.

[58] Exec Control Div OCSigO, Supplement to Annex 8, 16 Feb 42 (to biweekly OCSigO Achievements or Prog Rpt). SigC EC 319.1 Prog Annexes.

[59] (1) Incl 1, Notes on Instl, Maint and Repair of Special Airborne Radio Equip, to Ltr, Lt Col John H. Gardner, Dir of ARL, to CSigO, 17 Dec 41, sub: Test equip for SCR–521 and SCR–540; (2) Ltr, Gardner to CSigO, 3 Feb 42, sub: Sv and maint of Airborne Radar Equip. SigC 352 SSCS MT–32.

[60] Signal Corps Requirements for Technical Personnel, Superseding Report of 10 January, dated 14 January 1942. SigC Central File.

[61] (1) Memo for rcd, Maj Maude, 17 Jan 42, sub: Conf ref civ engrs and mechanics for Maint Div; (2) Ltr, CSigO to Sig Officer, Air Sv Comd, Wright Fld, Dayton, Ohio, 22 Dec 41, sub: Maint of radio sets SCR–270; (3) Memo, Lt Col John M. Heath for Air Com Div, 26 Dec 41. SigC 320.2 Gen 1, Jan–Feb 42.

Shaping the Response: Wide-Scale Training

At the turn of the year, the Signal Corps' military training facilities were still concentrated at Fort Monmouth. Its commander, Brig. Gen. George L. Van Deusen, was also the commandant of the Signal Corps School, which was under the immediate supervision of the assistant commandant, Col. William O. Reeder.[62] A second Monmouth training activity much larger than the school was the replacement training center, commanded briefly at the outset of the war by Col. Charles M. Milliken. When Colonel Milliken left for Washington to become chief of the Operations Branch in the Office of the Chief Signal Officer, Col. Frank E. Stoner replaced him, only to follow him to Washington a few weeks later to head the Army Communications Branch. Col. Edgar L. Clewell took command of the Replacement Training Center on 27 February 1942.[63]

During this period few changes were made in the conduct of either activity or in training doctrine. Both had been geared to war needs before December and the onset of war had not necessitated any perceptible alterations. Fort Monmouth fitted the men into bulging barracks and overflowing classrooms, and searched for instructors.

By the beginning of 1942 Signal Corps training institutions had been authorized large capacities, in comparison with prewar figures—larger on paper than the realities and circumstances of the day could immediately permit, but not large enough to meet all the demands for signal technicians. For the Signal Corps School the paper figures first ran up to nearly 3,000 (420 officers, 500 officer candidates, and 1,975 enlisted men). Before January had passed, the Secretary of War authorized doubling the school to 800 officers, 2,000 and then 3,000 officer candidates, and 3,724 enlisted men.[64] For the replacement training center, the capacity at the beginning of the year was set at 6,007: double that of the school. But the replacement training center capacity for the Signal Corps as a whole (in the pattern for the Army as a whole) was limited to 8 percent of the Signal Corps' strength, whereas about 68 percent of its table of organization strength was in technical positions.

Although two out of three Signal Corps soldiers would occupy positions requiring technical competence of one sort or another, only one of the two would be a product of a Signal Corps replacement training center. The remainder, bypassing the replacement training centers, would reach the units directly from the reception centers, and would receive only troop instruction, a poor substitute for technical training in a Signal Corps institution. Given under a variety of field conditions, troop instruction did not provide uniformity in the practical application of communications techniques, nor did it stress communications theory. Thus units which should have been two thirds specialists, in reality had fewer than one third, plus

[62] The school's administrative organization provided five departments: Officer, Officer Candidate, Enlisted Men's, Aircraft Warning, and Training Literature. The Enlisted Men's Department, by far the largest in size of student body, was subdivided into Wire, Radio, and Cryptographic Divisions.

[63] (1) History of the Eastern Signal Corps Replacement Training Center, 30 Oct 43, p. 32; (2) Orgn Chart, SigC School, 15 Dec 41. SigC SPSEO 100.

[64] Ltr, CSigO to CG SCRTC, Ft. Monmouth, 4 Jan 42, sub: Expansion of SigC RTC, and 5th Ind OCSigO to CG SCRTC, Ft. Monmouth, 23 Jan 42. SigC 353 SCRTC Ft. Monmouth.

some poorly trained technicians and some often untrainable basics.

In order to raise the proportion of skilled men in signal units, the Signal Corps School had always set aside space for quotas of students to be selected by field commanders from men possessing aptitude and background for communications study, but after war made manpower scarce throughout the Army the policy failed for lack of students. Field commanders would release few men, even temporarily, to the Monmouth school. There was always the possibility, they reasoned optimistically, that when a unit was alerted for overseas movement, somehow the Signal Corps would supply the technicians. The Air Corps, whose requirements for specialists were heaviest, was the worst offender. In this situation, the Signal Corps now had no recourse but to fill its school to capacity from its own replacement training center intake, culling out the better qualified recruits at the end of basic training for enrollment in the longer school courses in the more critical specialties. Replacement training center courses were accordingly limited to the simpler technical subjects which could be taught in less time. Thus a greater number of recruits could be given a modicum of technical training.[65]

The January increase in school capacity carried with it an authorization for theater-type construction to house an additional 3,000 men. But Fort Monmouth, thickly dotted with temporary buildings, was hedged by populous New Jersey communities. There was no room to expand. The post already occupied two and a half times its peacetime area. Classrooms served their purpose continuously as the students came and went in shifts, day and night. But barracks space was the bottleneck and General Olmstead was unwilling to resort to bunking shifts. Additional students could be accommodated only by putting 70 men in each 63-man barracks. The War Department had authorized that, but had cautioned that should respiratory diseases become epidemic, the post would be required to return to normal housing.

The New Jersey National Guard encampment site at Sea Girt, only a few miles distant from Fort Monmouth, provided the space for expansion. In January 1942 the Signal Corps leased the site from the state of New Jersey at a cost of $125 a day—power, water, and gas included. Fortunately, the camp already had twenty-two mess halls in which 1,700 men could be seated, a small post exchange, a large headquarters building, three stables which could be made into classrooms, a motor shop, a fireproof warehouse, drill grounds, and so on. It also had an excellent target range. All of this admirably suited the needs of the replacement training center for receiving recruits and administering basic military training.[66]

With the transfer of this activity to Sea Girt (Camp Edison) space would be available on the Fort Monmouth reservation for the expansion of the school. The new facilities and the decision not to duplicate in the training center any course taught in the school would enable the former to turn out an estimated 26,502 simple technicians by the end of 1942.

Instructors accordingly rearranged schedules and accelerated the pace. The replace-

[65] Memo, Dir of Sig Opns Sv OCSigO for Dir of Sig Supply Sv OCSigO, 7 Sep 42, sub: Spec tng for SigC specs. SigC SPSTP 5 Misc.

[66] (1) Ltr, CSigO to CG SCRTC, Ft. Monmouth, 4 Jan 42, sub: Expansion of SigC RTC. SigC 353 SCRTC Ft. Monmouth. (2) Memo, ACofS G-3 for CSigO, 15 Jan 42, sub: Mob and tng plan 1942. SigC MP 370.01 Mob.

ment training center set up classes for Saturday mornings and reviews for Saturday afternoons. Courses for administrative personnel, supply and warehouse clerks, truck drivers, and aircraft warning plotters were reduced to nine weeks; for message center clerks, linemen, local battery switchboard operators, messengers, and telegraph printer operators to 11 weeks; for automobile mechanics, cooks, permanent linemen, advanced switchboard operators, code clerks, aircraft warning operators, photographers, pigeoneers, and field radio operators to 13 weeks. The field radio operators were supposed to get their training through troop instructions in the field.[67] But so great was the shortage of radio equipment issued to troops that the replacement training center had to teach the subject in its classrooms. Selected recruits took only basic training and then went into the more specialized courses in the Signal Corps School; 16-week courses for cable splicers, framemen, insidemen, installer-repairmen, powermen, and cyptanalytic clerks; 20-week courses for radio electricians, switchboard installers, telegraph printer maintenance men, wire chiefs, and fixed station radio operators.[68]

Another even larger replacement training center was taking shape at Camp Crowder, Missouri, in the foothills of the Ozark Mountains, under the supervision of Brig. Gen. William S. Rumbough, commander of the camp and the replacement training center, assisted by Lt. Col. Robert A. Willard, executive officer, Lt. Col. R. P. Lyman, plans and training officer, and Capt. J. A. Joseph, adjutant.[69] The site of Camp Crowder, originally intended as a joint Infantry-Signal Corps training facility, had been turned over to the Signal Corps, except for space for four Engineer regiments to be trained there. The acquisition of the Infantry's buildings necessitated rearrangements in the use of space and some structural alterations to make the buildings suitable for Signal Corps use as classrooms.

On 15 February 1942 the first troops arrived for training. Classes began four days later, conducted by instructors drawn for the most part from Fort Monmouth. The recruits were divided among the twenty-four courses which constituted the replacement training center's training program. The largest class would be for truck drivers (1,619 students), the next largest for aircraft warning operators (1,319 students). Other large classes were for field linemen (1,099 students) and for field radio operators (1,022 students). The remaining classes averaged about 350 students each. The courses did not differ essentially from those at Fort Monmouth. At the end of basic training the recruit progressed to the specialist phase, in which he studied the subjects for which his civilian experience, education, and aptitude presumably best fitted him. Men qualified for study in advanced specialties were enrolled in the Signal Corps School at Fort Monmouth. As yet there was no advanced school at Camp Crowder, although one was in prospect.

The first recruits at Camp Crowder gave the Signal Corps little cause for enthusiasm, since the caliber of many of the men fell

[67] Mobilization Training Program 11–1, issued in January 1942.

[68] (1) Ltr, CSigO to CG SCRTC, Ft. Monmouth, 19 Jan 42, sub: Shortening of courses of instruction SCRTC. SigC 353 Ft. Monmouth (RTC) 1, Jan–Apr 42. (2) Memo, Capt Vaughan for Chief of Mil Pers Br OCSigO, 16 Mar 42, and 2 Incls. SigC 320.2 Gen 2, Mar–May 42. (3) Incl, Tab B, with Memo, Chief of Mil Pers Br for Deputy CSigO, 23 Oct 42, sub: Pers rqmts. SigC 320.22 Enlisted Strength, Oct 42 (MT–25).

[69] Reinstein, Signal Corps Training in World War II, p. 185.

below the standard for specialist training. They proved to be of only slightly higher aptitude than the men the War Department normally expected to receive at any of its reception centers, as well as below the already too low average which currently prevailed at Fort Monmouth.[70] In some of the contingents that arrived at Camp Crowder before the Army had established effective criteria for selecting men for the Signal Corps, as many as 40 percent were scarcely capable of learning the skills and techniques which modern communications work involves.[71] Some of these were trained as linemen and truck drivers, but most had to be shipped out as basics.

Just as replacement training center activities had outgrown the parent post of Fort Monmouth, aircraft warning training could no longer be held within its borders. Plans for a joint Signal Corps-Coast Artillery Corps-Air Corps school in the south—where year-round training would be feasible and where military airplanes and surface craft plying their normal trade would provide live targets for radar detection practice—had been under consideration in the War Department since the preceding July,[72] but up to the beginning of 1942 the General Staff had not authorized its establishment. A G–3 conference late in November 1941 had brought the proposal out of its pigeonhole and thrown it back to the Signal Corps for the preparation of a detailed plan for a joint Signal Corps-Coast Artillery School to be operated by the Signal Corps, apart from Air Corps radar training. On 19 January 1942 the Secretary of War approved the revised plan, and a month later the new establishment, Camp Murphy, was under construction at Hobe Sound, Florida.[73]

Pre-Pearl Harbor plans had also provided for an aircraft warning unit training center at Drew Field, Florida, under the III Interceptor Command, which would in effect be a finishing school for the students from Camp Murphy. Out of necessity, however, Radio "A" school at Drew Field had sprung into being soon after Pearl Harbor before the school at Hobe Sound had been authorized. It offered rather sketchy training to information center technicians, radio operators, and administrative clerks.[74]

On 15 January 1942 Lt. Col. Benjamin Stern, signal officer of the III Interceptor Command, went to Washington to attend an Air Corps conference on the training of radar specialists. Out of that conference grew the Radio "B" or radar department of the Drew Field school, which still had no official standing. The Army Air Forces considered it to be their school; the Chief Signal Officer thought of it as belonging to the Signal Corps. However that might be, the first radar class began its training on 2 February with 202 students and "three SCR–270–B units, three hospital ward tents, and a few pyramidal tents." Training aids were blackboards, circuit diagrams provided by the aircraft warning units, instructors' notebooks, and

[70] Special Inspec SCRTC, Camp Crowder, by IGD, 8 May 42.

[71] Col Robert G. Swift, "The Crowder Story," *Signals,* II (November–December 1947), 27.

[72] Ltr, TAG to CSigO and others, 19 Jan 42, and 1st Ind, CSigO to TAG, 24 Jan 42. AG 352 (7-22-41) MSC–C–M.

[73] Named for Lt. Col. William Herbert Murphy, who had been shot down by the enemy during a flight over the Netherlands Indies on 3 February 1942. He had pioneered in military radio developments, particularly the radio beam. CSigO, Annual Report, 1942, p. 187.

[74] History of 2d Training Battalion (formerly 588th Sig AW Bn) Third Air Force, Oct 43, App. I. AF Archives Sig–2–HI.

some obsolete commercial communications items. That was all until late in February when six SCR–270–A's were sent down from Fort Dix, New Jersey. These were not in working order but at least the students could study the parts. As instructors this group utilized six officers and thirty-six enlisted men who had had some experience with radar, either at Fort Monmouth or in the field.[75]

Until aircraft warning training should be firmly established on a large scale in Florida, the Aircraft Warning Department of the Signal Corps School at Monmouth was doing all it could to relieve the shortage of trained men. New classes were embarking each week upon radar maintenance courses but the students were too few.[76] The number dropped from 318 in January and February to 100 in March.[77] The Coast Artillery ceased altogether sending students after 21 February 1942, and the Air Forces Combat Command sent students to only one of six classes during the period 7 March–11 April.[78]

The Army Air Forces filled Signal Corps units assigned to it from allotments of untrained men granted by the General Staff, and organized and altered the units, sometimes without even consulting the Signal Corps. Few of these men reached the Signal Corps School, nor did they get any appreciable training as communications technicians in AAF schools. Consequently, many a Signal Corps unit with the AAF, which should have been filled with qualified technicians, was actually so top-heavy with nonspecialists that it was not competent to perform signal duties. By the end of March, the Signal Corps units serving with the air arm contained more than 19,000 nonspecialists above the number contemplated.[79] It was obvious that task force commitments could be met only by the assignment of units containing a mere skeleton cadre of specialists—a minimum of men who had received barely enough instruction to enable them, once arrived in the theater of operations, to continue the training they would have to experience and would have to impart to others before their organizations could qualify as efficient operating units. This was a point on which Brig. Gen. Harry L. Twaddle, the Assistant Chief of Staff, G–3, the Air Forces, and the Signal Corps were in agreement.[80]

Thus many of the men who left the United States in the early winter months of 1942 to serve in Signal Corps units accompanying the first task forces could not be permitted the luxury of completing their training and of acquiring experience before they went into action. Unseasoned, half-trained or worse, they would have to learn as they worked.

The strain of life in advanced areas, with that of learning difficult communications skills while maintaining full schedules of the

[75] (1) Interv, Sig C Hist Sec with Col Herrelko, Air Corps, Philadelphia, 11 Mar 47. (2) Hist cited n. 74, Apps. I, II, III. (3) "Signal Corps Training in the AAF," *Signals* I:2 (November–December, 1946), 26–30.

[76] These courses were added to the curriculum on 1 January 1942. Signal Corps Information Letter, No. 3 (Feb 42), p. 25.

[77] Totals were obtained from tables contained in Item 167, Signal Corps School Headuarters File 352, Aircraft Warning Department 1942.

[78] (1) Comment by Dir of AW Dept, SigC School, n. d., attached to Ltr, CG CAC to CG AGF, 7 Apr 42, sub: Maint course SCR–268, SigC School; (2) Tables of AW Dept Students. Items 167 and 199 in file cited n. 77.

[79] Memos, O/C Mil Pers Div OCSigO for Dir of Pers Hq AAF and for Dir of Pers SOS, 30 Mar 42. SigC 322 Sig AW Cos, 1940–43.

[80] Memo, O/C Air Com Div for Chief of Opns Br OCSigO, 19 Jan 42, sub: Plan evolved to meet anticipated immediate demands for task forces involving AW units. SigC 320.2 Task Forces, SPSTP 5.

usual military duties, was hard on the men. But the situation was even more cruelly disheartening to their officers. To wait anxiously for desperately needed technicians only to learn upon their arrival that they were not really trained at all was bitterly frustrating. Signal officers such as Maj. Gen. Spencer B. Akin of General MacArthur's staff in Australia were providing communications with almost no equipment and practically no seasoned men. They needed every pair of skilled hands. To Akin, the arrival of untrained signal troops was an actual handicap because it meant that he would have to divert men from his inadequate supply of skilled specialists to train the newcomers.[81]

If the Army could not afford the luxury of fully training its enlisted communications specialists, obviously it could not afford to send its officers to school for full terms, either. The Secretary of War announced late in January 1942 a policy of sending younger officers to service schools before their assignment to field force units. He had previously, late in December, authorized the Chief Signal Officer to retain any graduates of the officer candidate school who lacked technical ability in order to give them eight weeks of specialty instruction in the Signal Corps School.[82] But such schooling pronouncements were a bit unrealistic. The rapid activation of new units, the ballooning activity in every area of Signal Corps administration, the scarcity of officers everywhere—all these required that nearly every officer be put in a job, not in a school. Few could be spared from troop or administrative duties, and many who had been in the schools at the outbreak of war were now being withdrawn for urgent assignments before they had completed their courses. This situation was general; it had existed for months. For example, the Air Force Combat Command, although wanting Signal Corps-trained officers, had nevertheless warned, even before Pearl Harbor, that it could send no more officers to fill its quotas in the Signal Corps School. Once its officers had been assigned to units, they could not be removed for schooling because this would hold up the field training of their units. It was hard to get officer students; still harder to keep them in school.[83]

The Electronics Training Group provided an example of very sharply abbreviated training. By the beginning of 1942, none of the officers had completed the courses in the British Isles. Yet they were already in demand within the first month of the war. They were needed as radar instructors for the Aircraft Warning Service, for duty in the continental United States and in the vicinity of the Panama Canal, and for overseas requirements as yet indistinct. Training in ground control of interception (GCI), at Army Air Forces project TRIGGER in Florida, awaited the arrival of a handful who were receiving special instruction in Britain to fit them to teach the subject. These were withdrawn from the Royal Air

[81] Interv, SigC Hist Sec with Gen Akin, CSigO, 18 Oct 49.

[82] (1) Ltr, TAG to CG's All Corps Areas, 30 Jan 42, sub: Troop-age officers with overhead instls. AG 210.31 (1-23-42) OE–A–M. (2) Capt Frederick Reinstein, Training Study of the Signal Corps Officer Candidate School, 1939–1944 (1944), SigC historical monograph C–6, pp. 12–13. SigC Hist Sec File.

[83] Early in January, the War Department ordered blanket withdrawal from schools of all 34th Division officers. (1) Ltr, CG AFCC to TAG, 4 Nov 41, sub: Res Officers to SigC School, Ft. Monmouth; (2) AG Ltr to CSigO, 2 Jan 42, sub: Release of 34th Div Pers now at sv schools. AG 320.2 (1-1-42) (MT–A).

Force schools on 5 January and left England with only a small part of their course completed.[84]

Curtailed as their training had been, there was no substitute for the knowledge which these young officers possessed. In all the United States there was no other reservoir of men trained in the new techniques of radar, because up to this time the knowledge had been confined to a few men in Army and Navy laboratories, in the Radiation Laboratory of the Office of Scientific Research and Development, and in the firms which manufactured the equipment. The British co-operated by accelerating and abbreviating the training in order to speed the return of their American students to the United States. Eight, hastily trained in the very high frequency techniques of Chain Home Low (CHL) and Plan Position Indicator (PPI) radar equipment, returned in February. A larger group, who were receiving special instruction in siting, installation, and maintenance, followed early in March. Twenty-five officers who had begun training in the October class came back for assignment to the laboratories at Wright Field and at Fort Monmouth.[85]

Meanwhile, training which approximated that given the Electronics Training Group officers in British military schools was going forward at the Massachusetts Institute of Technology, and at a less advanced level at the Cruft Laboratory of Harvard University. Courses quickly undertaken in other civilian educational institutions of the country, under the U. S. Office of Education's war training program, were fitting many other men for duty with the Aircraft Warning Service in one capacity or another. By the end of February, the scope of all training had broadened encouragingly. But it would be months before the products of the schools could assume the duties for which they were being trained, and no one could tell what demands for signal specialists the next few months would bring. Could unskilled men in the numbers authorized and of the caliber received be converted into specialists in time? [86]

[84] Ruth F. Sadler, Mil Pers Br OCSigO, History of the Electronics Training Group in the United Kingdom (March, 1944), SigC historical monograph C-5, pp. 21, 28. SigC Hist Sec File.

[85] (1) *Ibid.*, pp. 20–21. (2) OCSigO R&W Action 1, R&D Div (M–7–D GH) to O/C R&D Div, 3 Jan 42, sub: ETG; (3) Msg, Chaney, London, to AGO, 31 Dec 41, No. 330. SigC 352.11 ETG.

[86] For a detailed account of signal schooling during the period January–July 1942, see Chapter VII, below.

CHAPTER III

The Call for Equipment

(January–May 1942)

Supply Dominating Research

Certainly the mustering of men in response to the call of declared warfare was the most pressing demand. But business-as-usual had restricted the amassing of equipment also. The lag had continued up to and right through the opening of belligerency—automobiles, for example, still coming off production lines; and only now were signs beginning to appear that the supply branches of the armed forces could count on access to industrial production facilities and stockpiles of material. Fortunately, during the months before Pearl Harbor both the activity and the outlook of the Signal Corps had sufficiently expanded so that, with the long period of waiting at an end, the men responsible for equipping the Army with signal machinery knew their problems better. They knew that they would have to meet daily demands bigger than many past yearly ones. There was too little in the field, or in the course of production, or under development.

The problem indeed seemed to be that to reach the field with signal equipment they would have to devise the sets and manufacture them almost simultaneously. Manufacture was a problem not chiefly theirs but American industry's. Development, too, they understood to be in large part shared. The achievement of mobile radiotelephony and, above all, of radar had demonstrated the limitations, along with the triumphs, of military laboratories and had made it plain once again that Signal Corps research would be almost as closely attached to civilian partnership as Signal Corps production would be. Signal Corps research and development activity would co-operate with civilian laboratories under the government, like the newly constituted Radiation Laboratory under the Office of Scientific Research and Development, and would also rely heavily upon the laboratories of large producers, like Bell or Westinghouse. Pressure upon research would be a pressure toward supply.

That supply dominated research was borne out by reorganizations, first within the Signal Corps, and then within the War Department itself. In August 1941 one of General Olmstead's first acts as Chief Signal Officer had been to transfer Col. Roger B. Colton from the Monmouth laboratories to the Washington headquarters. Here he had put Colton in charge of a newly created Materiel Branch. Under Materiel, the formerly separate divisions of Supply and of Research and Development became a team. After war came, there was never any doubt

as to which teammate dominated. It was supply. And Colton, primarily a research and development officer, had to devote the bulk of his efforts to procurement problems.[1]

This shift of emphasis appeared in the March 1942 reorganization, when three major commands emerged within the Military Establishment of the United States. Under one of the three and its commander, Lt. Gen. Brehon B. Somervell, all the technical and most of the administrative services were caught up in a single net and ticketed Services of Supply (SOS). The name tended to tag the Signal Corps, from then on, as a supply agency. Its duties as an arm, as an arbiter of communications, and as a research agency, suffered by comparison.

Olmstead realized what the effects of the reorganization would be when he first saw a copy of its chart. "I went down to the Deputy Chief of Staff, General [Maj. Gen. Richard C.] Moore, at that time," Olmstead related to a board investigating communications in May 1943, "and I said, 'The set-up is wrong in so far as Signal is concerned. For supply, yes, it is O.K.; but there are many, many things that the Chief Signal Officer has to do that affects the over-all communications of all concerned,' and I said," Olmstead concluded, " 'Every man is entitled to his day in court.' " General Moore's comment left no room for discussion. As Olmstead related his response, Moore flatly replied, "You won't have any day in court. This organization has been decided upon. Those are orders." But at a subsequent staff meeting in the SOS, General Somervell admitted the difficulties which the new organization created and said, as Olmstead recalled his words, "Well, let's try this thing out, and if it doesn't work, adjustments will be made." [2]

As an agent for procuring, distributing, and servicing equipment, the Signal Corps was appropriately gathered in with the other supply and service agencies of the Army under Somervell. In these tasks, its work continued to progress no less well at the new organizational level than before, when the Chief Signal Officer had stood one step higher in the Army's hierarchy.

But in his many other duties, especially in matters of communications policy, coordination, and control, the Chief Signal Officer's voice was muffled under the blanket spread between him and other Army agencies, and this at the very time when the unique and multifarious significance of electronics in warfare was beginning to obtain recognition. The Secretary of War, Henry L. Stimson, commented early in 1942, "I had been under the misconception that most have been under as to the importance of Signal Corps work in this war . . . ; it has suddenly leaped to the forefront of interest." He went on to observe that perhaps other branches had "rather high-hatted" the Signal Corps, thinking of it as a lot of men who "just made flags," rather than realizing that "the Signal Corps is now the focus of applications to war of a new science." [3]

Stimson's misconception and enlightenment did not relieve the Signal Corps from its lowered status. The March 1942 reorganization, which had dropped the Signal Corps to a lower level than it had formerly

[1] The consequences of this organizational expedient were far reaching. See below, pp. 541–44.

[2] Proceedings of Board to Investigate Communications, Tab P, p. 2. AG 311 (5-10-43) (1) Bulky Pkg, Army RG 207.03 Job A50–55. See also Tab M, page 14, for Brig. Gen. Frank C. Meade's account of this incident.

[3] Rpt of Press Conf of SW, 23 Apr 42 (unsigned). SigC 352.13 Speeches.

enjoyed, had done the same for all the technical services. It had also stepped down the Infantry, the Armored Force, and other Army components which the Corps was accustomed to serve. It left the Signal Corps' largest single customer, the Army Air Forces, one level higher. Figuratively speaking, when Olmstead talked to Arnold, the line would have to carry the voice of Somervell as well as his own. Moreover, the circuit to most signal officers in the field was broken; that to the Chief of Staff was blocked. Without a direct line to the Air or Ground Forces, or to the Staff, or to the corps areas, the Signal Corps was obliged to ask the Services of Supply to do its talking, expressing even the most technical sentiments to them.[4]

Yet if the organization of the Services of Supply seemed to pull together dissimilar functions, not all of which involved supply, it only repeated on a large scale what Signal Corps administrative changes had already been doing, and were continuing to do. For the Signal Corps, like Somervell's larger aggregation of services, was something of a hasty pudding whose ingredients tended to separate. General Olmstead was touring the west when the 9 March reorganization took place.[5] But he immediately had his office reflect the change by creating new supervisory levels and inserting them between the chief and the divisions just as the Services of Supply and the Army Ground Forces now stood between the Chief of Staff and the arms and services.

Brig. Gens. James A. Code, Jr., Roger B. Colton, and Charles M. Milliken now were designated respectively Deputy Chief Signal Officer, chief of the Supply Service, and chief of the Field Service. These two services, Supply and Field, were the new supervisory echelons. Under Milliken fell the co-ordination of communications and air communications as well as personnel and training, together with signal plans and operations. Code remained the principal administrative officer. For a time photography was removed from Army communications, where it had not fitted at all, and was attached to the Administrative Branch, where it fitted no better. Its divergence was immediately apparent, and so was that of the administrative communications complex; so that there was nothing to do but to raise each of them to the level of services also.[6] Simplicity of organization seemed unobtainable. Unrelated functions, boxed together in an organization chart, were not any more securely packaged in one than in another, whether in the Office of the Chief Signal Officer's box or in the Services of Supply's. They kept bursting the lid.

Meanwhile, a lesser move organized General Olmstead's executive staff into two directorates, Col. Frank C. Meade heading one for planning, Maj. William D. Hamlin continuing the executive function under a new title. The fact that Lt. Cols. Francis H. Lanahan, Jr., Victor A. Conrad, and Wesley T. Guest were all assigned to Meade suggested that the Directorate of Planning was to have considerable importance. All the while, after 9 March, the presence of the Services of Supply was making itself felt, so that planning in any echelon below it was likely to be reduced to either follow-

[4] (1) Memo, Col David McL. Crawford for Brig Gen Charles M. Milliken, 3 Jul 42, sub: Sig officers for AGF, AAF, SOS, WDGS; (2) Rpt of Bd of Officers, OCSigO, 10 Jul 42. SigC SPSTP–6.

[5] *Telecommunications Reports*, VIII, No. 28 (5 Mar 42), 13.

[6] As the Army Pictorial Service and the Army Communications Service, respectively. See Signal Corps Administrative Log, 1939–1945, OCSigO Orgn Charts through Jun 42. SigC Hist Sec File.

ing prescriptions from above or unobtrusively seeking to write the prescription.

These many changes in organization were made in an effort to keep up with an expansion so swift that even under a system with which they were familiar, administrators would have been strained to coordinate and supervise so many new units. The over-all Services of Supply was not familiar, but new, disparate, and untried. It added to paper work. Some of its directives were wholly extraneous. Some followed procedures already in effect but with just enough deviation to make reissues of Signal Corps directives necessary in order to conform.[7] Regulations became increasingly verbose. How properly to prepare letters, memoranda, and routing slips plagued the thousands who either dictated or typed them. Confusion of this sort penetrated to all levels of command. The Chief Signal Officer encountered it in dealing with his superiors in the Services of Supply and with his subordinates in the Signal Corps.[8] Yet somehow, in spite of annoyances, obstacles, devious channels, regulations, and directives, in spite of organizations which fell out and re-formed almost daily, the heterogeneous and hastily assembled office staffs and all the phases of Signal Corps activity in the critical early months of 1942 gathered momentum. Even Research and Development, however roughly shouldered by its running mate, Supply, continued to cover ground fast.

[7] For example, Signal Corps organization charts carried designations of branch for first level, division for second. Services of Supply decided upon a nomenclature of division for first level, and branch for second, necessitating reissue of all Signal Corps charts and memoranda. Memo, CofS SOS to TAG, 23 Jul 42. AG 020 (3-2-42) (1) Sec. 3.

[8] Office Regulations, OCSigO, Changes 217 to 443 inclusive, 9 Mar 42 to 3 Oct 42, inclusive.

Colonel Colton had come to Washington from the Signal Corps Laboratories to become chief of the Materiel Branch, now the Supply Service. Colton was in many respects the number two man in the Signal Corps, and as director of the Fort Monmouth laboratories had been at the forefront in the research and development organization. He was a man whose background included degrees in electrical engineering from Yale and the Massachusetts Institute of Technology. In its eighty years the Signal Corps had built up a tradition of technical men who were well able to deal with scientists on scientists' terms. Col. Hugh Mitchell, Colton's chief subordinate as head of the Research and Development Division, had long been associated with Signal Corps research, as had Lt. Col. Tom C. Rives, Mitchell's deputy. Both had M. S. degrees in electrical engineering from Yale, and Rives had been so long and so closely a part of the Signal Corps development work for the Air Corps at Wright Field that he knew the subject well. These were experienced research and development officers, as was also Colton's successor over the Signal Corps Laboratories, Maj. Rex Van Den Corput, Jr., not to mention Col. John H. Gardner, director of the Aircraft Radio Laboratory serving the Air Forces at Wright Field, Ohio.

At the Washington headquarters, Colton was demonstrating a feat of Roman riding. Of his two steeds, the one, Research and Development, which had been galloping hard upon Pearl Harbor, was being pulled short by the other, which was Supply. For the Supply mission, so much more the communications industry's creature than the Signal Corps', had scarcely begun to lengthen its pace. From now on, Supply demanded and got most of Colton's atten-

tion because shortages of almost all categories of equipment were critical throughout the Army.[9] The dual organization under Colton was based upon the "premise that Signal Corps supply begins with Research and Development." [10] On this premise a Radar Division made its appearance in January, because radar supply was the object of one of early 1942's most desperate calls. The demand for radar was universal; it came even from Secretary Stimson, who was highly alert to radar's capacities.[11] In a move which reached through the Office of the Chief Signal Officer to the Laboratories themselves, radar work was set apart from general development.

In the Fort Monmouth area what became known as radar was called Radio Position Finding. The RPF Section of the Signal Corps Laboratories became Field Laboratory No. 3, isolated for secret work, apart from the eyes of the curious, in the scrub barrens of Sandy Hook, New Jersey. Work on ground radar had already expanded into areas in Rumson, New Jersey, near the Hook; at Twin Lights, Highlands, New Jersey, at the very base of the Hook; and on Sandy Hook itself, site of Fort Hancock, then a Coast Artillery installation guarding the approaches to New York Harbor.[12]

Radar was the electronics prodigy, and in considerable part a creation which the Signal Corps had attended from the beginning. It had grown so rapidly (however secretly) that it had ceased to be merely a specialized field of radio.[13] Formally, the Signal Corps radars were still SCR's, but actually they had moved into another area of electrical communication altogether. It is worth quoting personnel figures to show the extraordinary advance of the new equipment in the total range of the Signal Corps' research and development interests. At the end of the fiscal year in June 1942, 62 percent of the officers assigned to research and development and 55 percent of the civilians were concerned wholly with radar or with the related work on aircraft communication and navigation equipment. The growth of the research and development function as a whole appears in the fact that 358 officers and 14,337 civilians were at work in the Laboratories and in Washington six months

[9] The several divisions of the supply function in the Materiel Branch were: Scheduling, under Lt. Col. Eugene V. Elder; Procurement, under Col. Clifford D. Cuny; Storage and Issue, under Lt. Col. R. C. Hildreth; and Maintenance, under Lt. Col. John M. Heath. The last of the seven divisions of the Materiel Branch was the Legal Division, under Lt. Col. Conrad E. Snow. Signal Corps Information Letter, No. 3 (February, 1942), pp. 15ff, including orgn chart, 21 Jan 42.

[10] *Ibid.*, p. 6.

[11] Henry L. Stimson and McGeorge Bundy, *On Active Service in Peace and War* (New York: Harper & Brothers, 1948), pp. 508ff.

[12] Two other Field Laboratories into which the Monmouth research mission overflowed were No. 2, which became the Eatontown Signal Laboratory and which worked on wire, direction-finding, sound-and-light, and meteorological projects; and No. 1, later known as the Coles Signal Laboratory, which developed radio equipment.

Historical Report of the Signal Corps Engineering Laboratories (Ft. Monmouth, 1944), pp. 5ff and 26f. Hereafter referred to as Hist Rpt SCEL. SigC Hist Sec File.

[13] By a series of flounderings and false steps in the top intelligence services, the word *radar* was first sanctioned, then forbidden. In deference to the confusion, both the Radar Division and the Signal Corps Radar Laboratory had to be renamed after they had been in existence for some time. They became the Electronics Branch and the Camp Evans Signal Laboratory, respectively. The ground radar laboratories moved early in 1942 some miles down the Jersey coast to Camp Evans, at Belmar. Camp Evans, so designated by War Department General Order, 17 February 1942, in memory of Lt. Col. Paul W. Evans, Signal Corps, who had died in the Panama Canal Zone on 10 April 1936, was dedicated on 31 March 1942. Lab Monthly Prog Rpt, Mar 42. Evans Sig Lab File, Belmar, N. J.

after Pearl Harbor, where six months before that event there had been respectively 63 and 1,619.[14]

Recognition of the fact that the emphasis was thus being redistributed brought about the January change in the Materiel Branch which made radar, with Colonel Rives at its head, a separate division. The assignment given the Radar Division was as explicit as it was total. It was to be "responsible for the supervision of all Radar and Aircraft Radio . . . from the inception of the project until the equipment is developed, procured, installed, and [provided with] the proper spare parts and maintenance personnel . . . ." [15]

At Wright Field a parallel change occurred, which brought radar into a separate unit supervised by Maj. William L. Bayer and merged the communications and navigation units into the single responsibility of Lt. Col. Hobart R. Yeager.[16] In the fact that Yeager was an Air Forces officer was proof that the Air Corps and the Signal Corps could co-operate. Further proof lay in the careers of Bayer, enthusiastic for airborne radar, and of the director of the entire laboratory, Col. John H. Gardner, who had been at Aircraft Radio Laboratory long enough to feel the pride of possession about it.

At Fort Monmouth, meanwhile, as Field Laboratory No. 3 became the Signal Corps Radar Laboratory in January (soon transferring to Camp Evans, Belmar, New Jersey), ground radar became the entire concern of Lt. Col. Rex Corput, Jr., one of the men who had known it longest and most searchingly. The pattern which began to appear with emphasis upon radar, dividing research and development equally between radar and other kinds of equipment, was thus completed at Monmouth as at Dayton. Lt. Col. Oscar C. Maier was appointed chief both of Squier, at Monmouth, and of the two Field Laboratories, at Eatontown and Camp Coles for wire and radio respectively, and together given the name General Development Laboratories. Correspondingly, Lt. Col. James D. O'Connell, an officer who had an amount of experience at the Fort Monmouth laboratories comparable to Rives' at Wright Field, became director of the parallel General Development Division in the Office of the Chief Signal Officer.[17] Thus all of the fundamental and vital Signal Corps research in the long-established fields like wire, radio, and meteorology came under O'Connell's supervision.

Wire, the Basic Equipment

Wire and wire signaling devices had long been the core of signal operational equipment and, in providing the bulk of communications for large Army installations in World War II, would remain so. A core of huge dimensions it would become, in direct proportion to the scale of vast, indeed world-wide, theater operations. Thanks to the application of the commercial carrier system to the military, a single wire circuit could carry not one but several signals simultaneously. Telegraph in particular would be entirely revolutionized, both in established administrative circuits and in temporary

[14] CSigO, Annual Report, 1942, p. 254.

[15] Signal Corps Information Letter, No. 3 (Feb 42), p. 14.

[16] Ltr, Col John H. Gardner, Dir of ARL, to Chief of Experimental Engr Sec, Wright Fld, 20 Jan 42, sub: Reorgn of ARL, in History of Aircraft Radio Laboratory, 1 Oct 43, doc supplement, p. iii. SigC Hist Sec File.

[17] (1) CSigO, Annual Report, 1942, pp. 31ff, including orgn chart, 23 Feb 42. (2) Hist Rpt SCEL, p. 27.

field installations, because of another recent commercial development, the teletypewriter.[18]

During 1942 teletypewriter equipment went into the field in a big way for the first time, and not a moment too soon to meet the needs of the many huge installations springing up throughout the zone of the interior. In March 1942 production of telegraph printer sets EE–97 and EE–98, for mobile and fixed operation respectively, began with the delivery of 150 sets in the first batch, somewhat ahead of schedule.[19]

The introduction of the teletypewriter into the Army required a new switchboard and suitable accessories, in fact a whole telegraph or teletypewriter central office set, which became the mobile TC–3. Under project 4–17 set up in the summer of 1940 the Signal Corps Laboratories had begun to develop the heart of the set, switchboard BD–100, a 10-line board, weighing only 200 pounds, which was phenomenally light for equipment of this kind. The BD–100 was but one quarter to one third the size of the nearest comparable equipment which the Bell Telephone Laboratories had offered to the Signal Corps. The reduction largely resulted from the neutral system of teletype operation which the Signal Corps preferred to the polarential. The BD–100 gave excellent service throughout the war as part of the TC–3, and constituted "one of the major contributions in the field of telegraph-and-teletype-switchboard design." [20] In the spring of 1941 the Signal Corps Board had given test models a thorough going over and then its blessing. By September the Signal Corps had completed procurement arrangements, and now in 1942 the Army began getting the new teletypewriter switchboards, while the Signal Corps General Development Laboratories at Eatontown completed the development of the TC–3. The complete set, including one TG–7, a rectifier, the heavy power unit PE–75, the switchboard itself, together with tools and spare parts, weighed about a half-ton.[21]

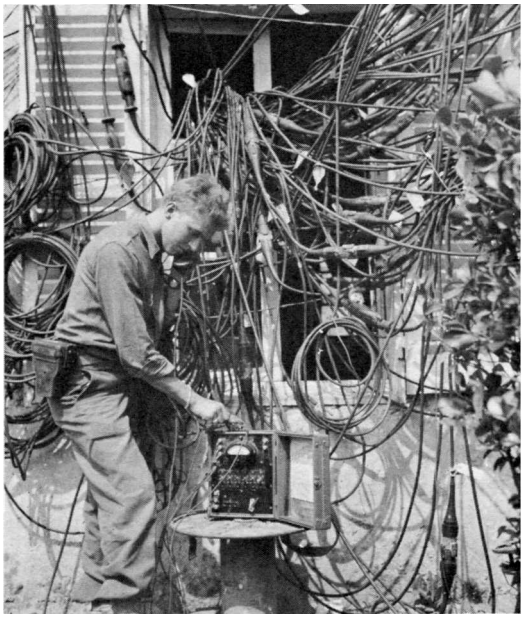
The immense traffic potential of teletype would mean little if the linking wire lines were inefficient, limited in capacity, easily injured or disrupted, slow to install on poles. This had been the situation in the 1941 maneuvers when Maj. Raymond C. Maude had reported that the limited range of field wire W–110–B restricted it to use within a division. What was wanted, he had said, was a field wire able to carry voice 35

[18] For a list of the more important wire equipment items, see Terrett, *The Emergency*, Appendix.

[19] The TG–7 which constituted the chief component of the sets was a modification of commercial model 15 manufactured by the Teletype Corporation. (1) Ltr, Lt Col William S. Rumbough to President SigC Bd, 8 Aug 41, sub: Use of telegraph printers and associated equip. SigC 413.44 (BD–100) Telegraph Printers Associated Equip. (2) Office of Stat Svs Hq SOS, Weekly Stat Rpt, Sec. II, Air and Sig, No. 40, 4 Apr 42, p. 4. Until 9 March 1942, these reports were issued by the Statistical Branch, OUSW. From 9 March to 9 April 1942 they were issued by the Office of Statistical Services, Headquarters SOS. From 9 April 1942 they were known as the Weekly Statistical Summary rather than as the Weekly Statistical Report.

[20] Maj Gen Roger B. Colton, "Army Ground Communication Equipment," *Electrical Engineering*, LXIV:5 (May, 1945), 175.

[21] (1) Hist Rpt SCEL, p. 167. (2) SigC Labs Annual Rpt, 1941, p. 38. (3) OCSigO Coord and Equip Div Case 5, Telephone Switchboard, 24 Jan 42, and Case 16, Telegraph Central Office Set TC–3 (Printer) (BD–100) vs. Telegraph Central Office Set TC–7 (Printer) (69–C–1), 10 Feb 42. SigC C&E Cases. C&E Cases originated in the Coordination and Equipment Division, which in February 1942 became the Communications Coordination and Equipment Division, under the Operations Branch. In the March 1942 reorganization, the activity became the Communication Coordination Branch, having under it several divisions, of which one was the Equipment Coordination Division. Hereafter referred to as C&E Case. (4) SigC 3 (ASF Catalog) Sig Supply Catalog, Sep 45, p. 356.



NEW DEVELOPMENTS IN SIGNAL COMMUNICATIONS *included spiral-four cable (left and right above) and the BD-100 teletypewriter switchboard (below), with three TG-7 teletypewriters.*

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to 40 miles and capable of being installed quickly. Open wire construction involving pole lines was too slow, he added, to keep up with moving armies. The Eatontown Laboratory now had spiral-four, the answer to Maude's wishes.[22] It received its name from the arrangement of its four wire conductors, which spiraled around a fiber core. The whole, wrapped in wire shielding, then encased in an insulating rubber jacket, was devised to provide long-range carrying power with minimum electrical loss and cross talk. Flexible, half an inch in diameter, of a tensile strength over 600 pounds, yet not excessively heavy, it could be handled far more expeditiously than other cables that the Signal Corps had used before. The Signal Corps developed plastic snap connectors, so that crews unrolling the quarter-mile lengths (called cable assemblies, CC–358) from standard Signal Corps reels DR–5 (or adapted for spiral-four as DR–15) could quickly link one length onto another. Moreover, into each connector was built a loading coil and balancing condensers which extended the talking range to 40 miles, without the use of repeater equipment. In January 1942 the Signal Corps announced this new field cable, with high hopes for favorable reception. By the end of the month, on 26 January, the Signal Corps Technical Committee recommended its standardization and the War Department made it official on 18 February. Western Electric, General Cable Corporation, and U.S. Rubber each contracted for small quantities for service testing.[23]

[22] Memo, Maude for Actg CSigO, 7 Oct 41, sub: Rpt of observation Second and Third Army maneuvers. SigC 354.2 Second Army Maneuvers 1942 (Aug–Oct 41) (AR–110).

[23] (1) Signal Corps Technical Information Letter, No. 2 (January, 1942), p. 25. (2) Hist Rpt SCEL, pp. 168ff. (3) SCL Monthly Prog Rpt, Jan 42, p. 4. (4) Memo, O. B. Jacobs (Bell Telephone Labs), 23 Feb 42, sub: SigC carrier cable system. SigC 413.42 Carrier Sets 1, Jan–Jun 42.

The Signal Corps did not have the honor of devising spiral-four (WC–548). It had been adapted, through the British, from a German long-range field cable, some of which British commandos had seized in early raids upon the Continent. From it, the British had developed what they called quad cable. Signal Corps laboratory representatives had seen samples for the first time in the Bell Laboratories during the summer before Pearl Harbor. Perfected for American use by the Bell and Signal Corps Laboratories working together, spiral-four helped make possible military use of commercial carrier circuits and the extension of the heavy duty communications systems directly to the theaters of war.

By 1942 Signal Corps wire engineers had this field cable so well in hand that they had begun to develop carrier communication equipment for it. A C-type spiral-four carrier permitted four conductors, whether on poles or in a cable, to carry many telephone, telegraph, and teletypewriter circuits simultaneously. A single spiral-four field cable could do the work of multiple open wire lines and obviate the slow tedious preliminaries of setting poles, fixing crossarms, and stringing the individual wires. Spiral-four, laid on the ground or buried, also avoided the exposure to enemy action which a pole line invites. Under laboratory projects 2–4, entitled Field Cable Research, and 4–18, Carrier Telephone Systems, this work was now progressing. Field wire systems which in former days sufficed for distances of only a few miles and for the transmission of only occasional messages were going to be supplemented by systems which could relay messages for hundreds of miles, and not just occasional signals, either, but unbroken torrents of voice and teletype flowing night and day. This became communications in

the fullest sense, and spiral-four cable helped to make it possible even in the field.[24]

As the laboratories developed spiral-four and looked into the application of carrier systems to the military, field arms fast came up with requests for the new development. The Air Force Combat Command, for example, was beset with a need for multiple communication channels, both in order to serve the far-flung multifarious business of air defense and in order to channel quickly large numbers of aircraft sighting reports into information centers and then to convey instructions dispatched to intercept airfields. Thus swamped with communication needs which dwarfed any previous military requirements for a field arm, the Combat Command drew up the following request in the days immediately after Pearl Harbor. Learning from a Signal Corps laboratory memorandum of 15 December that spiral-four field cable was practicable, the Air Forces at once asked for 2,100 miles of spiral-four; 36 sets of telephone and telegraph carrier terminal sets, each to handle 3 voice channels and 4 teletype circuits; 60 carrier repeaters; and 12 sets of telephone terminals, each to handle 4 voice channels.

In short, the Signal Corps was going to have to provide carrier equipment at the telephone and telegraph terminals of the spiral-four cable, also repeater stations along the cable line to amplify the signals on their way. This equipment would be needed to feed the several simultaneous signals into the cable, to boost them any distance, and then to filter them out at the other end in an orderly intelligible manner. This AAF requirement reached the Signal Corps in the first week of 1942.[25]

These requirements for military communications on a huge scale, backed up now by the realities of war, brought forth from the Signal Corps C-type carrier equipment. For some months under project 4–18, Carrier Telephone Systems, the Laboratories had been considering military applications of Western Electric's types H and G telephone carrier systems. By mid-1941 the project got a shove from spiral-four developments and the promise of huge communication capacity which the new field cable held forth. At the end of October 1941, the Signal Corps Laboratories reported that spiral-four research had "brought forth preliminary plans for a comprehensive system of voice telephone, carrier telephone and carrier telegraph systems to span distances from 50 to 150 miles and up. The projected system," the report continued, "will furnish four speech channels over a single cable, one of which may be utilized for the transmission of 4 to 6 channels of voice-frequency carrier telegraph." This would soon become C-type carrier equipment, a modification by Bell Laboratories of existing commercial equipment adapted for military use.[26]

Thus, under pressure of Army needs, the Signal Corps in collaboration with Bell Telephone during early 1942 worked up specifications both for carrier telephone terminal equipment, which became CF–1 (part of TC–21), and for repeater sets, which became CF–3 (part of TC–23). By

[24] (1) SCL Monthly Prog Rpt, Aug 41, pp. 4, 9f. (2) Memo for File, B. S. Anderson, Electrical Engr SSL, 14 Aug 41, sub: Discussion of proposed new wire transmission medium and transmission systems. SigC 413.43 (WC–548) Cable 1, 1941–43. For further discussion of spiral-four, see below, pp. 225–29, 367–70.

[25] Ltr, CG AFCC to Chief of AAF, 23 Dec 41, sub: Urgent field com facilities and 1st Ind, Marriner to CSigO, 5 Jan 42. SigC 413.43 (WC–548) Cable 1, 1941–43.

[26] SCL Monthly Prog Rpt. Nov 40 and thereafter, under project 4–18. Quotation is from report for 4 October 1941, pages 10 f.

March arrangements had been made also for telegraph carrier terminal sets CF–2 (part of TC–22). The Signal Corps placed orders with Western Electric for two sets each of CF–1 and CF–2, and for six sets of the repeaters CF–3, all to work with spiral-four field cable. This equipment would give the Army such long-range heavy duty communications as it had never before enjoyed in the field.[27]

But the Army would have to wait a while, for Western Electric to build the sets, for these to receive service tests, and for full production to follow, if all went well. Meanwhile, the Signal Corps prepared specific figures on what would be required to meet the needs that the Air Force Combat Command had outlined in January 1942. General Olmstead had asked the Monmouth laboratories to make the estimate. He got the answer late in March from Colonel Maier, now the head of the Signal Corps General Development Laboratory. Accomplishment of what the AAF wanted would call for some extras—ringing equipment for telephone channels, gasoline engine-driven generators, storage batteries, and trucks with trailers to house and convey the equipment. The cost, Maier estimated, would run to two million dollars.[28]

[27] (1) *Ibid.*, Jan 42, p. 11; Mar 42, p. 10. (2) Colton, *Electrical Engineering*, LXIV: 5, p. 175.

[28]

Equipment	*Unit Cost*	*Number*	*Total Cost*
WC–548 on DR–5, wire (miles)	[a] $525	2,100	$1,102,500
Carrier telephone terminals (CF–1)	3,000	48	144,000
Carrier telegraph terminals (CF–2)	5,600	48	268,800
Carrier repeaters (CF–3)	1,500	60	90,000
Voice frequency ringers (EE–100)	500	[b] 192	96,000
Power equipment (PE–195)	1,600	48	76,800
Storage batteries (three at each repeater station)	20	180	3,600
Trucks and trailers	4,000	48	192,000

[a] Cost per mile.
[b] Four at each telephone terminal, if all four channels are used for voice.

(1) Ltr, CSigO to Dir of SCL, 24 Jan 42, sub: Cost data on com equip for AAF. SigC 413.43 (WC–548) Cable 1, 1941–43. (2) Msg, TWP–4 Maier, SigC Gen Development Lab, Ft Monmouth, to Signals, Washington, 25 Mar 42. SigC 413.42 Carrier Sets 1, Jan–Jun 42.

Although telegraph in the form of teletype (both wire and radio) would carry far and away the bulk of World War II long distance communications, telephone would receive very heavy use, too, especially in headquarter installations. By 1942 the Signal Corps had either in production or under development big telephone switchboards and central office sets which would quite repair the need Colton had claimed two years earlier, after the 1940 maneuvers, to be most urgent—namely, new switchboards for heavy duty headquarters use.[29] Late in 1941 TC–1 for army headquarters, a huge central office set built around the 100-line switchboard BD–80, had gone into production. So too had TC–2, designed for use in corps headquarters, employing the 60-line board BD–89. These sets were ponderous affairs weighing tons, and might include not one but several switchboards installed side by side as traffic needs might require. The Air Corps men, wanting a small set weighing less than the divisional TC–4 (BD–96), got it when the Signal Corps Laboratories' Wire Section (Eatontown Laboratory) developed the TC–12 around the efficient 20-line BD–91 (even it weighed a walloping 300 pounds). In January 1942 an Air Corps unit at Selfridge Field, Michigan, and another unit at Mitchel Field, New York, completed service testing the set. In February both returned a unanimous report—approved. On 9 March Lt. Col. Francis J. Magee, head of the Equipment Coordination Division, recommended BD–91 for standardization.[30]

[29] Terrett, *The Emergency*, pp. 154, 233.

[30] (1) Hist Rpt SCEL, pp. 156, 158–60. (2) SigC TM 11–487, Electrical Communication System Equipment, Oct 44, pp. 62–64. (3) Ltr, Col Magee to Subcommittee SCTC, 9 Mar 42, sub: Standardization of Switchboard BD–91. SigC 413.42 Switchboards 1942.

SIGNAL CORPS SWITCHBOARD BD-72

All of the Army headquarters telephone and teletypewriter equipment, spiral-four and carrier, was heavy, entirely unsuitable for fighting men to carry forward with them. For them, in order to keep sharp the fighting edge of wire communications, the Signal Corps provided field telegraph set TG–5 (a buzzer, battery, and key for sending dah-dits), field telephone EE–8, battery-powered, and, later in 1942, sound-powered field telephone TP–3 (TS–10), conveniently unencumbered by any battery at all. The Signal Corps provided the portable switchboards BD–71 and 72, lightweight field wire W–110, the still lighter weight assault wire W–130, wire-reeling devices such as the one-man chest reel CE–11, holding a quarter of a mile of assault wire, or such as the two-man cradle RL–31, or axle RL–27 employed to pay out W–110 from reels DR–4 and DR–5.

For fighting men on foot in the field, light weight was a prime desideratum, along with as great efficiency as might be compatible therewith. Though quantities of these items were already flowing to the field troops in early 1942, the Eatontown Laboratory continued work altering and improving. This it did with Signal Corps wires particularly, ever trying to increase their talking range, their strength, and the efficiency of their insulation against moisture and against the abrasion of rough use. Poor splices in the manufactured product were giving trouble, and in January the laboratory reported that it was pressing the factories to reduce the number of splices and to strengthen the unavoidable ones. In February the laboratory workers were trying out a knitted covering for W–110 in place of the braid whose manufacture consumed too much time. They kept up a continual effort to find insula-

tion substitutes, thiokol, vinylite, buna, and so on, to reduce the consumption of precious rubber.[31]

BD–89 was the new division headquarters board, replacing BD–14. In the regiments, switchboards BD–9 and 11, of World War I vintage, had been replaced by BD–71 and 72, and not very happily either. They were the portable boards, with six or 12 plugs, which the forward fighting troops lugged to front positions and which connected up the light assault wire, W–130, or field wire W–110–B, as infantrymen furtively laid it from chest reels (CE–11) or from hand-carried cradle RL–31 or from the same cradle hauled in a jeep. The chief trouble with the boards was their unnecessary weight, about 50 pounds for BD–71, over 70 pounds for BD–72. And though the most obvious fault, weight was not their only defect. They were at first built from salvaged parts. On 15 January 1942 Capt. R. Lutes of the 54th Coast Artillery, Camp Davis, North Carolina, turned in an unsatisfactory report on the line signal coil: the lead-out wire broke from handling shocks and the coil itself shorted because of poor insulation. When the complaint came to the Laboratories, Capt. Floyd A. Minks, charged with Field Laboratory No. 2 (Eatontown), replied that the failure surprised no one. The coils had been salvaged from old switchboard units EE–2–B which had long languished in depot stocks. BD–71 and 72 had been built as stopgap sets and money savers, from parts of old World War I switchboards BD–9 and 11. The Signal Corps, harassed by money shortages until the first bonanza year, fiscal year 1941, had had to conserve.[32]

The Army was burdened throughout the war with improvised regimental switchboards. The obvious need for better portable boards led the Signal Corps, in April 1942, to prepare new military characteristics. In June, however, the effort was quashed by the Services of Supply and General Somervell, who "directed that no development of a switchboard to replace switchboards BD–71 and BD–72 be undertaken since the man-hours and the materials required for subject development could be employed to greater advantage on more essential projects for which no substitute exists." [33] The unsatisfactorily heavy BD–71 and 72 had to serve, and even they were not at hand in sufficient quantity (nor telephone EE–8, either) when war came. The Army had to use stocks of old BD–9 and 11, as well as the World War I telephone set EE–5.[34]

Radio for Mobile Armies and for World Communication

In 1942 the illusion of pushbutton warfare appeared, in electronic communcation

[31] (1) Signal Corps Technical Information Letter, No. 2 (January, 1942), p. 25; No. 3 (February, 1942), p. 61. (2) SCL Monthly Prog Rpt. Jan 42, proj. 2–4, pp. 3ff. (3) SigC Gen Development Lab Monthly Prog Rpt, Mar 42, proj. 2–4, pp. 3f.

[32] Rpt, Lutes to Mat Br, Maint Div OCSigO, 15 Jan 42, and 1st Ind, Minks to CSigO, 25 May 42. SigC 413.42 (BD–71 and 72) No. 3, 1942–May 1943. For telephone equipment generally, see Colton's remarks in *Electrical Engineering*, LXIV: 5, pp. 174–75.

[33] 3d Ind, CSigO to Dir of SCGDL, 27 Jun 42, on Ltr, CO Wire Sec SCGDL to CSigO, 23 Apr 42, sub: Tentative mil characteristics for switchboard to replace switchboards BD–71 and 72. SigC 413.42 Switchboards 1942.

[34] Unsatisfactory Rpts 1 and 2, 2d Lt Frank Doehner, Com Officer 113th Inf, to CSigO through Sig Officer II Army Corps, 29 Jan 42, and 3d Wrapper Ind, CSigO to Sig Officer First Army, Governors Island, N. Y., 23 Feb 42. SigC 413.42 Gen. 1, Jan–Jul 42.

at least, with the arrival of the "500" and "600" series of radio sets (one might also include Air Corps' VHF command set, SCR–522, with its four pushbuttons). In tactical combat among highly mobile fighting machines, these pushbuttons marked the beginning of really facile communications, in the sense that Colonel O'Connell had long been insisting upon at the Signal Corps Laboratories, as when he frequently declared, in effect, "We're all through with radio; hereafter we want communications." [35]

What O'Connell meant, of course, was instantaneous radiotelephone or intelligible voice exchange, not radio in the long-established military sense of continuous wave telegraph—spelled out laboriously in Morse code, if not further bedeviled by conversion into a secret code or cipher, into which the sender must first convert the plain text, and out of which the receiver must recover intelligible phrases.

During the two years before 1942, most vociferous of the ground troops demanding better radio equipment had been the Armored Force, seeking desperately to ready for combat its two original divisions, the First and the Second. Before the end of 1940 the Armored Force Board and the Signal Corps had decided upon a series of radio types that would completely meet all Armored Force needs. The types were AF–I, II, III, and IV, of which the III and IV would be multichannel sets with crystal control, allowing instant tuning or selection of frequency channels. By the turn of 1940 Capt. Grant A. Williams had induced the Armored Force to embark upon FM radio, based on police equipment built by Fred Link. Immediately, vehicular frequency modulation so pleased the tank men that the Armored Force switched from amplitude modulation to frequency modulation for its short-range tank sets. By early 1941, therefore, the Signal Corps had ordered hundreds of Link radios, short-range frequency-modulated transmitters and receivers, as substitute and training sets, pending the time when the Bell Laboratories and Western Electric could perfect and produce standard AF–III's, converting them from their amplitude-modulated prototypes into the frequency-modulated pushbutton crystal-controlled sets to be known as the 500 series.[36]

The Signal Corps had begun getting the frequency-modulated Link sets for the Armored Force before the end of 1941, not so soon as the frantic tank men wanted them but somewhat sooner than radios of the 500 series could be had. The Link stopgaps were the SCR–293 (transmitter and receiver) and the SCR–294 (receiver only), of which 1,200 of the former and 400 of the latter had been put on order early in 1941. With unwarranted optimism the contractors had expected to complete delivery by September. But production tarried as one difficulty arose after another respecting the frequency channels of the sets, the power sources, and so on. Despite pressure from the Deputy Chief of Staff and Signal Corps appeals for a high priority, no sets were delivered until October 1941. Thereafter production grad-

[35] Interv, SigC Hist Sec with Gen Colton, Exec vice-president Federal Telecom Labs, N. Y., 14 Feb 50, p. 4. SigC Hist Sec File. Other forward-looking officers, such as Capt. Grant A. Williams, Signal officer serving with the Armored Force, insisted likewise. See Terrett, *The Emergency*, p. 139.

[36] For a discussion of FM types of radios, see Terrett, *The Emergency*, pp. 141ff., 178.

Of the Armored Force 500 series, AF–III comprised SCR–508, 528, and 538; AF–IV comprised SCR–509 and 510. SCR–509 and 510 were developed by the Signal Corps Laboratories and were built by the Galvin Manufacturing Co. (Motorola).

ually increased to reach a total of nearly 700 sets, 554 SCR–294's and 138 SCR–293's, by the week ending 3 January 1942.[37]

Now, in January 1942, with the war on in earnest, the production of the 500 series by Western Electric had just barely begun and the deliveries of the Link stopgap sets were behind schedule. Desperately the Armored Force increased requirements for short-range FM's, even including the substitute training Link sets, which were never intended for battle use. They would see combat just the same, since they were the first produced and since every last FM vehicular radio was needed on fields of battle.

By mid-January the Signal Corps had not yet completely equipped even the 1st and 2d Armored Divisions with modern radio. Armored Force's latest radio requirements, just drawn up by Lt. Col. William P. Withers, demanded over 2,500 sets for the 1st and 2d Divisions—a mighty increase over 500 sets, the request for which had seemed so huge only a year and a half earlier.[38] Moreover these 2,500 sets were all (except for 169 SCR–193's and 6 SCR–299's) the startlingly new and superior type of radio which employed frequency modulation. Withers wanted the FM types by 1 March and 15 March deadlines.[39]

Thus, in consequence of Armored Force demands for the latest and best in radio, the Fort Monmouth Laboratories were reporting by January 1942 that the design of vehicular radio sets "has undergone a marked change"—rather an understatement. It had been revolutionized from amplitude modulation to frequency modulation, going over to a totally new type of smaller short-range set affording better communication, radiotelephone exclusively of course, with less interference, operating in the very high frequencies. The use of numerous crystals, each of a size greatly reduced from prewar types, permitted instant selection of any ten channels from an available total of 80 in the case of the 500 series. By the end of March, Armored Force units were receiving these sets from Western Electric in the hundreds each week.[40]

The first of Field Artillery's 600 series sets came out in 1942 after the artillerymen, having seen the 500's, had asked for similar radios modified to operate in Field Artillery's frequency band having 120 channels. The SCR–608 got its tests at Fort Monmouth during 25–28 February 1942 and proved rather better even than its prototype, SCR–508. Meanwhile, Field Artillery rushed plans to issue the new 600 sets to all its units by the end of the year, to replace in particular the SCR–245, inci-

[37] (1) Ltr, CSigO to Dir of SCL, 30 Jan 41, sub: Radio equip for Armored Force; (2) Ltr, CSigO to Priorities Committee, ANMB, 24 Mar 41, sub: Preference rating. SigC 413.44 (SCR–293) No. 1, 1941–Apr 1942. (3) Weekly Stat Rpt No. 18 (1 Nov 41), p. 3; No. 19 (8 Nov 41), p. 3; No. 28 (10 Jan 42), p. 15.

[38] OCSigO R&W Action 1, Col Mitchell, Dir of R&D Div, to CSigO, 26 Jun 40, sub: Estimate of rqmts of Sig equip for one armored div, and attached Memo, Brig Gen A. R. Chaffee for CSigO, 25 Jun 40, same sub. SigC 320.3 Armored Force and Armored Div, 1940–43.

[39] Memo, Rives for Mat Div OCSigO, 12 Jan 42, sub: Immediate radio set rqmts for 1st and 2d Armored Divs. SigC 413.43 Gen. (Sets) 1, Jan–Apr 42.

[40] (1) Signal Corps Information Letter, No. 2 (January, 1942), p. 29. (2) Weekly Stat Rpt 39, 28 Mar 42, p. 2. (3) See Terrett, *The Emergency*, pp. 180–82.

The Weekly Statistical Report lists the deliveries for the first three weeks of March as 175 SCR–508's, 339 SCR–528's, 312 SCR–538's. By July 1942 deliveries of BC–603 and 604, receiver and transmitter components of the SCR–508, would be scheduled at 11,600 a month. Ltr, OCSigO to O/C Philadelphia SigC Proc Dist, 20 Jul 42, sub: Delivery schedule radio transmitter BC–604, radio receiver BC–603. SigC 413.44 (BC–603) Radio Receiver.

dentally at a cost of about $1,450 more per set. The new-fangled frequency-modulated 608 cost at first about $2,400, quite a sum at that date for a maze of wire and parts comprising one transmitter and two receivers, the whole occupying but some three cubic feet of space.[41]

While the 608's largely relegated the SCR–245 to the background in the Field Artillery, the somewhat smaller frequency-modulated SCR–609 similarly replaced the SCR–194, which had served for some years as the artilleryman's walkie-talkie. Early in January 1942 artillerymen at Fort Sill, Oklahoma, ran comparative tests on the two radios, especially as used by a gun spotter flying in a reconnaissance plane and reporting to ground. The 609 proved to be much the better set.[42]

The story of Infantry's famous walkie-talkie, the SCR–300, an FM set and successor to the foot soldier's first walkie-talkie, the SCR–195, lies principally in 1942, though production sets would not reach the field till 1943. On the other hand, the first beginnings of the set go back to 1940 when the Signal Corps Laboratories undertook project 10–3, radio set SCR–300, entitled Ultra High Frequency Sets for Front Line Use. But efforts to develop, at that time on AM circuits, a nettable set which would work up to a seven-mile range and which would weigh not more than twenty-five pounds proved unsuccessful. The Infantry thereupon was induced to moderate its SCR–300 characteristics. In December 1941 the Infantry scaled down the required range to only two miles while increasing the weight limitation to thirty-five pounds. Four manufacturers were willing to attempt a very high frequency radio to meet these characteristics, two of them (Hazeltine and Wilcox-Gay) making the attempt with standard AM circuits, two (Galvin and Philco) taking a fresh departure with the new revolutionary FM circuits. It would be Galvin's FM service test offering which would win out in the SCR–300 competition. Galvin held already a head start in FM development since the company had acquired much experience in the new type of circuits as it built AF-IV, SCR–509 and 510, which the Signal Corps Laboratories had designed and developed. Moreover, Galvin now enjoyed the skill of a foremost FM designer, Daniel Noble, the one who had suggested that the Connecticut State Police try FM and who had thus helped to launch FM vehicular radio upon its spectacular career.[43]

[41] (1) Ltr, Lt Col B. Evans, FA, to president FA Bd, Ft. Bragg, N. C., 16 Mar 42, sub: Test of Engineering model of SCR–608 at Ft. Monmouth; (2) Ltr, Brig Gen G. R. Allin, Comdt FA School, Ft. Sill, Okla., to CG Replacement and School Comd, Washington, 18 Mar 42, sub: New radio equip; (3) Memo, Capt D. A. Newlin for R&D and Supply Divs, 26 Aug 41. SigC 413.44 (SCR–608) 1, 1941–Mar 1942.

[42] Memo, J. V. Fill, Asst Radio Engr, and George F. Wright, Senior Engr Aide SCL, for John Hessel, Chief of Fld Radio Sec, 19 Jan 42, sub: Test of radio sets SCR–609 and SCR–194 at Ft. Sill, Okla., beginning 5 Jan 42. SigC 413.44 (SCR–609) 1, 1941–March 1942. On the 500's and 600's generally, see John J. Kelleher, "VHF and Microwave Communication Systems," *Signals* I:4 (March–April 1947), 44–48.

[43] (1) SCL, Annual Report, 1941, p. 66. (2) OCSigO Engr and Tech Div, History of Signal Corps Research and Development in World War II (hereafter referred to as SigC R&D Hist), VIII, Pt. 2, proj. 814, 10–3. (See Bibliographical Note.) (3) Memo, Maj Hessel for Col Elder, 1 Nov 42, sub: Pertinent info concerning dev of radio set SCR–300. SigC 413.44 (SCR–300) 1, 1942. (4) See Terrett, *The Emergency*, pp. 158, 183–84.

Capt. F. F. Urhane, Assistant Officer in Charge of Field Laboratory No. 1, had even mentioned the British wireless set 48 as a possible answer to Infantry's need for a front-line radio. OCSigO R&W Action 1, M–7–C–1 R&D to C&E, 23 Dec 41, sub: Portable radio set, front-line use and incls. SigC 413.44 Inf Sets 2, 1940–41.

THE SCR-300 (ABOVE) AND THE SCR-536 (BELOW)

While infantrymen had to wait until 1943 before they got their first FM portables (hand-tuned VHF, on 40–48 megacycles—the SCR–300's), they received several AM field sets: the SCR–284 and its temporary substitute SCR–288, the SCR–511, and the SCR–536. The 511, designed originally for Cavalry, and the 536 for parachute troops, both became standard Infantry sets.[44]

The SCR–284 was not, of course, portable in the sense that the 511 and the 536 were; several men had to back-pack the 284 and then set it up as a stationary field station. But either the 511 or the still smaller 536 a single soldier could carry and operate as he walked. In fact, the five-pound 536 had been designed for one hand and the men dubbed it the handie-talkie by analogy with the older SCR–195, the original walkie-talkie.[45]

Three hundred of the very first handie-talkies built by Galvin apparently went to the Dutch in the East Indies early in 1942. A few days after Pearl Harbor Lt. Col. N. J. C. Tierie of the Netherlands Purchasing Commission in Washington asked that the United States Army permit Galvin to divert 200 sets for the parachute troops of the Netherlands Indies army in Java and 100 sets for the Marine Scouting Patrol at the Soerabaya Naval Base. Tierie first met with refusal (the Signal Corps itself had not received a set as of 23 December 1941). He persisted and in January Colonel Colton recommended that the Chief Signal Officer allow the diversion of the 300 sets since Galvin was by this time producing 50 sets a day.[46]

The handie-talkie was destined to serve as an Infantry front-line set, although it had been launched as Signal Corps' first tentative answer to Army's request for a very small radiotelephone which parachute troops might use. In fact, some at first regarded it with no great enthusiasm since Col. Rumbough had described it, in October 1941, as a "stop-gap" radio, which Infantry would tolerate only until it got a more satisfactory, specifically a more powerful, set. At the same time Air Corps men looked sourly upon any such paratroopers' set since they "very strongly objected to receiving tactical orders from every 'lance-corporal' of the parachute troops" who might, for example, have the audacity to ask for bomber support.[47]

Galvin, manufacturer of Motorola radios and specialist in automobile receivers, built both the 536 and the 511, which were alike in that each was a single-frequency set, crystal controlled, operating in high frequencies 3–6 megacycles. The SCR–511 was an odd little radio, not to say a bit anachronistic, built around a guidon staff which a cavalryman, it was intended, would carry mounted, resting one end of the staff in a stirrup. Yet it was not used on horseback but in the hands of infantrymen either afoot or in jeeps. Beach parties and boat-

[44] In August 1941 the Acting Chief Signal Officer had informed the Assistant Chief of Staff G–4 that the Infantry would have to wait till perhaps February 1942 for its first SCR–284's, accepting meanwhile the substitute SCR–288. Actually the 284 did not appear till the week ending 8 June 1942, when 31 sets were delivered, out of 17,681 on contract. (1) Memo, Col C. L. Eastman for ACofS G–4, 29 Aug 41. SigC 413.44 Inf Sets 2, 1940–41. (2) Weekly Stat Rpt 51, 18 Jun 42, p. 23.

[45] Terrett, *The Emergency*, pp. 139–40.

[46] (1) Ltr, Tierie to Col H. S. Aurand, GSC, 11 Dec 41, sub: Petition to obtain diversion for delivery of 300 portable radio transceivers type BC–611–A to be used for parachute troops; (2) 1st Ind, Colton for CSigO, 16 Jan 42, on Ltr, Col R. C. Benner, GSC Supply Div G–4, to CSigO, 7 Dec 41. SigC 413.44 Inf Sets 2, 1940–41.

[47] OCSigO R&W Action 1, W. R. [Rumbough] WP&T to O/C Opns, 8 Oct 41, sub: Dev of radio sets for Inf. SigC 413.44 Inf Sets 2, 1940–41.

men participating in amphibious operations also used it. The Signal Corps prepared the procurement specifications and standardized SCR–511 in January, issued a letter of award to Galvin in February, and by the middle of 1942 production began.[48]

The early months of 1942 saw coming into use nearly all the SCR communication sets which would serve American forces in World War II. The laboratories were at work on newer and better developments, some of which would appear in the field before the war's end as AN types.[49] But the great majority of combat radios were the SCR's, which had by now passed through the development stage and were in production.

Now to shift from the smallest of the SCR's, the five-pound handie-talkie SCR–536, to the largest, the SCR–299. The 299 had at least one point in common with the 536—it too had developed as a stopgap, only to prove invaluable and indispensable in its own right. A giant mobile set, filling a truck and a trailer, putting out three to four hundred watts of power compared with the 536's one-fourth watt, the SCR–299 satisfied Armored Force need for AF–I, rendering unnecessary the contemplated development of AF–I originally planned as SCR–505 in the 500 series. The 299 came to be used by everyone and his brother, not just by the Armored Force alone, but also by the Infantry, by the Air Forces, and by the Allies. Production began in the early spring of 1942, when Hallicrafters delivered the first model in March and more than a hundred in April.[50]

The SCR–299 could travel anywhere its truck transport and trailer, carrying its excellent power plant, PE–95, could negotiate. Its mobility, then, accorded perfectly with the needs of America's new motorized armies. Moreover, its power and reach were impressive, not just "100 Miles in Motion" for which the Signal Corps Laboratories had developed it. On selected high frequencies using sky waves, the 299 could fling Morse code signals for many hundreds of miles; this, of course, in addition to serving as a reliable radiotelephone up to 100 miles.[51] Its range put it in a class with the smaller of Signal Corps' fixed transmitters, which contributed to Army's world-wide communication networks.

For fixed radio stations, providing long channels (continuous wave only) for military purposes, the Signal Corps employed commercial transmitters and receivers, either unaltered or only slightly modified to meet military characteristics. A common receiver, for example, was the Hammarlund Super Pro,[52] used in its commercial

[48] SigC R&D Hist, VIII, Pt. 2, proj. 814–B, pp. 5–6, 9. For a general discussion of SCR–284, 300, 511, and 536 see Colton's article in *Electrical Engineering*, LXIV:5, pp. 178–79.

[49] SCR nomenclature was replaced during the war by a new system which reflected a growing tendency to standardize and collaborate among the armed services. This was the Army Navy, or AN, nomenclature system.

[50] (1) SigC R&D Hist, VIII, Pt. 4, proj 832–C, p. 8. (2) Weekly Stat Rpt 44, 30 Apr 42, p. 23. Four of the first SCR–299's had been designated for the 835th Signal Service Company, which was outfitting for the China-Burma-India theater. However, the company departed from Charleston, South Carolina, in the third week of March without any 299's—all of which occasioned considerable hullabaloo in the Office of the Chief Signal Officer, especially in its Storage and Issue and War Plans Divisions. See Memo, Col Meade, Dir of Planning, for Deputy CSigO, 23 Apr 42, sub: Failure to ship four radio sets SCR–299 with the 835th Sig Sv Co (China) with attached R&W's. Evidently no production sets became available to the field before 31 March. SigC 413.44 Radio Sets (EO) Gen. 1942–44.

[51] See below, pp. 363–64.

[52] Memo, Brig Gen Frank E. Stoner for Exec Control Br, 21 May 42, sub: Prog Rpt, 14–20 May 42. Weekly Achievement Rpts 27 Apr–8 Jun 42, SigC Central Files.

form or adapted as the SCR–244, which served Army's intercept and fixed receiving stations all over the world. As for the transmitters, the choice related directly to the distances which a given installation might be called upon to cover. For relatively short distances of 100 miles or so there was the BC–460, a 200-watt job built by Collins Radio. A commercial 250-watt Collins transmitter, the 30–J, with two Super Pro receivers, constituted the first equipment assigned to 2d Lt. C. V. Connellan and his team of Signal Corps men serving the Engineers along the Alcan Highway in 1942.[53]

For really long-range communications the Federal Telegraph and Radio Corporation provided the Signal Corps with BC–339, a 1-kilowatt high-frequency transmitter, employed in Hawaii, Alaska, Iceland, and Puerto Rico. Coupled with the power amplifier BC–340, this set became a 10-kilowatt station. Such was Army's transmitter in Hawaii, at Fort Shafter, in 1941.[54] Such also was Army's first radio in India, installed by the 835th Signal Service Company at Karachi early in 1942—the first Signal Corps radio in the China-Burma-India theater which could span the skies to the United States, though it could do so only sporadically. According to Maj. Paul C. Davis, this "Federal Telegraph Transmitter, consisting of one BA–22A rectifier, one radio transmitter BC–339–A and power amplifier BC–340–A serial No. 4, functioned exceptionally well at all times, requiring only routine maintenance." [55]

Still another Federal Telegraph transmitter built for the Signal Corps was BC–447, a 300-watt high-frequency job much employed in China-Burma-India for communication both within the theater (within and between points in India and China) and outside, to points in Australia especially. Globe Wireless built a 2.5-kilowatt high-frequency transmitter, of which the Signal Corps ordered twenty-five sets in April 1942.[56]

Such are examples of the fixed radio equipment which provided Army's communication and administrative needs, serving in the corps headquarters throughout the States, in Army posts among the several possessions, and in the theaters of war. These items of equipment also served AAF airway stations. Because they were commercial items and because they were not needed in great numbers, their production and supply were not at all comparable to the hectic situation touching the SCR's. For example, only 136 BC–365's (a medium frequency 300-watt transmitter built by Federal Telegraph and Radio Corporation) had been ordered by early 1942: 31 on a 1939 order, 55 on a 1941, and 50 on a 1942 order.[57]

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[53] Interv, SigC Hist Sec with Connellan (formerly radio operator at Whitehorse, Y. T.), 9 Nov 43. There were six Signal Corps teams serving the six Engineer regiments that built the road. Connellan's team, a detachment from the 60th Signal Battalion, Fort Lewis, Washington, used the Collins 30–J sets for fixed work and vehicular SCR–193's for mobile contacts along the highway. See below, pp. 137–38.

[54] Dr. Donald O. Wagner, Army Command and Administrative Network 1941–1945 (1945), SigC historical monograph E–6, Pt. 1, The Pacific, p. 8. SigC Hist Sec File. See also below, p. 103.

[55] Interv, SigC Hist Sec with Davis (formerly O/C Radio Teams C and E, Movement 4502–X, Karachi), 24 Nov 44. See below, p. 114.

[56] Interv, SigC Hist Sec with Chief Warrant Officer George C. McVickers (formerly radio officer in China), 14 Oct 44. (2) Signal Corps Information Letter, No. 7 (June, 1942), p. 24. (3) Memo, Stoner for Exec Control Br, 14 May 42, sub: Prog rpt 7–13 May 42. Weekly Achievement Rpts, 27 Apr–8 Jun 42. SigC Central Files.

[57] Descriptive Information on Radio Transmitter BC–365 F and Remote Control Unit RM–10–F, submitted by Federal Telegraph and Radio Corporation (1 Sep 42). SigC 413.44 (BC–365) Transmitter.

These fixed radios were telegraph sets, either hand-operated, by Signal Corps men pounding out dah-dits on brass keys, or semiautomatic, served by high-speed Boehme equipment. In either case they provided old-fashioned single-channel radiotelegraph, or continuous wave, communication, which was neither very fast nor very efficient, as judged by the later standards of radioteletype. This was true of all Signal Corps' large radio installations, as in Washington, San Francisco, Hawaii, the Philippines, and a number of other large central military establishments. Signal Corps radio equipment of greater power than the SCR–299 was of commercial design.[58]

Hitherto, 10 kilowatts was the maximum power output allowed any Army radio station. Until the spring of 1942 only the Navy, within the military family, was permitted to shout in the radio spectrum with a louder voice. Navy had long employed very powerful radiotelegraph stations, up to 40 kilowatts, to communicate with its world-navigating ships. The Army had not previously wandered so far or so wide on the continents of the globe. But now it would, and by virtue of emergency needs, Signal Corps radio for the first time exceeded 10 kilowatts. Numbers of Press Wireless 15- and 40-kilowatt transmitters went on order. On 1 May the Chief Signal Officer announced in his monthly Information Letter that "purchase of a number of 40-kilowatt high frequency transmitters has been initiated for use on long distance radio circuits to task forces. The highest power used previously by the army consisted of 10-kilowatt radio transmitters. These transmitters are being made by Press Wireless and are similar to transmitters they use for their news service to all parts of the globe." [59]

Radio Airborne

In the Signal Corps Aircraft Radio Laboratory (ARL) at Wright Field, Ohio, two of the most important radio developments early in 1942 were copies, SCR–522 and 578. Even the work of copying, ARL left largely to industry, limiting itself to the work of testing and adapting industry's products to Air Corps' special needs. There was, of course, one large exception, command radio set SCR–274–N, which the Signal Corps, the Navy, and the Aircraft Radio Corporation had created together. It was the only powerful command set (succeeding the SCR–183 and 283) available to American aviators at the beginning of the war, pending American production of the British VHF set, SCR–522. The 274 had been in production since June 1941. A huge number—huge, that is, compared to pre-Pearl Harbor standards—had been built in the last six months of 1941. The number totaled 2,722 sets, this being the quantity that Aircraft Radio Corporation had delivered through 3 January, coming very close to the schedule, which called for delivery of 2,850 by 31 December, out of the total on contract, 28,142.[60]

The 274 proved to be an excellent high-

[58] There was one exception, SCR–698, a movable broadcast station of one-kilowatt power, carried in a caravan of trucks. Only a very few were built. (1) SigC R&D Hist, VIII, Pt. 4, proj. 832B. (2) Hist Rpt SCEL, pp. 442–43. (3) Lt Col L. C. Sigmon, "Sigcircus," *Signals* III:6 (July–August 1949), pp. 27–28.

[59] Signal Corps Information Letter, No. 6 (1 May 1942), p. 27. See also Pauline M. Oakes, Army Command and Administrative Communications System (1945), Pt. II, Signal Corps Domestic Communications Network as Extended to Overseas Terminals FY 1941–15 August 1945, SigC historical monograph E–5b, p. 39. SigC Hist Sec File.

[60] Weekly Stat Rpt 28, 10 Jan 42, pp. 2, 6.

frequency aircraft voice radio. Nearly a year earlier, when the Air Corps first began pressing the Signal Corps to adopt *in toto* the British VHF system, including the VHF crystal-controlled command set, Lt. Col. Harry Reichelderfer had spoken up for the American SCR–274. The ARL, he pointed out, already had a project under way to provide VHF components which could be used interchangeably with the 274. And the fact that the 274 did not use crystal control he thought a point in its favor, since the supply of crystals seemed most critical at that time.[61] Though VHF and crystal control won out, the SCR–274 saw a very great deal of service in the war, especially in such areas as the Pacific where it was not necessary to co-ordinate with British VHF. In March 1942 Col. Alfred W. Marriner, AAF Director of Communications, informed Lt. Gen. Henry H. Arnold that "the SCR–274N is a new Army-Navy Standard Command set which has been giving excellent service since its adoption."[62] He added, however, that frequency control gave some trouble. "The SCR–274N," he told Arnold, "required careful setting on the ground. I suspect that because of inexperience, due care is not fully exercised in setting these equipments with a result that all the transmitters being used in a squadron or flight are not on the same desired frequency."

Although the 274 deliveries at the time of Pearl Harbor were up to schedule, that schedule, like most prewar planning, fell far short of what was now wanted. Faced with the realities of war, the Air Corps was demanding not mere thousands but tens of thousands of SCR–274's. Pressed for faster delivery, Aircraft Radio Corporation asked Col. John H. Gardner, director of the Aircraft Radio Laboratory, to call a conference toward relaxing specification limits and to consider substitution for critical materials. The conference was called on 11 March. Gardner reported that some relaxations were allowed when "advantageous, particularly if delivery schedules are to be improved." But this was a solution that could scarcely be afforded. Equipment, if inferior or downright defective, no matter how improved or modern its design, is worse, if it does not work, than older equipment which does function. A reminder of this occurred when the ARL received several receiver and transmitter components of the 274 which were worthless because of defective insulating elements.[63]

With far more ardor, the Air Forces pressed the Signal Corps for SCR–522, American version of the British VHF command set. For radio control of aircraft the British had gone to frequencies above 100 megacycles (the high-frequency SCR–274 originally went only up to 20 megacycles). VHF embraced more than just command sets for talk between aircraft, together with ground sets so that controlling officers on the ground could direct planes toward the enemy or assist friendly pilots back to their fields. It included also a complex net of VHF direction-finder stations on the ground, whose operators took bearings periodically on an intermittent signal emitted by friendly pursuit planes every few seconds and transmitted over one of the four channels built into each VHF command set. The

[61] Ltr, Reichelderfer, Actg Dir of ARL, to CSigO, 28 Mar 41, sub: Ultrahigh frequency radio sets for aircraft. SigC 413.44 British Sets, purchase of, (RB–2331).

[62] Memo, Marriner for Arnold, 21 Mar 42, sub: Cablegram 88 from U. S. Commissioner, New Delhi (to Arnold from Brereton). AAG 413.4–H Com Equip.

[63] Aircraft Radio Laboratory Progress Report, Mar 42, proj. 51, p. 18f. Hereafter referred to as ARL Prog Rpt.

gadget which automatically emitted the signal, the British dubbed "pipsqueak"; Americans called it a contactor. All this equipment the Signal Corps was feverishly pressing to produce for airmen, who were frantic for it even before Pearl Harbor.

The ground elements, fixed and mobile VHF radio sets, VHF direction finders and a complex of control center equipment, all constituting SCS–2 or SCS–3 sets, were the worry of the General Development Laboratories at Fort Monmouth.[64] The airborne components concerned the Aircraft Radio Laboratory, which specialized in all the troubles that arise when electronic equipment goes aloft where ethereal conditions impose many a problem unknown to earthbound electric circuits. The simplest airborne component of VHF, pipsqueak or contactor unit BC–608, gave little trouble and was in production by January 1942.[65] But not so the SCR–522. This was a precise set having four channels and covering an extraordinarily wide band of frequencies, from 100 to 156 megacycles. The British had originally contemplated two sets to cover this great range of frequencies, all of which the multiple needs of aircraft communication required. But the Americans had believed it possible to cram the entire band range into one set. Rives had argued for this and won his point.[66] American laboratories succeeded in a feat of collapsing two sets into one, occupying no more space and weight than the original British TR–1143 had taken up and with only half the ultimate frequency coverage.

The AAF demand for SCR–522 did not stand alone. The British wanted quantities of these copies of their VHF command set too. In this, as in other cases where they pressed the United States to copy their equipment, they had the good reason that they wished to extend their production sources. If American equipment were interchangeable with theirs, they could fall back on American factories when and if their producers were bombed out. Already, two months before Pearl Harbor, General Olmstead had informed the Assistant Chief of Staff G–4 that the recently standardized SCR–522 was in immediate demand both for U. S. Army airplanes and for the British, who wanted 5,000 sets. The Air Ministry, because of destroyed factories, Olmstead said, "is relying upon deliveries under Lend-Lease to provide 250 sets per week beginning the first week in January, 1942." Olmstead asked G–4 to hand down a decision upon the allocation of monthly production between the United States and the United Kingdom. Even though America was not yet at war, the AAF would grant the British no sets till its own immediate needs had been met. General Arnold on 10 October had ordained that no sets could be spared before 1 June 1942.[67]

[64] (1) Hist Rpt SCEL, pp. 211ff. (2) SCL, Annual Report, 1941, proj. 12–5.1, pp. 1ff.

[65] One hundred sets had been delivered by 3 January 1942. Weekly Stat Rpt 28, 10 Jan 42, p. 2. Incidentally, the usefulness of pipsqueak to keep track of friendly airplanes was already yielding to GCI innovations employing PPI radar. (For a description of GCI and PPI, see Terrett, *The Emergency*, p. 257.) Some months earlier, Maj. Gilbert Hayden had reported from England that contactor fixing was falling off, and that it was no longer used at night because of universal reliance on GCI. See Hayden's correspondence to CSigO, 23 Oct 41, sub: VHF radio equip in use by or being developed for RAF. SigC 413.44 Gen (RB–2164) Memos-London-Maj G. Hayden.

[66] Memo for File, Rives, 7 Apr 41, sub: Conf. SigC 413.44 Gen. British Sets, purchase of (RB–2331).

[67] (1) Memo, Olmstead for ACofS G–4, 4 Oct 41, sub: Rqmts for radio sets SCR–522; (2) Memo, Chief of AAF for Col V. V. Taylor (Defense Air), 10 Oct 41, sub: SCR–522 sets. AAG 413.4 E Com Equip.

Bendix Radio undertook the first contract for SCR–522, beginning deliveries in March when the Aircraft Radio Laboratory put them to test, found minor defects, and corrected them in collaboration with the manufacturer.[68] By the end of the month production was mounting. Rives informed the AAF that "one hundred fifty-two (152) Radio Sets SCR–522–T2 had been delivered on March 31. It is anticipated that twenty-one (21) more will be delivered tomorrow and that in addition eight (8) SCR–522–A will be delivered tomorrow. Production is beginning to roll on these sets now," Rives wrote, "and it is believed that they will rapidly build up to quite a sizeable figure. The above figures," he added, "apply only to Bendix Radio Corporation itself. A number of subcontractors are being utilized to assemble complete radio sets, but it is not believed that any sets will be delivered by the subcontractors for approximately one month." He estimated that within three months the total output of SCR–522's would attain a peak of 3,000 monthly.[69]

Rives may have been a bit overoptimistic. Production figures for the 522 did not begin to appear in the weekly summaries of the Statistical Branch, now under Services of Supply, until the week ending 22 April. Nor did they snowball as fast as he had anticipated. Bendix was at first the sole producer, whom for some reason the British had preferred. Producing this American copy of a British radio raised difficulties comparable to the troubles American manufacturers were having imitating British radars. British insistence on secrecy was one difficulty, as Olmstead had pointed out to the Under Secretary of War in October 1941. "The British," he said, "have insisted that a high degree of secrecy be maintained on this equipment . . . ." He went on to describe it as "of strictly British origin, the American action being limited to redesigning the set to adapt it to our manufacturing process to use American parts and tubes and to increasing the frequency band covering from 100 to 124 megacycles to 100 to 156 megacycles." [70]

Just as the SCR–522 was a copy built under the supervision of the Aircraft Radio Laboratory, so too was the SCR–578, the curvaceous "Gibson Girl," saving angel of many a wrecked aircraft crew adrift on the sea. Ironically enough, a German set gave the idea. One day in 1941 the British had picked up an emergency transmitter from the English Channel. It was the Notsender, N.S.2, an ingenious watertight portable transmitter to which a waterlogged airman could give energy by grinding a crank, energy which would automatically broadcast a distress signal to friendly listeners up to several hundred miles away. The British had brought the captured set, along with a specification written around it, to America in mid-1941, seeking a manufacturer either in Canada or in the United States. With their predilection for Bendix, they had approached Bendix Aviation Limited, North Hollywood, California, to undertake development of this "dinghy transmitter," as they termed it. Both Army and Navy became interested after members of the Brit-

[68] ARL Prog Rpt, Mar 42, proj. 47–2, p. 17.

[69] Ltr, Rives (for CSigO) to Chief of AAF, 3 Apr 42, sub: Shipment of radio set SCR–522. AAG 413.4–H Com Equip.

[70] (1) Weekly Stat Rpt 44, 30 Apr 42, p. 22. (2) Memo, Actg CSigO for USW, 22 Oct 41, sub: Approval of award. SigC 413.44 (SCR–522) 2, Mar–Dec 41. (3) SigC R&D Hist, III, Pt. 2, proj. 304–A, p. 16. Airborne radio in general and the VHF SCR–522 in particular, for the second half of 1942, are discussed further in Chapter VIII, below.

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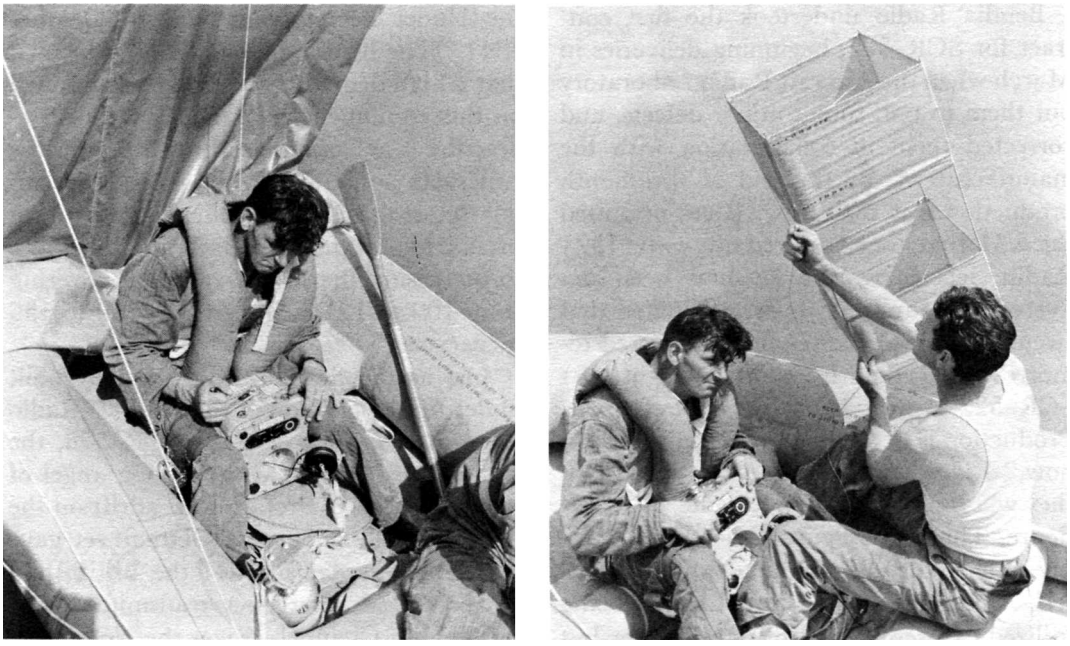


THE SCR-578, GIBSON GIRL RADIO. *Distress signals were automatically transmitted when the crank was turned (left) and the antenna raised (right).*

ish Air Mission in Washington suggested in August that the Americans prepare a joint specification. The Air Forces, in response to the Chief Signal Officer's request for military characteristics, had at once evinced interest. The interest swiftly mounted to a demand after Pearl Harbor. While Lt. Col. George F. Metcalf in the Research and Development Division on 12 December urged the Signal Corps Technical Committee to take action on military characteristics without waiting for the Joint Radio Board to function, General Arnold asked on 24 December for 11,600 sets "as soon as humanly possible," requesting the Signal Corps to place a contract with Bendix Aviation Limited, taking advantage of the development which that company had already accomplished upon the original British specification.[71]

While the Signal Corps set about getting the transmitters (deliveries began in the last week of May 1942),[72] the procurement of antenna-raising equipment gave pause, and trouble. The 300-foot antenna wire had to be lifted into the air, either by a kite if the wind was blowing, or by a balloon inflated by the castaways, crouched precariously in

[71] (1) Ltr, Chief of AC to CSigO, 24 Dec 41, sub: Radio set for aircraft type emergency dinghies, and three Incls: (a) Ltr, R. Hill, Air Marshal, to Col Mitchell, Special Subcommittee for Radio Standardization OCSigO, 18 Aug 41, sub: Standardization of dinghy transmitters; (b) Ltr, CSigO to Chief of AAF, 21 Aug 41, sub: Radio set for aircraft type emergency dinghies; (c) Ltr, Brig Gen C. W. Russell, GSC CofS, to Chief of AAF, 22 Sep 41, sub: Emergency transmitter for sea rescue and 1st Ind, Lt. Col W. W. Dick, AAG, to CSigO, 22 Sep 41. AAG 413.4–F Com Equip. (2) OCSigO R&W Action 5, R&D to C&E, 12 Dec 41, sub: Tentative Mil characteristics for emergency transmitter. SigC 413.44 (SCR–578) 1, 1941–42.

[72] Weekly Stat Rpt 50, 11 Jun 42, p. 18.

their rubber boats. General Olmstead, under pressure from the AAF, repeatedly goaded the ARL for information as to when antenna equipment might be expected. He could not wait for the drawing up of formal specifications; he wired Gardner on 2 February. Gardner replied that he expected Bendix to deliver models of antenna-raising equipment on 9 February.[73] A few days later Arnold, irked that Bendix' final sample was not yet completed, pointedly concluded a note to the Chief Signal Officer with the sentence, "A dinghy-load of Army pilots, who are now somewhere in the South Atlantic, could give eloquent testimony to the need for this equipment." [74]

By the end of March the Aircraft Radio Laboratory and Bendix Aviation Limited were settling upon a production model when the third sample of the transmitter (BC–778–T2) received tests and approval at Wright Field "except for minor mechanical and electrical changes which can be made prior to or during early production." As for antenna-raising equipment, Colonel Gardner reported that no satisfactory samples had yet put in an appearance. But he expected something soon, in particular an improved hydrogen generator (to inflate the balloon), using rare lithium, rather than calcium, hydride. Of lithium hydride there was only one source (in the Dakotas) and toward supplying it in quantity the Signal Corps lent government financial assistance to a number of American producers.[75]

[73] (1) Teletype, Olmstead to ARL, 31 Jan 42; 2 Feb 42; (2) Msg, TWP–9, Gardner to Signals, 3 Feb 42. SigC 413.44 (SCR–578) 1, 1941–42.

[74] Ltr, Chief of AC to CSigO, 13 Feb 42, sub: Emergency dinghy transmitter, type SCR–578. SigC 413.44 (SCR–578) 1, 1941–42.

[75] (1) ARL Prog Rpt, Mar 42, p. 24. (2) Signal Corps Technical Information Letter, No. 19 (June, 1943), pp. 39f. (3) SigC R&D Hist, III, Pt. 2, proj. 304–G.

Radar Into the Air for Interception and Search

Here and there along the coasts, ground radar stood guard to alert the guns, searchlights, and interceptors of the defense stations against the approach of enemy aircraft, but airborne radar had yet to go into action. The nation's defenses were eager for it, because the attack upon an outlying territory had made continental targets seem fearfully vulnerable. The country was primarily apprehensive of carrier-based attack, but the threat of long-range submarines to coastwise shipping became the dominant menace. To meet either threat, radar was what was needed. Moreover, it must be radar which was not obliged to accept the conditions imposed by the attacker, as even the most mobile ground radar had to, but which could move out to find him. To acquire this degree of range and mobility, radar would have to be installed in airplanes.

Signal Corps responsibility for research in airborne radar naturally centered in its Aircraft Radio Laboratory. For several years the laboratory, generally in its Air Navigation Unit, had pursued various projects of what now had come to be air radar devices. The ARL had not itself done much basic scientific research on airborne radar. One of its established principles had always been that it did not study electronic fundamentals. For these it depended upon other research agencies, both of private industry and of the services. In the specific case of airborne microwave radar, for example, it looked to the National Defense Research Committee's Radiation Laboratory, located in the Massachusetts Institute of Technol-

ogy, Cambridge, Massachusetts.[76] But the applied engineering research required after a basic development in order to produce satisfactory military equipment was the laboratory's concern. Consider the fact that a model might work well on a laboratory bench but not in a hurtling airplane. The business of adapting the model to aircraft installation and to effective operation, while meeting both the military characteristics which the Air Forces demanded and the form which industry could produce, was a function combining applied military and applied production research of a specialized and exacting sort, quite different from the Monmouth laboratories' development of ground electronic equipment. Equipment which is comparatively simple to develop for ground use, such as antenna arrays, becomes a problem when it must be attached to an airfoil or fuselage. Further problems arise from aircraft vibration, weight and space limitations, and from operation at high altitudes where, in thin air, high voltage circuits tend to arc and break down.[77]

One of the most vital airborne radar devices, useful in both peace and war, was the absolute altimeter. The SCR–518, which the Radar Unit of the ARL was bringing to a climax at this time, was an instrument which showed the pilot the precise distance to the ground below by measuring the time taken for a radar pulse to touch the earth and return to the airplane. It constituted a vastly better altimeter than the former barometric type which, giving elevation above sea level only, was not a very precise instrument at best and was of no use at all as an indicator of absolute elevation—of actual clearance above the ground. The AAF wanted the radar altimeter principally as an aid to bombing from great altitudes, so as to set the data into a bombsight computer like the Norden. The pulsed type of radar altimeter which the Radio Corporation of America had been developing in the years just before the war had proved to be the answer. The Navy, interested, tried a number of these sets, but at first without much regard for applications other than mere calibration of its barometric altimeters. Thinking in terms of ocean patrol and of low-level bombing, and not of high-altitude and long-range bombardment over land, naval air service planning had tended to neglect the possibilities which the ARL and the AAF immediately perceived.[78]

In February 1942 while the ARL tested several versions of the absolute altimeter and developed test equipment to keep the sets calibrated for peak performance, the production prototype SCR–518 arrived from RCA factories. Mounted in a B–17 and flight tested, the set gave reliable readings up to 25,000 feet. This was considerably better than the 20,000-foot requirement for

[76] (1) Dr. Henry E. Guerlac, Hist Div OSRD, Radar, 1945, pp. 421–25 in the consecutively numbered pages of the photostat copy in SigC Hist Sec File (see Bibliographical Note). In the original pagination these pages are Sec. C, Ch. I, pp. 14–16; Ch. II, p. 1. (2) CSigO, Annual Report, 1942, p. 275. (3) Terrett, *The Emergency*, pp. 185ff.

Radar was the concern of Division 14 of the National Defense Research Committee (NDRC), within the Office of Scientific Research and Development (OSRD). The R&D Work of Division 14 was concentrated in the large secret Radiation Laboratory at MIT. (4) Guerlac, Radar, pp. 7–9 (Sec. A, Ch. I, pp. 1–3). (5) United States Government Organization Manual 1952–53, National Archives and Records Service, GSA (rev. 1 July 52), p. 628.

[77] (1) Editorial comment, Aug 49, by Col William L. Bayer, SigC, JCS, on 1st draft MS by George R. Thompson. (2) Terrett, *The Emergency*, pp. 90–91.

[78] (1) Interv, SigC Hist Sec with Dr. Irving Wolff, consultant RCA Labs, Princeton, N. J., 9 Feb 50. (2) Terrett, *The Emergency*, pp. 186–88.

which the military characteristics called. Still another version performed well right up to the ceiling of the test plane's rise, 31,300 feet. Even at that altitude, so much reserve sensitivity remained in the receiver's reception of the ground echoes that the laboratory planned to make further flight tests with smaller antenna arrays which would offer less resistance to the wind.[79]

Another important project involved airplane identification. It had been obvious since radar's inception that the ability to detect aircraft at distances far beyond the range of vision would be of slight value unless some means could be devised to distinguish friendly craft. That accomplished, unidentified airplanes would be presumed hostile. To this end the U.S. Army and Navy had already begun work on airborne radar equipment which they called RR, for radio recognition. The British called their somewhat similar development IFF, Identification, Friend or Foe. After the Americans and the British compared notes on radar, the Americans adopted the British terminology, and by 1942 were adopting their equipment also, despite the fact that in some respects the American RR was better. In January, while continuing work on the airborne component of RR, the SCR–515, the ARL also went about converting a considerable number of British IFF Mark II sets to SCR–535's. By March, the Radar Unit was working also on American versions of a newer IFF, the Mark III and III–G, copied as SCR–595 and 695, respectively.[80]

Still another airborne radar development at this time touched upon the highly significant matter of RCM, or radar countermeasures. It is an easy axiom that every new weapon of war brings forth a counterweapon. Radar was not an exception to the general rule. Electronic countermeasures had been a matter of life or death since the British had begun misleading German night bombers by jamming the guide beams which directed the forays over English cities. It behooved American laboratories, too, to study German and Japanese radar frequencies and other operating characteristics in order to develop equipment which could, in effect, blind the enemy's sets. On 28 February 1942 British commandos raided Bruneval, just north of Le Havre on the captive Channel coast of France. The purpose of the raid was to bring back to English laboratories a German *Wuerzburg*, nemesis of many an Allied plane and the most accurate ground radar in the war until the SCR–584 entered combat in 1944.[81]

Whether through notice from the British to General Olmstead or from the Radiation Laboratory to Wright Field, or because word was coming in of Japanese jamming tactics in the Pacific, the ARL recognized the importance of RCM at about the same time by setting up a project for "Derax Warning." (*Derax* was an early name for radio position finding, which the term *radar* was now, in 1942, generally replacing). It

[79] ARL Prog Rpts, proj. 31, Jan 42, p. 2; Mar 42, p. 1. For more details on these radio altimeters, see below, pp. 243–46.

[80] (1) ARL Prog Rpt, proj. 63C, Jan 42, p. 9; Mar 42, p. 5. (2) Terrett, *The Emergency*, pp. 190–91, 197, 264–66. For further details on IFF, see below, pp. 242–43.

[81] (1) Interv, SigC Hist Sec with Sir Robert Watson-Watt, Vice Controller of Com Equip, British Ministry of Aircraft Prod, Washington, 22 Dec 43, p. 4. (2) James Phinney Baxter, III, *Scientists Against Time* (Boston: Little, Brown and Company, 1946), p. 145.

The bold Bruneval raid succeeded. A Wuerzburg radar, entire and intact, was snatched to England for study, and contributed to effective Allied countermeasures against German aircraft detectors and gun-laying sets. "The Raid on Bruneval," *Military Review*, XXXI:5 (August, 1951), pp. 94–96.

would not be possible for Allied aircraft crews to take effective counteraction against enemy radar, either passively, by evading the rays, or actively, by jamming, until they possessed equipment which could reveal the presence and frequency of radar radiations. The new project, tentatively established pending the receipt of funds, led to the development of a panoramic receiver, the SCR–587, equipped with a radarlike oscilloscope in which an operator could see the impact of enemy radar beams and read their frequency.[82]

The demands of the dangerous defense situation of the early months of 1942, however, were overshadowing these and other remarkable developments, such as navigation by radar. All the problems which the ARL was encountering in the development of airborne radar, sufficiently perplexing in themselves, were now compounded by urgency. The two prime needs were for devices capable of intercepting unseen enemy airplanes and detecting unseen raiders or submarines. Both were about to come off the first production lines. AI, the airborne interception equipment, would enable a pilot to "see" his opponent on the instrument panel, whether he could actually see him ahead or not. ASV, air-to-surface-vessel radar, mounted in a patrol bomber, would show up hostile watercraft even though they might be lurking beneath clouds or darkness. ASV was first included in the BTO, or bombing-through-overcast, project, but was soon given separate effort because of its immediate importance. Air intercept equipment came under a project to develop an airborne aircraft detector.[83] Though originally used for purposes of defense, radar now suddenly became an instrument of offense. Its potentialities doubled.

Airborne interception equipment had been an urgent development, it will be recalled, since Sir Henry Tizard first revealed it to America in September 1940.[84] It had been the one British radar application totally new to American military electronic research. AI sets, as developed to meet the vehement demands of the U. S. military air organization, were radars of relatively short range which, installed forward in pursuit planes, enabled the pilots both to "see" a bomber several miles ahead and, by centering the bomber's reflection in their oscilloscopes, to hunt it down. The ARL had two types well in hand by 1942. The first was a long-wave model, calibrated at about 200 megacycles. This was the SCR–540, copy of the British AI–IV. It was not a very good set. For one thing, its one and a half meter wavelength required large external antennas, a bane to aircraft design. All through the last half of 1941 the ARL and Western Electric had had difficulty in adapting this American copy of a British set to American airplanes. They were still having trouble as 1942 began. In January Western Electric samples of SCR–540 components failed vibration tests and had to go back to the factory for modifications.[85] By March the first 80 sets under contract were supposedly so nearly ready that Colton, Acting Chief Signal Officer during General Olmstead's westward tour, set up a priority list for their delivery to radar training schools. Yet only five sets arrived. And in each of them a single component, the Gen-

[82] ARL Prog Rpt, Mar 42, proj. 80, p. 19.

[83] *Ibid.*, projs. 61C, 71, 77, Jan 42, pp. 5ff, 14; Mar 42, pp. 3, 10, 17ff.

[84] Terrett, *The Emergency,* pp. 191ff. See his Chapter X for AI and ASV developments prior to Pearl Harbor.

[85] ARL Prog Rpt, Jan 42, proj. 71, p. 14.

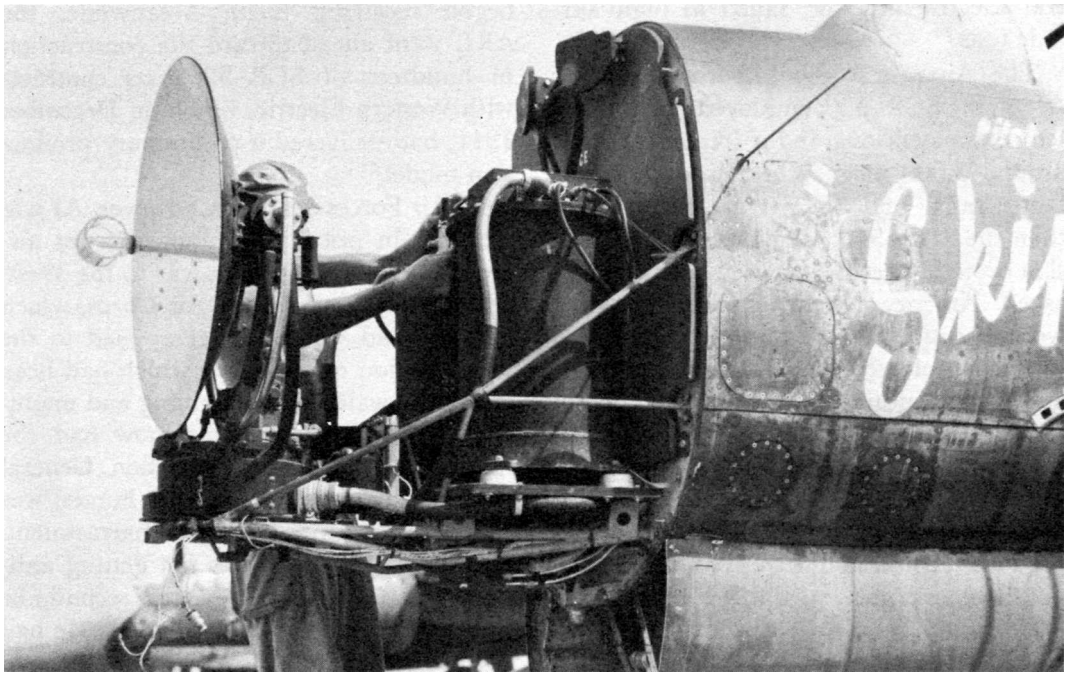
eral Electric inverter, failed in high altitude tests.[86]

The Aircraft Radio Laboratory's other AI set, the SCR–520, employed microwaves ten centimeters long, in the frequency range around 3,000 megacycles. It was a much better radar and became available sooner than the SCR–540. When the Tizard Mission brought over the cavity magnetron and asked American help toward designing workable radar circuits for it, London had just then defeated the Luftwaffe day raids and was awaiting Germany's night bombers. Faced with the need for a better air intercept set than their long wave AI–IV, the British sought it in microwave equipment. As soon as the Bell Laboratories could produce the new magnetrons for generating powerful microwaves, the Radiation Laboratory had gone to work on a ten-centimeter AI (AI–10) and had come up with a model of it early in 1941. Tested at the ARL, this model attained considerable success despite its awkward bulk. Though heavier—it weighed about 600 pounds—than the SCR–540, the new ten-centimeter SCR–520 used a compact dishlike transmitting and receiving antenna array, two feet in diameter, which could be mounted wholly within the plane's nose. In performance, this microwave AI radar gave more distinct reflections from targets and suffered far less interference from undesirable ground reflection. Taking a page from British success with equipment built in a laboratory, that is, "crash-built," the Signal Corps had ordered a number of sets from Radiation Laboratory's own shop, the Research Construction Company, and had already begun receiving them. Meanwhile, the ARL went ahead toward the construction of hundreds of SCR–520's on contracts with Western Electric, which, in December 1941, had delivered a preliminary production model.[87]

In Air Forces demands, however, AI was receding in priority. Submarines, not airplanes, were bringing the war to the Western Hemisphere, and the Air Corps, which in 1941 had wanted what applied to the war situation of 1941, but which had been obliged to wait for the planning and manufacture of this equipment, now had the same problem in a 1942 situation. General Arnold, chief of the Army Air Forces, was confronted with a double embarrassment. In the first place, he was not getting antisubmarine equipment. In the second, he was getting air interception radars. He had asked for them, but now found he had no airplanes ready for them. Here was the Signal Corps, offering more sets of the newest and best AI radar than the AAF knew what to do with. Quietly store them, or something, Arnold advised his Director of Air Defense, Col. Gordon P. Saville, lest the Signal Corps return with interest the accusations which the Air Forces had been in the habit of lodging with the top Army command. "The first thing you know," Arnold wrote, "we will have a complaint being registered by the Signal Corps to the Secretary of War. Isn't it possible to take the AI–10's and put them in storage in our own warehouses, or do something along that line, so that the Signal Corps won't have reason for their present feeling of

[86] (1) Msg (no number), Actg CSigO to ARL, 12 Mar 42; (2) OCSigO Radar Div R&W Action 1, 1st Lt Wilbur H. Vance, Jr., to Capt Earl J. Atkinson, 27 Mar 42, sub: Delivery status of SCR–540. SigC 413.44 SCR–540 No. 1 (RB–1383).

[87] (1) Ltr, Gardner to CSigO, 25 Jun 41, sub: Sv test of AI–10 equip. SigC 413.44 SCR–520 AI–10 No. 1 (RB–1378). (2) Memo, Rives for Chief of Mat Br, 14 Dec 41, sub: Expediting critical contracts. SigC 413.44 SCR–521 No. 1 (RB–1379).



AIRBORNE AI-10 RADAR, SCR-520

'what's the use of producing these sets when all we do is store them away.' " [88]

Both to the American in the street and to the American in the Constitution Avenue war room, the greatest immediate need was for a way to deal with the submarine attacks which were sinking more and more ships, often within sight of American shores. The radar answer was to be ASV. Here again, as with AI, two versions lay in the Aircraft Radio Laboratory's active projects, a long-wave type and a microwave type. The long-wave version had been another British offering. This was their ASV–II, the radar to which Hitler is said to have attributed the defeat of his submarines,[89] although actually the subsequent microwave ASV and the related naval ASG sets did more to send the U-boats to the bottom.

The laboratory already had a copy of the ASV–II under way as the SCR–521 and had ordered thousands of them. The first contract, for about 6,000 sets, was made with a Canadian government firm, Research Enterprises Limited, at Toronto. A second contract had gone to Philco. In

[88] Hq AAF R&R CG ["H. H. A."] to Dir of Air Defense, 11 Feb 42, sub: Status of AI–10 Cm prod and instl. AAG 413.4–G C Com Equip. Saville had noted in a routing and record sheet to Arnold on 10 February that the delivery schedule of the AI–10's was anticipating the production program for the P–61, the new heavy fighter designed to take it. The smaller SCR–540 (AI–IV) could be fitted into existing A–20 light bombers, and used for training only. In same file.

[89] "One Signal Invention," *Radar*, No. 1 (April, 1944), pp. 29–30. SigC Hist Sec File. See also, Wesley Frank Craven and James Lea Cate, eds., *The Army Air Forces in World War II*, II, *Europe: TORCH to POINTBLANK, August 1942 to December 1943* (Chicago: The University of Chicago Press, 1949), 316.

actual production, however, copying British sets was not at all the short cut which the General Staff and the AAF supposed. Differences in American airplanes and in American components imposed delays. It was difficult to tailor the large external antennas of the ASV–II (SCR–521) to U. S. aircraft, as Colton explained in mid-March, answering insistent War Department demands for ASV. Furthermore, faulty oscilloscopes gave trouble. During the winter months of early 1942, the ARL took preproduction models of the SCR–521 up on flight tests, found flaws in their operation, and had to eliminate the difficulties in concert with the two manufacturing companies. Before the factories began mass production of the thousands of 521's on order, the ARL also mounted, tested, and made ready for operation a number of the ASV–II prototypes which the British had sent over more or less complete some months earlier.[90]

Throughout the first three months of 1942, the Army had to be satisfied with the copy of ASV–II, the long-wave SCR–521, if indeed the Signal Corps could lay hands on it at all, for it was something of a will-o'-the-wisp. Research Enterprises Limited had originally promised to start delivery in December 1941, but subsequently moved the date up to January. When February arrived, while coastal shipping continued to be sunk in increasing quantity, there were still no SCR–521's, the nearest thing to them being the several British prototype sets which the ARL was adapting.

Pressure meanwhile doubled and redoubled for Army ASV-equipped airplanes, not only so that they could sink submarines but so that they might also maintain patrols, constantly searching the sea for Japanese aircraft carriers along the Pacific coast and in the Panama area. Late in January 1942 Robert A. Watson-Watt, British radar expert, reporting on the Pacific coast air defenses, recommended to Robert A. Lovett, the Assistant Secretary of War for Air, that both Army and Navy aircraft get hold of ASV–II, as a matter of "highest urgency," in order to maintain unceasing patrol. On 10 February Harvey H. Bundy, special assistant to Secretary Stimson, urgently telephoned the Signal Corps' Radar Division, seeking to find out why the delivery was so belated. General Colton at once had Lt. Col. Gilbert Hayden describe the entire ASV situation. Of the prototype ASV–II's, Hayden told Colton, four had been installed, ten were ready for installation whenever the AAF could supply the planes, and 18 more were awaiting transmission cable. As for the thousands of SCR–521's on order, Research Enterprises Limited had last promised to deliver between 50 and 100 before the first of March. The Navy had already received nearly 200 sets (not all of them complete) on a prior contract.[91]

[90] (1) Memo, Colton for Lt Gen William S. Knudsen, OUSW, 16 Mar 42, sub: Deliveries of radio set SCR–521. SigC 413.44 SCR–521 No. 2 (RB–1380). (2) ARL Prog Rpts, Jan 42, proj. 61C–1.4, pp. 5f; Mar 42, proj. 77, pp. 17f.

[91] (1) OCSigO R&W Action 1, Hayden to Vance, 10 Feb 42, sub: Bundy re SCR–521 sets; (2) Memo, Hayden for Colton, 10 Feb 42. SigC 413.44 SCR–521 No. 2 (RB–1380). (3) Report by Robert Watson-Watt on the Air Defense System of the Pacific Coast of the United States, Jan 42, Pt. I, p. 9, Incl with Ltr, CSigO to Dir of SCRL, 8 Feb 42, sub: Rpt. SigC 676 (ET–1439) Air Defense System of the Pacific Coast, Rpt by Watson-Watt.

Incidentally, one of Watson-Watt's companions on his Pacific coast inspection tour was Alfred L. Loomis, a kinsman of Secretary Stimson. Loomis was a pioneer in microwave radar work and subsequently became head of OSRD's Division 14, of which the Radiation Laboratory was a part. These facts doubtless help explain Stimson's very timely and keen awareness of the new electronic weapons. See Baxter, *Scientists Against Time*, pp. 33, 141.

SCR–521's from Canada at last began to dribble into the ARL during the first week of March. Meanwhile, ship sinkings were terrifying. The Navy's antisubmarine operations by sea and by air were not enough. In fact, the Navy was somewhat behindhand with the new airborne radar applications. Because of general military ignorance of the new offerings of science, the Navy had so far failed "in making full offensive use of new airborne weapons and devices in the pursuit and destruction of the U-boats." [92] Fortunately, Secretary Stimson kept goading the rest of the military to keep up with the times. On 18 February War Department planners received a memorandum from Bundy awakening them to new developments whose progress was both so secret and so rapid that "important officers of the General Staff and especially those in War Plans Division have not been and are not currently advised of their existence, functions and effect on strategy." One of the examples which Bundy cited was the use of "airborne search radar as an additional defense for Panama." [93]

Therefore, it is not surprising that by March, since the Navy could not yet cope with the submarine and as the General Staff learned more about airborne radar, the War Department was putting increased pressure upon the AAF and the Signal Corps. On 16 March Lt. Gen. William S. Knudsen, one of the chiefs of war production, called upon General Colton for a report. Colton again collected the facts, this time from Colonel Gardner at Wright Field. Twenty-seven SCR–521's had now been installed, although the Air Forces had not yet been able to decide what type of airplane should be used for ASV. A major obstruction had been lack of the several antennas required; another was an insufficiency of men and time to do individual installation. The antenna shortage went back to an inadequate allotment of steel tubing to the manufacturers and to an insufficiency of insulators. As for trained installation crews, the ARL had only one, whose members could put in but a single set a day. To train additional crews would require several weeks. Altogether, the most Gardner could foresee was that about 150 antenna sets would be on hand and 33 installed by mid-April. All of this Colton passed on to Knudsen, only to receive another call on the next day, ordering the delivery rate to be doubled. Gardner immediately got the word, and was told that he would be given double-A priorities to break any bottlenecks.[94]

Meanwhile, very great effort was being concentrated upon microwave ASV. Prior to 1942 both the Aircraft Radio and the Radiation Laboratories had accomplished a good deal with ten-centimeter BTO and ASV equipment. But no sets were ready for use. Fortunately, a ready stopgap lay at hand. One could convert AI–10's into ASV–10's, taking some of the sets which the Research Construction Company had already built and for which the AAF had no great use at the moment. One could then

[92] *Ibid.*, p. 31. Even after it should have known better, Navy long rejected Army's belief that airborne microwave radar would revolutionize the mode of antisubmarine warfare. See Stimson and Bundy, *On Active Service in Peace and War*, p. 509.

[93] Baxter, *Scientists Against Time*, p. 29.

[94] Interoffice Memo, Rives for Hayden, O. I. Lewis, and Vance, 18 Mar 42, sub: Summary of status of radio set SCR–521 as of 17 Mar 42. SigC 413.44 SCR–521 No. 2 (RB–1380). Incidentally, Gardner was required to report weekly on this ASV progress. He more than met the 300 objective by mid-April. See Ltr, Gardner to CSigO, 29 Apr 42, sub: Rpt of delivery status of radio set SCR–521. SigC 413.44 SCR–521 No. 3 (RB–1515).

put the converted sets into large airplanes, installing them in blisters beneath the fuselage so that the parabolic reflector would project the microrays downward and the antenna dipole would receive echoes from objects upon the sea. Accordingly, Colonel Marriner, the AAF Director of Communications, had sent a request through the Signal Corps to the Radiation Laboratory "to modify ten service-test AI–10's into ASV–10's as soon as possible" for installation in B–18's, which workers at Wright Field were already modifying. In forwarding the request, Hayden had assured Dr. Edward L. Bowles, head of the Radiation Laboratory, that the Aircraft Radio Laboratory would co-operate toward fabricating the correct accessories and installing the complete sets without delay.[95]

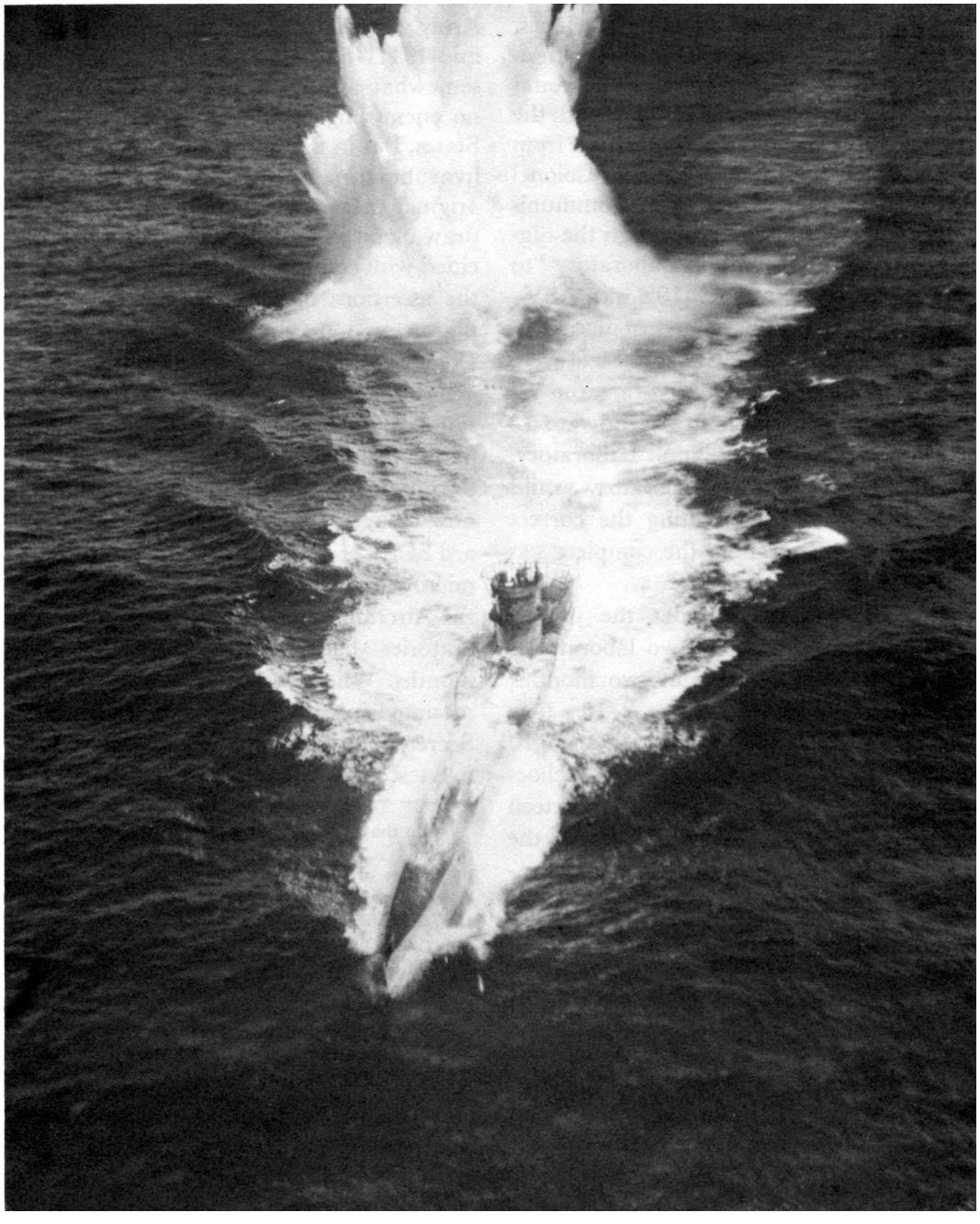
The job was done under the utmost pressure on all sides. The two laboratories completed the conversion in two months, and on 27 March one of the B–18's flew over Block Island Sound to test its ASV–10 against the submarine *Mackerel*. The echoes came back reliably at ranges up to nineteen miles. By the end of the month, four of the ten bombers thus equipped were in operation out of Boston, and the remaining six at Langley Field, Virginia.[96]

Designated SCR–517–A, these ten sets were as phenomenally successful as the Army's first microwave AI–10 had been in mid-1941. The success of AI–10 had been somewhat academic, however; there were no enemy night bombers over the United States. But in the spring of 1942 there were live submarine targets off U. S. coasts. These original microwave ASV's could and did draw blood at once. Their service tests coincided with combat action. The ASV–10, on the assertions of some, sank its first submarine on 1 April 1942.[97] A few days later Colonel Marriner asked the Signal Corps to get 100 sets of ten-centimeter ASV's, either standard SCR–517's or modified SCR–520's, and demanded that they receive a priority "over any other radio equipment now being procured." Speaking of "standard SCR–517's," Marriner meant the other microwave ASV development upon which the Aircraft Radio and the Radiation Laboratories had been working for some months. When one of these sets had been mounted in a B–24 in the spring of 1942, Secretary Stimson himself accompanied it in a test flight. He returned confirmed in his

[95] (1) Ltr, Chief of AAF to CSigO, 5 Jan 42, sub: Modification of AI–10's to ASV–10's; (2) Ltr, Hayden to Bowles, 17 Jan 42. SigC 413.44 SCR–520 No. 2 (RB–1705).

[96] (1) Submarine Tests Using Radiation Laboratory ASV–10 Equipment in B–18 Army Planes, 29 Apr 42. SigC 413.44 SCR–517A No. 1 (RB–1375). (2) Memo for Rcd, Rives, 4 Apr 42, sub: Maint of ASV Equips. SigC 413.44 SCR–521 No. 3 (RB–1515). (3) *The Army Air Forces*, I, 527. The AAF historians, emphasizing the equipment shortages, mention only the four radar bombers at Boston.

[97] On that date, a B–18 equipped with an ASV–10 detected a surfaced submarine eleven miles away by means of its radar, tracked the vessel, and attacked it, claiming the first radar-assisted kill from the air. The claim, it seems, was optimistic, since Navy records indicate that the first confirmed submarine kill made by an Army bomber came off the Carolinas on 7 July 1942, the U–701 being the victim. However that may be, by as early as 28 May Army airplanes had already made 103 attacks on enemy submarines. (1) Baxter, *Scientists Against Time*, pp. 42, 150. (2) Samuel Eliot Morison, *History of United States Naval Operations in World War II*, I, *The Battle of the Atlantic: September 1939–May 1943* (Boston: Little, Brown and Company, 1947), p. 247n; 156. (3) Incl, AAF Hq, First Air Force, Mitchel Fld, 1 Jun 42, sub: Notes for conf re improvement in antisubmarine opns, with OCSigO R&W Action 1, Lanahan to Dir of Supply Svs, 8 Jun 42, sub: Improvement of antisubmarine opns and dev of an antisubmarine unit. SigC 413.44 SCR–517–A No. 3, Jul 42 (RB–1377).



AIR ATTACK ON A SUBMARINE. *Such attacks were frequently the result of airborne radar discovery of the enemy.*

enthusiasm, and redoubled his drive to introduce the sets.[98]

Ground Radar: The Continuing Exigencies of Coastal Defense

When Field Laboratory No. 3 in the area of Sandy Hook became the Signal Corps Radar Laboratory in January 1942, it had thirty-six ground radar projects under way. These projects were intended to serve a variety of functions. They were for directing searchlights, SLC sets SCR–268 and 541; for giving early warning of approaching aircraft, EW sets SCR–270 and 271, together with several modifications under development to determine target elevation; for detecting surface vessels, coast defense (CD) sets SCR–296 and 582; for ground-controlled interception, GCI sets SCR–516 and 527; for gun-laying, GL sets SCR–545, 547, and 584; and for identification, RR sets SCR–532 and 533, designed to query the airborne SCR–515. Radar was rapidly growing and changing. Three radars were so new at this date that the laboratory had not yet assigned them project numbers. Of these, two were developments of microwave circuits which the Radiation Laboratory had created about the cavity magnetron. These, the XT–3 and XT–1 sets, became, respectively, the SCR–582, a fixed radar for harbor protection, and the SCR–584, the remarkable mobile gun layer. The third set was the long-wave SCR–588, at first a copy of the British Chain Home Low, or CHL.[99] This copy was being built in Canada by Research Enterprises Limited, which was also helping to produce the airborne SCR–521 ASV–II radar. It had been requisitioned by the Army Air Forces and was already part of a dispute which reached a climax that spring.

In the 268, 270, and 271, the Signal Corps Laboratories had developed ground radars which for their day were very good. The Coast Artillery Corps was well satisfied with the SCR–268 for searchlight control. But officers of the Air Corps who had seen British CH or CHL sets, or who had heard enthusiastic descriptions of their applications, tended to dismiss the SCR–270 and type 271 as a "piece of junk." [100] Generally, during 1941 and early 1942 they wanted Chinese, that is, exact, copies of British sets.

Yet the performance of the Signal Corps equipment was individually not inferior to comparable British sets, and in some respects was better. Furthermore, Signal Corps sets were unsurpassed for ruggedness and engineering. Colonel Corput could say with good reason that "at the time that the

[98] (1) Memo, Marriner for Hayden, Radar Div OCSigO, 9 Apr 42, sub: Proc of ASV–10 sets. SigC 413.44 SCR–517A No. 1 (RB–1375). (2) Baxter, *Scientists Against Time*, pp. 33, 42, 149. (3) Guerlac, Radar, p. 433 (Sec. C, Ch. II, p. 9). See below, Chapter IX, for further details on airborne radar.

[99] Signal Corps Radar Laboratory Progress Report, Jan 42, pp. 1–2. Hereafter referred to as SCRL Prog Rpt. AB–2363, Evans Sig Lab File, Belmar, N. J. The L in CHL stood for Low because the set could detect targets at lower elevations than its predecessor, the CH, could. For a descriptive list of army ground radars see Terrett, *The Emergency*, Appendix, Signal Corps Equipment, World War II.

[100] A Signal Corps officer, 2d Lt. George D. Fogle, who first studied in England as an ETG student and then moved over to the Air Corps to work in air defense under Colonel Saville, so characterized the SCR–270 while comparing its performance with the GCI application of British CH and CHL stations, an application which the designers of the original 270 had never contemplated. Ltr, Lt Fogle to Hayden, 17 Mar 42, sub: Summary of a discussion with Col Green of the AW school at Ft. Monmouth, 16 Mar 42. SigC 413.44 SCR–527–627–12K (RB–1381).

Radio Set SCR–268 was placed in production, insofar as is known, there was no radio set in the world equal in performance." [101] It was compact and mobile and could determine azimuth, nearness, and elevation for ranges up to 24 miles. During 1940 and 1941 it had been the best searchlight control radar in existence. The SCR–270 and 271, built to use a three-meter wavelength, twice that of the 268, were slightly less successful in earlier models, but they too were rugged. Moreover, the 270 was mobile. It had plenty of power and a range extending to 150 miles, and completely met the early requirements of the Air Corps for detection of aircraft at long ranges.

Unfortunately, the Americans had not yet learned how to use it well. The British, on the other hand, working with large teams of researchers and military users, on a scale undreamed of in the United States before 1940, had learned to make full use of their fixed radars to an extent which America had not yet done with its mobile sets. The same British radar towers, if erected along the Florida coastline, might well have defended a comparable area from air attacks originating in Cuba or the Bahamas; but an entire continent would still have stretched undefended beyond. British CH radars could not move to new locations. The SCR–270 could. In the absence of any attack, and in a geography vastly different, American radar had not yet begun to capitalize its virtues or to understand its limitations. To have an SCR–270 which could determine elevation as well as azimuth and range would be good, the AAF thought; it would be better if the set able to do all of this were also mobile.[102] Yet the two attributes could not be combined in a long-range long-wave set. The British equivalent of the 270, the CH stations, gave approximate target elevation, but at the cost of mobility, for they had to use several antenna arrays which pinned the sets to very fixed positions indeed.

There were also various inherent limitations of the early radars which scientists did not at first understand. Army Air Forces observers, for example, had been impatient with what they felt to be the limited performance of radar during the late-summer Louisiana maneuvers of 1941. Lovett and Bundy had accordingly been hard on the Signal Corps. A widely shared ignorance of the abilities and limitations of mobile radars had led Lovett to write an adverse report because the sets could not detect airplanes approaching at levels below 3,000 feet. Soon afterward, Bundy had called upon Lt. Col. Eugene V. Elder in the Materiel Branch for facts. These Rex Corput, then a major and the director of the Signal Corps Laboratories, had supplied. At the maneuvers, he pointed out, SCR–270–B's were detecting airplanes at elevations as low as 700 feet when the planes were as far as 35 miles away, and at elevations as high as 5,000 feet when the planes were as much as 100 miles distant. This constituted good normal performance for a radar, which of course cannot be expected to "see" over the curve of the horizon, because very high frequency radiations follow the line of sight tangent to the curve of the earth. The performance in Louisiana seems even to have excelled that of British detectors in respect to low coverage. "It is of interest to note," Colonel Colton remarked concerning Lovett's criticism, "that the low pickup angle

[101] 1st Ind, Corput to CSigO, 15 Feb 42 (p. 9) on Ltr, CSigO to Dir SCL, 8 Feb 42, sub: Rpt. SigC 676 (ET–1439) Air Defense System.

[102] Terrett, *The Emergency*, pp. 124–25, 128.

of the SCR–270–B's is one third that of the long-range British equipment for equal heights of site." [103]

Weaknesses in the early American ground radars lay more in their application than in the sets themselves. Skilled crews could get excellent results with them, but few operators of that sort were yet available. In England, there were very many, women, as well as men, who were both trained and battle tested. In the American forces, although Signal Corps crews had been operating 270's and 271's spotted along the coasts of the United States, Iceland, Panama, and Hawaii, they had often lacked adequate training, as Private Lockard's Sunday morning practice at Pearl Harbor had illustrated. Moreover, the commands responsible for defense doctrine knew little more about the potentialities of radar than the untrained operator knew about the individual set. Admittedly, air defenses were poor.

During the first two weeks of January 1942, and at the request of Lovett, Watson-Watt inspected the air defenses of the Pacific coast. Watson-Watt, then the foremost British radar authority and the engineer who had proposed in 1935 the aircraft detection system which produced the CH stations, was scientific adviser on telecommunications to the British Air Ministry. Accompanied by Colonel Saville, one of the AAF's most vigorous advocates of radar, he hurried through a speedy inspection and followed it by a devastating report. The report was a bombshell. Blasting Signal Corps radar equipment and radar training, it exploded also against the AAF, the General Staff, the Western Defense Command, the Coast Artillery Corps, and everyone else in sight. Watson-Watt, a brisk little Scotsman of alternating ability to charm and to infuriate, saw nothing good in American military radar.

Watson-Watt saw a multitude of reasons why American radar, radar sites, radar organization, radar planning, and radar operators were not good. He pointed at shortcomings in operators ("ill-selected, ill-trained, inadequate in numbers, and only transitorily within [the] Western Defense Command"). He noted bad planning at top levels, declaring that the distribution of responsibility for planning between the War Department and the commands was indefinite and illogical and singling out staff deficiencies in several other respects. In his opinion, the higher commands did not realize the inherent technical limitations of radars. "There is no sufficiently firm staff realization," he said, for example, "that Radar screen can be made to give smooth continuous tracking in high raid densities; that the provision of individual stations each working technically well would not suffice to produce a coherent system; that such a system is essential to controlled interception by pursuit units; and that controlled interception is the only economical system of air defense." He observed in particular that the site is such an integral part of the radar station that it all but controls the performance and, in making this observation, added, "For this reason, Radar can never be truly mobile."

He swept the mobile SCR–270 aside. "The only available shore-based Radar

[103] (1) Memos, Elder for Colton and Colton for Olmstead, 19 Sep 41. SigC SPSTP 10. (2) Memo, Maj Maude for Actg CSigO, 7 Oct 41, sub: Rpt of observation, Second and Third Army maneuvers, pp. 7ff; (3) Notes on Observer's Tour—Combat Maneuvers Second and Third Armies, 17–23 Sep 41, signed by Col Mitchell, 25 Sep 41, p. 5. SigC 354.2 Second Army Maneuvers 1942 (Aug–Oct 41) (AR–110).

screen equipment SCR–270," he wrote, "is technically and operationally gravely unsuitable . . . ." Some of his criticisms of the 270 were justified, although generally they referred to defects to which all long-wave radars are subject. Others were beside the point. In its original specifications, for instance, the Air Corps had envisaged a set for early warning only, but Watson-Watt now objected to the "lack of height-finding means" in the set, which had never been designed to have them. One comment in particular must have stung the Signal Corps radar officers: his assertion that "the average dependable range of location does not exceed 30 miles."

To some of Watson-Watt's comments Colonel Corput, now head of the Signal Corps Radar Laboratory, wrote a pointed rebuttal. Taking the matter of the SCR–270's range, he calculated it at four or five times what Watson-Watt allowed it. "Its reliable maximum range is limited [only] by line of sight or 150 miles, whichever one is the lesser," Corput said. The higher an airplane flew, the farther an SCR–270 or 271 could "see" it. So low an average dependable range as 30 miles, Corput explained, "would obtain only in the case of a low height of site and a low flying aircraft," and he might have added that under those circumstances the same would be true of the range of the CH, the CHL, and the new CHL/GCI. Corput granted that on many points the report would be valuable to the Radar Laboratory and to the services which used Signal Corps radars. Yet it was obvious, he added, that it was based on a cursory survey. It was also obvious that Watson-Watt knew nothing of the reasons why the Americans had developed radar as they had. Mobility, for example, had been paramount in the minds of the planners, who had vast areas to defend and who thought in terms of shifting the detectors to this or that threatened area. Corput attributed Watson-Watt's extreme critical attitude to "a characteristic evident in many engineers, the tendency being to compare the latest developmental equipment which they have seen [in laboratories] with the equipment which they actually encounter in the field." [104]

Making use nevertheless of seemingly authoritative contentions, the Army Air Forces continued to urge British radar sets, which they believed superior to anything the Signal Corps had built or could devise. In a 1941 rumpus which had threatened Signal Corps control of electronic development and procurement, the Air Forces had already insisted that the Signal Corps copy the original British GCI.[105] A sample had reached Field Laboratory No. 3 in October 1941 and General Electric had taken on a contract for 210 sets; but it would be the spring of 1943 before a production model would actually appear as SCR–527. Watson-Watt's report had even recommended for some locations the old British CH radar, which "floodlighted" the areas it surveyed with a continuous flow of long-wave pulses radiated from fixed antenna arrays at heights of several hundred feet. For many locations, he declared that the American SCR–270's on the west coast ought to be

[104] Ltr, CSigO to Dir of SCRL, 8 Feb 42, sub: Rpt, with following Ind and Incl: (1) 1st Ind, Corput to CSigO, 15 Feb 42, pp. 2, 13ff, and (2) Rpt by Watson-Watt on the Air Defense System of the Pacific coast of the U.S., Jan 42, Pt. I, *passim*. SigC 676 (ET–1439) Air Defense System. See also *The Army Air Forces*, I, pp. 291–93.

[105] GCI, ground-controlled interception, employed a new type of oscilloscope, the plan position indicator, or PPI, which presented a round maplike radar picture of the area under observation. See Terrett, *The Emergency*, pp. 256ff.

replaced by British CHI/GCI sets equipped with continuously rotated antenna arrays and with plan position indicators. Research Enterprises Limited, the Canadian firm, was supposed to be manufacturing them in sufficient quantity as SCR–588's.

The equipment would be a combination set which could be used as a GCI in some locations. Known as a CHL/GCI, it would serve as either but not as both, according to its location. If the site were a high cliff-like spot, the set would be CHL, to provide long-range detection and good low coverage, but not target elevation; if it were a flat or somewhat bowl-shaped area, the set would function as GCI, thereby permitting rough height finding, for control of interceptor planes. But in order to serve as a GCI, the set would require a location almost impossible to find. It was supposed to be placed in a sort of shallow bowl, very flat in the center, level to plus-or-minus four feet for a half-mile radius around the set, level to plus-or-minus eight feet for another half-mile beyond that, and rimmed round at a distance of three or four miles by a low ridge of rising land. In Corput's words, "A careful reconnaissance covering many hundred square miles in the Northeastern part of the United States has failed to locate an area even approximating this requirement." [106]

The CHL/GCI in either usage would be practically a fixed installation, and in this respect a step backward. The requirement for mobility had been written into the original Air Corps request for radar. Subsequent combat experience would prove the correctness of the requirement. But during the early months of 1942, so long as the United States feared for the coasts and thought in terms of fixed protection for them, the Aircraft Warning Service desired a screen like that girding the British home island.

In February Colonel Saville pressed Watson-Watt's demand that the Signal Corps get CH radars. The British had evolved two less ponderous forms of their original Chain Home, the MRU and the TRU, mobile and transportable radio units, respectively, but even the MRU was not mobile according to American definition. On 18 February, in a spirited conference of AAF, Signal Corps, and British representatives including Watson-Watt, Saville indicated the AAF support of British models:

> What is the answer [to early warning and ground control of interception]? We have a more or less mobile piece of equipment in the GCI and CHL that we are talking about that can be interchangeably used simply depending on the site. [But] it does not give the entire early warning coverage that we want. Something else [is] required now. What is the additional thing? In my opinion, it is the thing the British have developed: floodlight of area by MRU.

After suggesting that the Signal Corps procure 100 MRU sets from England, Saville went on to argue for a dozen or fifteen CH sets also, to provide early warning protection immediately to the coastal cities. In this he received support from Watson-Watt's view that only radar at very low frequencies could detect aircraft at great ranges. "There is no other system known," the Scotsman said, "than 20 to 30 megacycles which will give us location at 150 to 200 miles . . . Low frequency," he categorically concluded, "is essential to long range." [107] Summing up the air defense

[106] 1st Ind, Corput to CSigO, 15 Feb 42, p. 4, cited n. 104.

[107] His view would be refuted before the year was out by such microwave radars as the Radiation Laboratory's MEW. See below, pp. 261–62, 274–75.

situation in America, Saville painted a dismal picture:

> We do not have sufficient distance coverage, early warning, no control device of any kind; we do not have a sufficient reliability and pick-up of a sufficient distance in any of the forms that we now have. Things are coming along such as gap filling, but until you get them you still have such gaps in the pattern that the performance cannot be relied upon to give accuracy. Whether the 270 can be made into the thing described as CHL, I don't know and don't care . . . At the present time our view is that it is not mechanically operationally satisfactory and that its early warning characteristics are such that it does not do the job to compare with other equipment. I am talking about part of a system. The 270 is good if you put it on a small island where the problem is not one of tracking but of discovery [but is not suited to continental GCI].

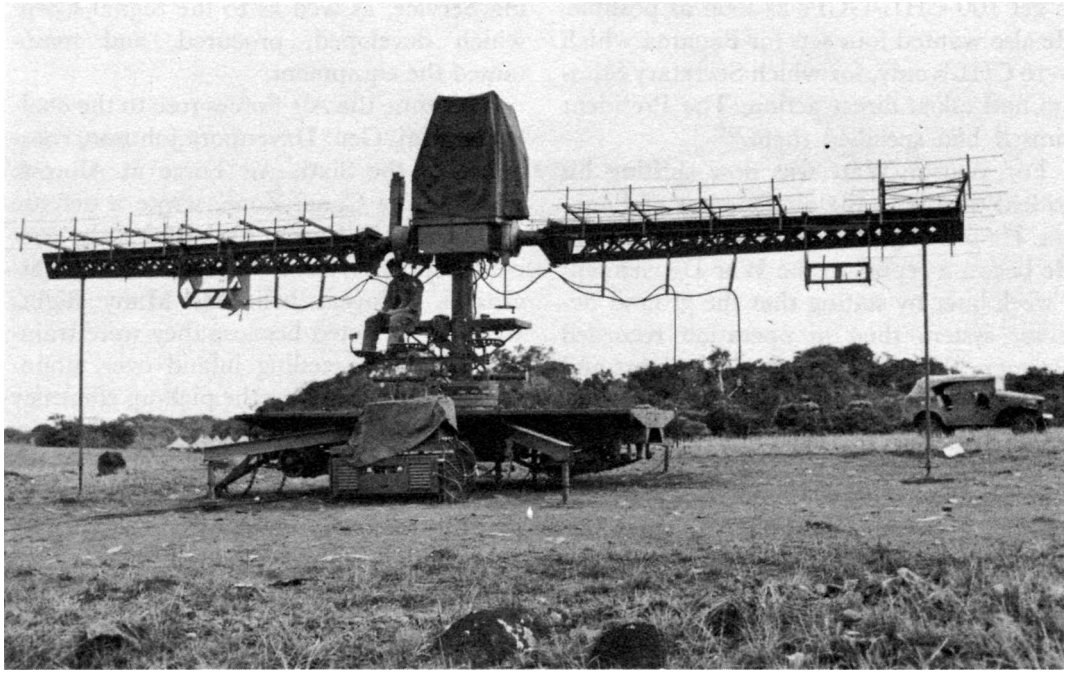
Obviously the Army Air Forces did not much care for American search radars. True, the SCR–270 could not be worked into a GCI system until it could determine target elevation readily and until gaps in its coverage could be filled. But the Signal Corps Radar Laboratory was hard at work at this very time upon such devices, even though the set might be reduced to immobility. The 270 was good, as Colonel Saville admitted, for simple aircraft detection, for "discovery," as he put it. Despite his implication that its range and reliability were poor, both were good if the set was well operated. Colonel Hayden pointed out in this conference that Watson-Watt tended to exaggerate the range (150–200 miles) of the celebrated CH. The operator of a CH station which Hayden had visited some months earlier in England had told him that the utmost range the station had ever attained was 152 miles, while the average daily maximum was about 110 miles, or just about the usual attainment of the SCR–270 and 271.[108]

After the surprising and lethal weakness of the Hawaiian air defenses at Pearl Harbor was revealed (a weakness in the radar warning system, not in the SCR–270 itself), American military men, worried before, felt real anxiety. A Japanese carrier attack upon the Canal seemed imminent, most probably at low level. Planes skimming in over the sea would not only escape visual detection until the last moment but would completely elude search radars, too. This fact greatly disturbed General Andrews and his signal officer, General Ingles.

Ingles wrote to Olmstead that he had repeatedly tested the four radars guarding the Pacific side of the Canal, sending low-flying planes in from the sea against them, but had never got any results. If the Signal Corps had any suitable equipment, he wanted to know about it. "As you know," he wrote, "secret developments are kept so secret that we officers in the field are in entire ignorance of [them] . . . ." He revealed incidentally that he did not share the general AAF opinion that British sets were superior, and concluded with a proposal for visual warning stations aboard ships equipped with radio.

A week later Olmstead answered, assuring him that the Laboratories were at work on solutions. As for the alleged superiority of British equipment, he thought it "not a question of difference between English and

[108] Memo, six pages, unsigned, for O/C Radar Div, 21 Feb 42, sub: Meeting to further discuss American GCI equip. SigC 413.44 British GCI (RB–2330). For another six-page version, see Memo, Norman A. Abbott, Associate Radio Engr, for O/C Radar Div, 21 Feb 42, sub: Conf for discussion of Air Corps rqmts for GCI/CHL equip and radio set SCR–527–A. SigC 413.44 SCR–527 (RB–1381).



SCR-268 AT PACORA, PANAMA. *Set is shown as positioned in April 1942.*

American equipment, but rather a question of the condition under which the respective equipments have been tested." The British CHL, he granted, did handle low-flying planes "reasonably well," not only because of its lower frequencies but also because of the "geometry of the situation," that is, the favorable nature of the United Kingdom's coastal terrain. He did add, though, that he had already ordered four British CHL/GCI radars from Canada—as he indeed had, on pressure from Secretary Stimson. Olmstead was going to replace four of the 268's in the Canal Zone area with versions modified for better low coverage, presumably SCR–516's. And in collaboration with the Air and General Staffs he had been working out plans for 50 warning boats such as Ingles had recommended, only to have the Navy come in at the last moment and demand control of the flotilla.[109]

Meanwhile, the Signal Corps Radar Laboratory was seeking solutions: converting the SCR–268 to the SCR–516; incorporating the superior British PPI cathode-ray tube; including additional antennas and providing different frequencies in the same set in order both to fill gaps and to provide target elevation data. The Air Force continued to press the Secretary of War and the General Staff for British radar. When Watson-Watt reported on the air defenses of the west coast, Secretary Stimson arranged for General Colton to confer with C. D. Howe, the Canadian Minister for Munitions and Supply. Colton sought

[109] (1) Ltr, Ingles to CSigO, 7 Feb 42; (2) Ltr, CSigO to Ingles, 14 Feb 42. SigC (EO) 413.44 Radar Equip Gen 1942–44.

to get 100 CHL/GCI's as soon as possible. He also wanted four sets for Panama which were CHL's only, for which Secretary Stimson had taken direct action. The President himself had specified them.[110]

For Watson-Watt was now shifting his critical talents to the air defenses of Panama. He arrived there on the first of March. He began a report to the War Department a week later by stating that the ground detector system then in operation recorded not more than 15 percent of all flights and that the number on which the evidence could be used operationally was much less.[111] On one occasion he had observed that although there were thirteen planes in the air, the operations board in the information center had showed only one. In a C–41 he had flown at various altitudes up to 10,000 feet, only to find on landing that the Aircraft Warning Service had failed to plot any part of his flight. In short, so bad in his opinion was the Aircraft Warning Service in this most vulnerable Zone, upon which the military had been concentrating its best efforts for some time, that he concluded "no measures which are economically possible within the next two years" could provide a ground warning service which would be as much as 80 percent reliable. These were devastating opinions to the Secretary of War, to the General Staff planners, and to the Army Air Forces, which was responsible for coordinating and utilizing the Aircraft Warning Service, as well as to the Signal Corps which developed, procured, and maintained the equipment.

This time the Air Forces rose to the challenge. Maj. Gen. Davenport Johnson, commanding the Sixth Air Force at Albrook Field in the Canal Zone, wrote a defense comparable to Corput's rebuttal of the west coast report. Watson-Watt had been overcritical, Johnson believed. Many flights were not detected because they were training planes proceeding inland over mountainous terrain, where the pick-up efficiency of the long-wave radars of that day was very low. Along the water approaches to the Canal, efficiency had been computed at 59 percent by comparing Aircraft Warning Service plots with known flights; over land approaches, it was 15 percent. But the "efficiency of the entire system at the present time," Johnson asserted, "is 52 percent." Watson-Watt had stressed the defects without noting that the Americans were well aware of them and were correcting them, Johnson declared, and concluded: "It is an excellent report and of great value to the 6th Air Force. However, it was written as constructive criticism of the system from a short inspection, with no background as to the efforts of the 6th Air Force or higher authority to improve the system. . . . In the main, the defects may be charged to shortage of equipment, trained personnel, and transportation." [112]

As in January for the west coast, so now in March for the Canal Zone, Watson-Watt urged that the SCR–270's and 271's be re-

[110] Incl 3, Notes of Meeting with Howe 1700 hours 2-13-42, on Memo, Colton for CSigO, 16 Fed 42. File cited n. 109.

[111] Secretary Stimson had requested this inspection and had asked that Watson-Watt report to him personally. Memo, Col Hoyt S. Vandenburg, Asst Chief of Air Staff A–3, for CofS, 25 Feb 42, sub: Inspec of air defenses of Panama Canal Dept by Watson-Watt and party. AG 333.1 (2-25-42) Regarding Watson-Watt.

[112] Maj John H. Baker, Communications and Radar in the Area of the Caribbean Defense Command 1940–1948 (1948), pp. 131ff; App. I, Brief of Mr. Watson-Watt's Detailed Report; App. II, Comments by Gen Johnson on Watson-Watt's Report, Ltr, Gen Johnson, Sixth AF, to CG CDC, 2 May 42, sub: Comments and recommendations on Rpt made by Watson-Watt. OCMH.

placed as quickly as possible by Canadian models of the CHL/GCI. He would give first priority, he said, to the XXVI Interceptor Command's need for a ground-controlled interception system, and second priority to sites on the Caribbean approaches, which he thought virtually undefended. Since the CHL/GCI's were not available at the moment, he granted that the 270's and 271's would have to be tolerated in the interim, but in his opinion they were such very poor pieces of equipment that even British operators would be unable to get very good results from them. He doubted if American operators could ever be taught much. Those crews which he had observed had shown so little interest in their work that they had not even taken the trouble to plot permanent echoes, he pointed out. For example, the staff officers of the XXVI Interceptor Command had suspected a large error in the bearing data given by an SCR–270 at Pueblo Nuevo, near the city of Panama, but no one had bothered to make the quick and simple cross-check of comparing indicated bearings with the known bearing of a prominent part of the landscape. These personnel deficiencies should have surprised no one, for with the explosive expansion of the Aircraft Warning Service after 7 December 1941, first the Signal Corps had been raided and drained of its relatively few trained operators and then men had been taken indiscriminately from anywhere.[113]

Although SCR–268's, 270's, and 271's had been in the Canal Zone for some time, neither the engineers who had made the installations nor the crews who worked the sets wholly understood them. As matters thus stood in March 1942, Panama air defenses were weak. Even a 50-percent-effective detector system left many a loophole, and it was well that no enemy attempted to blast the Canal.

Five days after Watson-Watt's Panama report, another Washington conference boiled up to discuss the situation. Signal Corps men, Air Forces men, and Britishers once again debated, among other things, the distribution of the 588's which they anticipated. Watson-Watt had urged four CHL's and two GCI's for the Canal Zone at once. That meant SCR–588's, which the Signal Corps had been seeking to obtain from Research Enterprises Limited since January. None had been delivered. Indeed, Research Enterprises was having some difficulty with its design and production. General Colton wanted some sets to use for training of operators, a reasonable desire in view of the basic deficiency. "I think it is foolish," he said, "to send equipment without training personnel. It is idiotic." But he lost his point. Suppose that the Japanese attacked the Canal and that the War Department had no 588's there, as General Marshall had ordered. Whether there was anyone trained to operate the sets or not, they at least had to be in place. Colonel Marriner said, "We will fix up Panama or else." Colonel Meade of the Signal Corps agreed. "I have had considerable dealings with the Panama situation," he said, "and it is my firm opinion that if anybody in this room decides anything is ahead of Panama that person will soon occupy a different position from that which he now holds." [114]

General Colton had ordered 100 of the Canadian-manufactured sets. Then, as he

[113] *Ibid.* See also *The Army Air Forces*, I, 299–302.

[114] Memo for File (unsigned), 13 Mar 42, sub: Notes of conf to discuss situation with respect to CHL in Panama with reference to detector equip. SigC 413.44 SCR–588 No. 1 (RB–1388).

explained, he had raised the total to 104 because the word had come down from President Roosevelt for the first four to go to Panama. Research Enterprises Limited was just now producing them. CHL's only, they did not have the height-finding equipment which both the Air Forces and Watson-Watt himself had assumed that they would have. They would not be able to serve as GCI's, the very application so much emphasized for the west coast and for Panama. Nor had the combined CHL/GCI yet been perfected. Watson-Watt had asked in January for CHL/GCI's to replace the 270's and 271's on the west coast. Now he was asking for them again, in March, for Panama.

If there was any good in this ill wind, it was that it helped to demonstrate to the Air Forces the difficulty in designing and producing intricate apparatus. A Canadian factory producing British equipment was experiencing the usual trouble and delay. A Signal Corps team journeyed posthaste to Toronto and spent three days in ascertaining the facts. One member of the group was John J. Slattery, chief of the Radar Laboratory's System Engineering Section. After the initial meeting with the Canadians on 14 March, he reported that Research Enterprises Limited admitted that, although a prototype model was well along, there was not any CHL/GCI.[115]

The Canadian-built SCR–588 thus began as a CHL. The first nine sets were without height-finding characteristics. Production of the CHL/GCI combinations, designated SCR–588–B, began so slowly that by June the Signal Corps had received for the Air Forces only ten 588's in all. The tenth was the first CHL/GCI to be delivered to the United States.[116] Far from replacing at a sweep the American 270 and 271, as Watson-Watt and the American top command had expected, operational 588's would remain relatively few right through to the end of the war. But the U. S. Army's original radars, designed by the Signal Corps and built by American industry, would multiply in numbers and in combat applications. The SCR–268, 270, and 271 proved themselves everywhere in the field during this winter and spring of the first year of the war.[117]

Thus during the first six months of World War II, the Signal Corps struggled to meet its equipment and troop requirements. Its schools, laboratories, and procurement organizations were getting into motion on the scale necessary to supply the unprecedented quantities of men and material which were needed for a global war. Meanwhile, until the flow could increase substantially beyond the first trickles, such signal troops as were already in the field or soon to arrive there had to serve with what little they had or could acquire.

[115] Memo for File, J. J. Slattery, 26 Mar 42, sub: Visit to Research Enterprises Ltd., Leaside, Toronto. SigC 413.44 SCR–588 No. 1 (RB–1388).

[116] (1) Ltr, CSigO to CG AAF, 5 Apr 42, sub: Canadian CHL/GCI equip; (2) Ltr, CSigO to Dir of SCRL, 20 Jun 42, sub: Proc of SCR–588. SigC 413.44 SCR–588 No. 1 (RB–1388).

[117] For ground radar developments in the second half of 1942, see below, Chapter IX; for their employment in the North African campaign, see below, pp. 374ff.

CHAPTER IV

The First Months of the War Overseas

(January–May 1942)

The springs and summers of other years, had been seasons for field maneuvers, for mock battles giving the Signal Corps an opportunity to try out its organization and equipment in pseudo warfare. This spring, in the year 1942, the field tests were real, with success and failure being measured in blood. From Washington to the most remote outposts of the United States Army, the realities of war were testing the men and equipment of the Signal Corps. Its losses in the Pacific theaters of war had to be compensated. Its obligations everywhere had to be met.

Toward Eastern Bastions

As the Signal Corps looked to Europe early in 1942, the paths were being blocked. Submarines infested the North Atlantic, beset the harbors and coasts of the Atlantic States, and then carried their destruction into Caribbean waters. Communications had to be at least established and secured before large-scale military movement against Germany could be begun, whether by sea or air. Looking toward England, the Signal Corps had already, before Pearl Harbor, dispatched men and equipment eastward to build aircraft warning and communication facilities in Iceland in order to bolster the North Atlantic sea and airways. On 25 January 1942 the entire 50th Signal Battalion joined thirty-nine of its men who had previously sailed to Iceland in August 1941 with Task Force 4. The battalion had wire to put in, and pole and cable lines to install and maintain in the bitter darkness of the northern winter.

At Reykjavik in Iceland a Signal Corps one-kilowatt transmitter, station WVHC, had been working with the War Department's headquarters radio station WAR in Washington since November 1941. Adverse electromagnetic conditions and poor electrical ground conductivity of the terrain seriously hindered communications over this channel of the Army Command and Administrative Network (ACAN). By the summer of 1942 the one-kilowatt transmitter was shifted to a shorter circuit, to Northern Ireland, while the channel to WAR received a boost from a new ten-kilowatt transmitter, a BC–340. In March 1942 three 300-watt transmitters, BC–270's, ar-

rived in Iceland to provide a local radio net over the island.[1]

Since radio was not entirely satisfactory in Iceland, the Army decided early in 1942 to stretch an independent wire network over the island. General Olmstead sent two Signal Corps officers to make a survey. Their recommendations developed into a project which the Chief of Staff approved in May with the request that it "be accomplished as promptly as possible." The wire system was planned to make use of commercial carrier equipment, something new to Signal Corps construction units. It was so new in fact that Signal Corps men lacked experience in its use, and therefore they gave the job of engineering the proposed layout to the Long Lines Division of the American Telephone and Telegraph Company and the Bell Laboratories. It would not be spiral-four and military C carrier, which were not yet in production, but commercial H and C carrier, which Western Electric would fabricate.

"Latitude 65°," as this project became known, called for 1,000 miles of four-wire pole line extending through the northern and eastern sectors of Iceland. The four open wires would provide enough service in some areas; in others, where more circuits might be needed, the same wires would provide multiple circuits under H and C carrier operation. In the more populated southwest area, the planners sought to install about 350 miles of lead tape cable carrying from ten to fifty-one wire pairs, the cable to be buried except in places where lava rock forbade. Construction on Latitude 65° fell chiefly to three of the larger signal units on the island: the 26th Signal Construction Battalion, and the 50th and 54th Signal Battalions. The 50th, whose landing in January preceded by six months the arrival of the 54th and the 26th, at once started upon its first task amid the rigors of the frigid wind-ridden arctic winter, laying a ten-pair rubber cable over lava fields from the Reykjavik area to Patterson Field near Keflavik.[2]

Among the first Signal Corps units to arrive in Northern Ireland, the next great steppingstone toward the enemy in Europe, was the 63d Signal Battalion. It sailed in January, to be followed in February by the 203d Signal Depot Company. A group from the 161st Signal Photographic Company, Lt. Robert M. Lande and six men, arrived at Belfast, Northern Ireland, on 19 January 1942. Col. Floyd T. Gillespie and S. Sgt. Joel M. Hirsh of the 63d Signal Battalion initiated signal services for the United States Army forces in Northern Ireland at Belfast on 28 January, a few days after the first large body of troops landed. It was nearly a month later before a depot of American communication equipment took form at Carrickfergus under the 203d Signal Depot Company. At first, therefore, the Signal Corps men of this task force used Irish facilities, and only gradually substituted their own. They set up a radio station

[1] (1) Ltr, Sig Officer Iceland Base Comd to CSigO, 1 Apr 42, sub: SigC Quarterly Rpt. SigC SPSTP 7 Gen Rpts. (2) 1st Lt Charles R. Novick, A Story of Signal Communications in Iceland (1944), SigC historical monograph E–4a, pp. 7–12. SigC Hist Sec File. (3) Terrett, *The Emergency*, p. 280.

[2] (1) Capt Frederick Reinstein, Signal Corps Fixed Communications in the European and Africa-Middle Eastern Theaters (1945), SigC historical monograph E–7, pp. 9–10. SigC Hist Sec File. (2) Novick, Story of Signal Communications in Iceland, pp. 30–36.

After the 50th Signal Battalion, the next signal units to arrive in Iceland during the first half of 1942 were the 5th Signal Company and the 121st Signal Radio Intelligence Company, both landing in May. Unit Hist cards, AGO Organization and Directory. For further details on Signal Corps activity in Iceland, see below, pp. 305–06.

SIGNAL LINE CREW CHECKING CABLE *in Iceland. The men are from the 50th Signal Battalion.*

to communicate first with Iceland and then with other points. On 3 March ten officers and 58 enlisted men of the 827th Signal Service Company reached London to set up facilities for the new preinvasion headquarters there.[3]

Until the headquarters for the United States Army Forces in the British Isles was organized, the American military and naval personnel comprising the special observers' groups had occupied joint headquarters at 20 Grosvenor Square. At first they had depended upon British communication facilities and those of the American Embassy. But when the 827th Signal Service Company arrived, the men soon established a signal center at 20 Grosvenor Square, with the message center and teleprinter room located in flats 116 and 117 and the code room in a vault in the basement. Because neither time nor shipping space permitted the transport of U.S. Army equipment across the Atlantic, the 827th called on the British to provide the necessary equipment and office supplies. But by this time such

[3] (1) ETO Hist Div, Administrative and Logistical History of the European Theater of Operations, Pt. I [Henry G. Elliott] The Predecessor Commands: SPOBS and USAFBI, pp. 218–21. OCMH. (2) Interv, SigC Hist Sec with Col Gillespie (formerly Sig Officer Advance Staff Group NIBC), 11 Aug 43. (3) U.S. Forces ETO, Sig Sec, History of the Signal Corps in ETO, pp. 8–12, 22. 314.7, Mil Histories, Vol. 2 (C–2496, Kansas City Rcds Center). (4) Brig Gen Francis H. Lanahan, Jr., "Build-up for Battle," *Signals,* I:1 (September–October, 1946), 17–21.

On 9 March when the Signal Center took over traffic for Hq USAFBI, traffic averaged only 1,000 words a day. Reinstein, Signal Corps Fixed Communications in the European and Africa-Middle Eastern Theaters, p. 24.

materials were very scarce in Britain, and to get the equipment needed the British General Post Office stripped some of its own installations and drew on stores of outmoded equipment and components. Working with an odd assortment of apparatus, some of it venerable enough to invite the interest of museums, the 827th managed within a few weeks of its arrival to have the Signal Center set up, and was handling a rapidly increasing volume of traffic.

By May the rate of increase in traffic and of expansion of the communications system was feverish: new officers were pouring into London, sometimes as many as three or four hundred landing in a single day; new headquarters were springing up; new circuits had to be installed at the rate of at least one a week. During this period of violent activity the officers at the Signal Center were obliged to perform the time-consuming labor of paraphrasing all messages received in code. They were submerged in shipping manifests, a particularly troublesome kind of message to decode. In May alone there were upward of 250 of these manifests, running as high as 5,000 items each, and the daily need of finding new ways of saying such things as "In the fourth deck we have guns and automobiles" taxed the highest powers of invention. Not until fall was the Signal Center relieved of the paraphrasing assignment.

New American equipment was on its way, in particular a powerful Press Wireless 40-kilowatt multichannel radio transmitter with which Signal Corps operators could call halfway around the world, now that they were free from the 10-kilowatt limitation formerly imposed by the Navy. In mid-July this direct ACAN radio link to WAR became established. Meanwhile, on 17 April, a Western Union channel to the Second Corps Area at Governors Island, New York, and to the New York Port of Embarkation went into operation. By the end of May, the Signal Corps had installed four additional teletypewriters, providing direct circuits to the Air Ministry, to U.S. Army Headquarters in Northern Ireland, and to the United States Bomber Command at High Wycombe.[4]

The northern route to Iceland and England might on any day be blocked, if not by submarine, then by German invasion of those island bastions. The southern areas guarding and flanking the Caribbean and Panama were vital also. To assure access to Africa and the Middle East, the eastward bulge of Brazil became strategically important. Signal Corps men had already been dispersed rather thinly along this route, serving especially the Army Air Forces, which was engaged in ferrying aircraft and transporting crews and supplies along a string of hastily established air bases. The 860th Signal Service Company, Aviation, went to Panama in April; the 73d Signal Company to Puerto Rico in March. Other Signal Corps units, particularly aircraft warning and aviation types, had long preceded them.[5] The 22d Signal Service Company had landed in Trinidad in mid-1941. Later in 1942 others came there and also to Ascension Island lying in mid-ocean en route to Africa.

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[4] (1) Reinstein, Signal Corps Fixed Communications in the European and Africa-Middle Eastern Theaters, pp. 17–18. (2) Pauline M. Oakes, The Army Command and Administrative Communications System, Pt. II, Signal Corps Domestic Communications Network as Extended to Overseas Terminals FY 1941–15 August 1945, SigC historical monograph E–5B, p. 89. SigC Hist Sec File. Signal Corps preparations in England for the last half of 1942 are discussed further, below, pp. 312ff.

[5] (1) See Terrett, *The Emergency*, pp. 282–83. (2) See also Unit Hist cards for these Signal Corps units. AGO Orgn and Directory.

During 1942 men arrived in increasing numbers. Aircraft warning companies became battalions; signal platoons, air base, became signal companies. The 22d Signal Service Company on Trinidad doubled its size within the year. Special units appeared, such as the 120th Signal Radio Intelligence Company coming in April and dividing itself between Panama and Trinidad in order to intercept clandestine Axis radio transmissions.[6]

By now radars such as SCR–270, 271, and 588 together with skilled radar men came increasingly to the Caribbean. So did radar critics, in the persons of high-ranking officers and prominent civilians, notably Watson-Watt and Secretary Stimson. The Secretary of War feared more for Panama than for Hawaii. Inspecting the Canal's defenses in March 1942, he was told that the radar and intercept facilities there could not yet cope with aircraft once they had been launched from their carriers.[7] Before the end of April four additional radars went into operation in Panama, and more were readied. In the second week of April two new SCR–588's began operation, one at Fort Sherman and one near Rio Hato, Panama, both ahead of schedule. By April, too, radar protection along the south or Pacific approaches to the Canal extended for 510 miles. Along the north or Caribbean side, an area 450 miles from east to west and 150 miles deep was now covered. But over mountainous areas there remained gaps in radar coverage which the long waves of the early types could not fill. By May technicians, spare parts, and maintenance stores were arriving, all badly needed.[8]

The mushrooming of aircraft warning installations and of airfields throughout the Caribbean area was demanding and getting extensive wire nets supplemented by radio. Pole lines crisscrossed Panama; in Puerto Rico a cable went in between San Juan and Borinquen Field; in Jamaica, a cable provided comunications between Kingston and Fort Simonds. By September 1942 the teletype system alone in Panama would embrace 22 wire nets and 96 machines, providing tactical, administrative, and weather nets. Tactical radio facilities appeared all over the Caribbean, too. By the end of March 1942 the Sixth Air Force was served by 20 radio nets.[9]

More radio than wire went to all the islands, including the big installations for Puerto Rico and Trinidad. At Trinidad military communications had been chronically confused and the despair of more than one Signal Corps report. One root of trouble was a fuzzy delineation of responsibility between the Signal Corps and the Engineer Corps for installing wire systems. A reassignment of functions in April was expected to mend matters.[10] Earlier in the year, General Andrews of the Caribbean Defense Com-

[6] Maj John H. Baker, Communications and Radar in the Area of the Caribbean Defense Command, 1940–1948 (1948), pp. 83–86.

The parent of all aircraft warning units, the original Signal Aircraft Warning Company, Panama, had become the 558th Signal Aircraft Warning Battalion on 15 January 1942. Three other aircraft warning companies in Panama at this date were the 687th, the 688th, and the 706th.

[7] Stimson and Bundy, *On Active Service in Peace and War*, p. 407.

[8] Baker, Comunications and Radar in the Area of the Caribbean Defense Command 1940–1948, pp. 142–46.

[9] (1) *Ibid.*, pp. 97–109. (2) Memo, Gen Stoner for Exec Control Br, 4 Jun 42, sub: Prog rpt 28 May–3 Jun 42, Rpt 39, Item 1b2. SigC (AC) 319.1 Weekly Prog Rpt, Army Com Br, Dec 41–Jul 42.

[10] (1) Ltr, CofS Caribbean Defense Comd, to Dir of Engr Caribbean Div, 28 May 42, and reply, 11 Apr 42; record of telephone conversation between O/C Plant Div OCSigO and Col Covell, Div Engr, N. Y., 24 Apr 42. SigC 676, Gen 1, 1940–42. (2) Ltr, CG Caribbean Defense Comd, to CG Panama

mand had written to General Olmstead commenting upon plans for radio on the island which had "evidently visualized that the Trinidad Base Command would be rather unimportant." He added, "Actually, it is one of the most important areas in the whole Caribbean theater; much more so than Puerto Rico." Olmstead assured Andrews that he was expediting a radiotelephone installation for Trinidad.[11]

Beyond Trinidad and to the east would soon develop many more Signal Corps activities, as yet hardly more than paper plans in Washington. Ascension Island, lonely, hitherto almost uninhabited except by sea birds, the British governor, and the Cable and Wireless station, was becoming a vital link along the South Atlantic air ferry route. When the advance echelon of Composite Task Force 8012 landed there early in the spring, it brought a communication detachment, one lieutenant and seven men, of the 692d Signal Aircraft Warning Company. With them came the makings of a communication system which would serve the future military installations, the airfield, and the radar stations. While the men were completing the information center late in May, two SCR–271's were on their way from the Lexington Signal Depot.[12]

Meanwhile, plans for large ACAN stations in Asmara, Eritrea, and in Basra, Iraq, were being realized. By the last week of May Press Wireless filled a Signal Corps order, in the record time of three and a half months, for a 40-kilowatt transmitter for shipment to Asmara to become the main station serving the U. S. Military North African Mission. At the same time transmitters were on order for the U. S. Military Iranian Mission: a one-kilowatt station for Basra together with four lesser transmitters, two 300-watt and two 75-watt.[13]

Toward Pacific Outposts

Everywhere throughout the Pacific area communications were in demand, especially in the Territory of Hawaii. Oahu, America's first combat theater of the war, experienced its last enemy action on the night of 4 March 1942, when three bombs fell upon the outskirts of Honolulu. Interceptor airplanes failed to track the craft which dropped the bombs. Thereupon Maj. Gen. Delos G. Emmons, commander of the Hawaiian Department, demanded that the Signal Corps provide him at once with AI radars, SCR–540's. He asked for three sets in order to equip a like number of swift A–20 attack bombers as night fighters, able to detect and hunt down enemy planes in darkness.[14]

From a theater of war, Hawaii was now fast growing into a huge base of supply. Men and material were accumulating pre-

Canal Dept and Others, 21 Apr 42, sub: Responsibility for Sig instls: (3) Ltr, CG Caribbean Defense Comd to CSigO, 21 Apr 42, sub: Sig Liaison Sec Office Div Engr, Caribbean and North Atlantic Div, with 1st Ind, CSigO to Sig Liaison Officer, 4 May 42, and 2d Ind Sig Liaison Officer Caribbean Div to CSigO, 16 May 42. SigC 300 Gen 1, 1941 (PEA).

[11] Baker, Communications and Radar in the Area of the Caribbean Defense Command 1940–1948, pp. 106, 112.

[12] Memo, Brig Gen Thomas T. Handy, ACofS U. S. Army, for CG AAF, 4 Jul 42, sub: Radar equip priorities. OPD 413.68 Ascension Island.

[13] Memo, Stoner for Exec Control Br, 28 May 42, sub: Prog rpt 21–27 May 42, Rpt 38, Items 1a1 and 3. SigC (AC) 319.1 Weekly Prog Rpts, Army Com Br, Dec 41–Jul 42. For details on subsequent Signal Corps activity in the Caribbean area, in Africa, and in the Middle East, see below, pp. 306–12.

[14] Msg, Emmons to CofS WDGS No. (46) 2586, 4 Mar 42; No. (28) 2672, 9 Mar 42. Msg Log file [WD General] Staff Com Center.

paratory to movements ever deeper, in ever greater mass, into the far Pacific. The 9th Signal Service Company (later the 972d Signal Service Company) maintained and operated communication facilities in Hawaii. At the same time the company furnished radio operators going out to Christmas, Canton, and Fanning Islands, and supplied operators for transports sailing between San Francisco and Hawaii and for boats plying between the islands of the Territory itself. In this the company was performing a service like that of the 17th Signal Service Company in Washington, which was the parent organization for all Army transport radio communicators operating out of Atlantic ports. Like the 17th too, the 9th Service Company quickly outgrew its authorized strength several times, growing toward 700. Organization charts did not catch up with it until late 1943, when it appropriately became a battalion.[15]

On 10 March 1942 Signal Corps men in Hawaii established a direct ACAN link from station WTJ, Fort Shafter, to a Royal Australian Air Force (RAAF) station near Melbourne, which served U.S. Army headquarters "down under." [16] This was the first entrance of Australia into the ACAN system, and not a moment too soon, in view of the approaching break in the Philippines. Writing in the dry laconic manner of a message center log book, Signal Corps men at WTJ, Hawaii, were soon recording the silencing of the Philippine radios. "WTA, Manila [actually, Bataan], was last heard by WTJ at 0701 HWT on 4 April, 1942. A circuit was established to WVDM, Fort Mills, P. I. [that is, the Corregidor transmitter], on 3 April, 1942, and WVDM notified station WTJ on 9 April that WTA was lost. Contact with station WVDM was lost 1807 on 5 May due to loss of Corregidor to the enemy." [17] Supplementing Hawaii's direct link to Australia utilizing a ten-kilowatt transmitter at WTJ, lesser circuits of three- and one-kilowatts came into use, linking Hawaii with Christmas and Canton Islands, and so by relay with Suva in the Fijis and with Nouméa in New Caledonia, extending communications along the supply route to Australia and to the encampments preparing for the coming offensive in the Solomons and New Guinea. The Canton Island link, to station WVHT, was established on 14 May 1942, followed in July by the link to Christmas Island, WVHW, and by direct channels to Suva, WVHU, and to Nouméa, WVJN.[18]

Signal Corps groups, both large and small, were moving out in order to extend and build up communication facilities. In mid-February 1942 a task force landed on Christmas Island, about a thousand miles south of Hawaii. Lacking a signal officer, the task force commander appointed 1st Lt.

[15] (1) Dr. Donald O. Wagner, Army Command and Administrative Network, 1941–1945: Pt I, The Pacific, SigC historical monograph E–6, pp. 10–11. SigC Hist Sec File. (2) Mary E. Boswell, The 17th Signal Service Company, A Component of the War Department Signal Center from World War I Through World War II (1945), SigC historical monograph E–5a, pp. 37–46. SigC Hist Sec File.

[16] (1) Hist of Sig Sec, appended to History of Subsection G–2, HUSAFMIDPAC, United States Army Forces, Middle Pacific and Predecessor Commands, I, Sec. 3, Radio, p. 10. OCMH. (2) Memo, Stoner for Exec Control Br, 20 Mar 42, sub: Prog rpt 13–19 Mar 42, Rpt 28, Item 8a1. SigC (AC) 319.1 Weekly Prog Rpts, Army Prog Rpts, Army Com Br, Dec 41–Jul 42. The RAAF station had been in radio contact with Hickam Field, Hawaii, since November 1941 for the transmission of flight and weather information. Wagner, Army Command and Administrative Network, 1941–1945, p. 23.

[17] Hist of Sig Sec cited n. 16(1), p. 10. It was 6 May in the Philippines, across the date line.

[18] (1) *Ibid.*, p. 11. (2) Wagner, Army Command and Administrative Network, 1941–1945, Pt. I, p. 10.

Robert Yakerson, an infantry communications officer. His Signal Corps force comprised 17 men, these being 5 wiremen, 4 radio operators, 4 switchboard operators, 3 truck drivers, and the section chief. Yakerson found that while he had enough wire equipment, he had very little radio, aside from an SCR–195 walkie-talkie, which he used for ship-to-shore contact. It was radio he needed most, but it was two months before he could get his orders filled.[19]

In March 1942 Task Force 6814 arrived at its destination, the islands of New Caledonia and Espiritu Santo, lying south of the Solomons. On Espiritu Santo, in the New Hebrides, troops went ashore along with the Provisional Signal Service Company (later the 809th Signal Service Company), which operated the base administrative radio station and the message center. But the bulk of the task force established itself on the large island of New Caledonia, chiefly at its capital city, Nouméa, where the 26th Signal Company provided communications with considerable effort, since the facilities already existing on this French possession were primitive. Headquarters on the 250-mile-long island were at Nouméa, at the southern tip. The main airfield was at Tontouta, 35 miles away, while a second airfield at Plaines des Gaiacs lay over 100 miles farther north. Beyond even that was a detachment of about a battalion of Australian commandos stationed in the extreme northern end of the island.[20]

When the first Signal Corps men landed at Nouméa, they viewed the situation, perhaps not with alarm, but certainly not with enthusiasm. The only telephone equipment available was all French and included some switchboards, a handful of field telephones, steel-stranded field wire wound on cumbersome wooden reels, a few rolls of rubber tape, and several reel units similar to Signal Corps RL–31's. Even pliers were scarce; only one pair was allotted to each crew of eight men. The day after they landed they laid the first wire lines along the ground. Within three weeks, wires had appeared along every road and city street. By April, after American equipment began arriving, the business of wire laying became somewhat better ordered. One of the first field telephone lines which signalmen completed ran between La Foa, the advance command post, and Tontouta, 35 miles away over rough country. EE–8 telephones powered by 24-volt external batteries were at first unsuccessfully installed on the line. Teletype failed, too. Rain and dampness penetrated to the wire strands and short-circuiting the current limited the opportunity for any kind of communications to the hours when the sun was high. Poles also were a problem. Many of them quickly rotted. Many more were snapped, sideswiped by vehicles passing along the narrow roads. Until the poles were relocated, the La Foa command post relied upon its radio. Not till May 1942, when heavier wire, W–50, was used to replace the W–110–B first employed on the circuit, did La Foa and Tontouta enjoy dependable wire communications, both telephone and teletype. The task of tying together the military communication lines over the island, including a teletype circuit between Tontouta and Plaines des Gaiacs airfields, kept the 26th Signal Company ex-

[19] Interv, SigC Hist Sec with Lt Yakerson (formerly Sig Officer at Christmas Island), 26 Sep 43.

[20] Intervs, SigC Hist Sec with (1) 1st Lt James G. Charles (formerly Bn Com Officer 754th Tank Bn GHQ-RES in New Caledonia and Radio Officer at Espiritu Santo), 6 Oct 43; with (2) Capt Clyde Bryce; with (3) Lt Col R. B. H. Rockwell (formerly Sig Officer Task Force 6814, New Caledonia), 9 Sep 43.

tremely busy with wire work. Besides, there were radio channels to operate, both the long ones which extended to Hawaii in one direction and to Australia and New Zealand in the other, and the shorter ones of the local net which connected with other islands nearby, Espiritu Santo and Efate. In all this the 26th Signal Company acquired much tropical experience which would serve the men well during their labors to come, on Guadalcanal and on through the Solomons.[21]

Early in 1942, when the war in the Southwest Pacific was at its gloomiest, General MacArthur and his staff arrived in Melbourne from doomed Corregidor. Headquarters officers now based their planning on a defense line running through Brisbane west-northeast, and called for extensive communications and radar installations. As for radars, there were none at the time in operating condition in Australia. There were two SCR–271's, but they lacked receivers as well as other parts. Several SCR–268's had gone to Java. They evidently had given little comfort to the Allies. According to one report, they had been shipped without instruction books, whose secret classification required special and separate handling.[22] They may well have given comfort to the enemy, for although the Dutch gave assurance that they had destroyed the sets, the Japanese subsequently built radars quite similar to the 268. Actually, eight SCR–268's had gone to Java about 1 February. Col. Calvert H. Arnold, then the theater signal officer, turned them over to the Navy for the defense of Soerabaja. Before Java collapsed, Ensign John D. Salisbury, USNR, supervised the installation of five of them for the Royal Australian Air Force to operate. The remaining three sets were in a Dutch depot. A surviving Dutch signal officer asserted that the Dutch completely destroyed the equipment, of which, he said they had made "very little use." But Salisbury, who also survived, could give no assurance of their total destruction since none of the RAAF or Dutch officers who had been directly charged with the sets had escaped.[23]

As for the two SCR–271's in Australia, the Signal Corps men at Brisbane patched them up and sent them with operators to the Samoa Islands and Tongatabu. Since some of the parts were missing, the men improvised substitutes while the headquarters made up a radar company using any troops within reach and training them from scratch with such odds and ends of equipment as were available.[24] Some relief for the desperate equipment shortages was on its way, however. In early March G–4 in Washington sent word that 220 ship tons of spare parts and supplies for SCR–268's, 270's, and 271's, as well as for aircraft and vehicular radio sets, were being assembled

[21] (1) *Ibid.* (2) Incl 1, Signal Corps Activities in the SPA, with Ltr, Actg Sig Officer SPBC to Dir of Plan and Opns Div OCSigO, 31 Jul 44. SigC 319.1 SPBC. (3) Col Arvid B. Newhouse, Sig Res, "SOPAC Signals," *Signals*, II:5 (May–June, 1948), 35. (4) Walter D. Kunhart, Signal Corps Activities in the South Pacific Theater, December 1941–July 1944. SigC Hist Sec File, A46–160. See below, pp. 468ff., for South Pacific communications from late 1942 to mid-1943.

[22] Intervs, SigC Hist Sec with Frank W. Hogan, Shops Br Proc and Distr Div OCSigO, 1, 5 Jul 49.

[23] (1) OCSigO R&W Action 1, Capt A. V. Hazeltine to Deputy CSigO, 12 Jun 42, sub: Radio equip on Java; (2) SigC Intel Memo 4–S *Netherlands*, 28 May 42, sub: Notes on interv with Dutch signal officer recently returned from Southwest Pacific theater; (3) 4th Ind, CSigO to ACofS G–2, 8 Aug 42, on Ltr, Chief of MIS to CSigO, 30 May 42, sub: Possible compromising of SCR–268 sets on Java. SigC (EO) 413.44 Radio Sets Gen 1942–44.

[24] Intervs with Hogan, 1, 5 Jul 49.

for shipment to Australia. With luck this equipment should arrive in April, and with luck it did. Shortly before the Battle of the Coral Sea, Signal Corps men installed two SCR–270's near Brisbane, and subsequently an SCR–516 and some 268's at Port Moresby in New Guinea. Toward early summer they got also an SCR–270 to install north of Townsville and, a little later, one for Darwin.[25]

As for communications, General MacArthur's headquarters in Melbourne had at first only one link to Hawaii and it was an Australian transmitter located in an RAAF radio station. In mid-March this station began working on an hourly schedule with Fort Shafter.[26] Meanwhile a Signal Corps lieutenant, Roger E. Dumas, with a team of 19 men, only one of whom had ever had any experience with fixed installations, was setting up an ACAN system for U. S. Army headquarters in Australia. Dumas and his men had arrived in February along with the 52d Signal Battalion with a good deal less than all the equipment needed to carry out their mission. With Australian sympathy and assistance, together with "whatever could be scraped up . . . and a considerable amount of improvisation," they managed to establish a radio network. Its control station, WTJJ, Melbourne, presently began bringing McArthur's headquarters into better communication with the various base sections and numerous island posts in the Pacific. Yet its transmitter was only one-kilowatt. An ACAN chart dated in May 1942 showed channels in operation from WTJJ to Hawaii, by way of Nouméa (WVJN) in New Caledonia, to Darwin (WVJK), to Townsville (WVJL), and to Sydney (WVJM).[27]

Transmission over all the channels was accomplished by hand-keying. There was nothing like what was wanted and necessary in the way of equipment. In some instances, supplies were exhausted temporarily; in others, the equipment requested had not yet been produced. For example, Colonel Arnold, the theater signal officer early in 1942, asked for ultrahigh-frequency keying equipment. He wanted two transmitters and two receivers with antennas and installation material. Word came back from Washington that specifications had not yet been completed and that the units would not go into production for nearly a year. An additional request for three one-kilowatt radio stations for high-speed operation, also for one one-kilowatt manually operated station, together with the radio teams needed to install and then operate the stations, brought the reply that no high-speed (Boehme) equipment would be available before June.[28]

Thus Colonel Arnold early in 1942 found himself trying to make bricks pretty much without straw. Not only was he desperately short of equipment to start with, but many of his men were taken from his Signal Corps

[25] (1) *Ibid.* (2) Ltr, CofS to CG USAFIA, 6 Feb 42, sub: U. S. Army Forces in Australia, with list of sig equip; (3) Memo, ACofS WDGS G–4 for CSigO, 18 Feb 42, sub: Equip for Force 4502, and Ltr, ACofS WDGS G–4 to TAG, 23 Feb 42, sub: Equip for SCR–271 sets for X. G–4/33861 Jan 42 Sec. II. TC File 33861.

[26] Memo, Stoner for Exec Control Br, 20 Mar 42, sub: Prog rpt 13–19 Mar 42, Rpt 28, Item 8a1. SigC(AC) 319.1 Weekly Prog Rpt, Army Com Br, Dec 41–Jul 42.

[27] (1) Interv, SigC Hist Sec with Maj Robert E. Dumas, 24 Nov 44. (2) Wagner, Army Command and Administrative Network, Pt. I, pp. 22–24, and chart, Army Administrative Radio System, South Pacific, 9 May 42. The 52d Signal Battalion, part of the 176th Signal Company, Repair, and several radio teams and detachments had left San Francisco in January aboard the *Mariposa* and the *President Coolidge*.

[28] T. C. File 33861, *passim*.

units also. Directly after their arrival in Melbourne in February, Arnold himself had embarked a considerable portion of his best signal specialists, together with such tactical equipment as they had, intending them to go to Java. But almost at once Java fell to the enemy and the ships carrying the men were diverted to India. Not only had Arnold lost these men, but he temporarily lost others of the 52d as well who were detailed here and there in Melbourne as guards, dock workers, and military police. Signal specialists found themselves serving as janitors and chauffeurs. A few actually did signal work, operating the headquarters message center and switchboard. By mid-April the 52d Signal Battalion was becoming a discouraged and disheartened outfit, chafing under the uncertainty of its mission, the continued dock details and fatigue duty, the cold wet weather, and the conviction that they were stepchildren. The morning report of each company showed that most of the men were either on detached service or on special duty. At first, the only infractions were minor, but as the weeks went by, courts-martial became frequent. There being no assigned battalion commander, a captain who was the senior officer present assumed command until 19 April, when Lt. Col. John C. Green was assigned to command. Battalion strength was down to 15 officers and 399 enlisted men by 31 May. Still another month passed before the 52d Signal Battalion got replacements for the officers and men sent to India in February. After that would come the return of men on detached duty, and a 1,200-mile move to a new camp near Brisbane, Queensland, followed by a period of intensive training of teams for all phases of signal communications, designed to make the battalion a group of self-contained units, each capable of functioning independently in a combat zone.[29]

Meanwhile at Melbourne, Army's radio, WTJJ, during its first weeks of operation into early May handled the last flow of messages from the besieged Philippines. Relayed through Darwin to Melbourne and then retransmitted by way of Honolulu to the War Department, this load ran to about 30,000 groups a day, both ways, and was carried on one duplex manual circuit. Total traffic in Melbourne during April and May averaged up to 40,000 groups daily. Yet there were no serious transmission difficulties during these early months. The only exception was delay of messages calling for air support during the Battle of the Coral Sea on 7 May; this was fought before sufficient facilities had been built up to accommodate a large volume of traffic.[30]

China-Burma-India Vicissitudes

It was in February 1942 that Colonel Arnold dispatched to Java, he thought, some of his Signal Corps men from the 52d Signal Battalion, together with a number of his Signal Corps teams, which had recently arrived in Australia. These officers and men never reached Java. At Fremantle, in Western Australia, they found themselves suddenly transferred to vessels which sailed on and on, westward, into the Indian Ocean. In mid-March the ships docked at Karachi,

[29] (1) History of the 52d Signal Battalion, 1 February 1942–24 December 1944, pp. 1–6. Opns Rpt SGBN–52–0.1 (20063). (2) Interv, SigC Hist Sec with Brig Gen Calvert H. Arnold, 1 Jul 49.

[30] (1) Interv with Dumas, 24 Nov 44. (2) Wagner, Army Command Administrative Network, Pt. I, p. 24. The account of Signal Corps activities in Australia and in the Southwest Pacific theater generally is continued for the second half of 1942 in pp. 298ff., below.

a dusty port in the northwestern desert lands of India. On the very day of landing, seven of the Signal Corps men set up a message center while Teams C, J, and part of E went to work erecting a radio station. Team H hastened to New Delhi in central India in order to construct a station which would control the future radio network of the China-Burma-India theater.[31]

Back at Karachi the Signal Corps crews first installed a 300-watt BC–447 transmitmitter in an airplane crate, turned on the power, and made contact with New Delhi on 7 April. What was most wanted was a direct contact with home, with station WAR in Washington. The men had a powerful 10-kilowatt transmitter, but no generator for it. The one intended for it had been left far behind, on the other side of the globe, in the States, and local power supplies were uncertain at best. But the Signal Corps men did have a smaller one-kilowatt transmitter BC–339, together with a suitable generator. Erecting a rhombic antenna,[32] they hoped to beam a sufficiently strong signal across the North Pole to reach down to WAR. On 22 April they succeeded.[33] Station WVNA, Karachi, thus entered the ACAN system, although uncertainly because the direct circuit passed through the electrically unfavorable polar areas. This circumstance continued to hamper the signal even after the men at Karachi subsequently installed the ten-kilowatt transmitter and obtained a large 75 KVA generator from the Standard Oil Company of Arabia. In the following month Karachi established its next contact, uncertain as the WAR circuit; it reached to Chungking, where a Navy transmitter, taken from a Yangtze River boat, replied with a weak 300-watt output.[34]

During April and May 1942, other Signal Corps teams moved from Karachi to varied posts in India. The movement became especially rapid after the 835th Signal Service Company arrived on 16 May, when the *Brazil* docked at Karachi two months after sailing from Charleston. Men of the 835th, amazed to find that American troops had preceded them, commiserated with their fellow signalmen as they moved to their quarters in the heat and dirt of clay barracks at New Malir, in the desert about seventeen miles out of Karachi.[35] Tasks of enormous proportions awaited them where there had been relatively little radio before and where such wire nets and equipment as already existed were old and unsteady. Communication nets had to be set up and maintained over a gigantic area from China across India and beyond. Teams and detachments would soon penetrate to all parts of the China-Burma-India theater: to Calcutta, Ramgarh, Chabua, and Ledo in India; to Kunming in China, and, in the opposite direction, to Asmara in Eritrea,

[31] (1) Sgts John and Ward Hawkins, *History of the 835th Signal Service Battalion 1942–1946*, pp. 2–3, 12. SigC Hist Sec File, A47–200, Drawer 15. (2) Interv with Arnold, 1 Jul 49.

[32] A rhombic antenna sends out a maximum strength signal in a predetermined direction. The antenna wire is strung in the shape of a rhombus, or diamond, poles supporting it at the four corners.

[33] Both the Hawkins history and the SOS CBI history give 22 April, 1307 GCT, as the date and time of the first *two-way* contact with WAR. (1) Hawkins, *History of the 835th Signal Service Battalion*, p. 3. (2) History of the Services of Supply, China-Burma-India, App. 25, Sig Sec, Pt. IV, p. 2. OCMH. Listeners in WAR first heard Karachi's faint calls on 18.3 megacycles the day before, but they had been unable to put a reply through on 17.56 megacycles. Memo, Stoner for Exec Control Br, 23 Apr 42, sub: Prog rpt 17–22 Apr 42, Rpt 33, Item 5c. SigC (AC) 319.1 Weekly Prog Rpts, Army Com Br, Dec 41–Jul 42.

[34] Hawkins, *History of the 835th Signal Service Battalion*, p. 3.

[35] Interv, SigC Hist Sec with T/4 John J. Wildmann (formerly of the 835th Sig Sv Co serving in the CBI theater), 24 Nov 44.

Africa. Team Seven left Karachi late in June for Asmara, in order to make the initial installation there of a very important relay station. Henceforth the unreliable direct circuit between Karachi and Washington over the Pole could be bypassed, relayed by way of Asmara over the equatorial regions of the earth, where transmissions can be radiated dependably at all times.[36]

Before the 835th Signal Service Company arrived in mid-May, the first Signal Corps teams on the Indian scene were already moving to what must have seemed the very ends of the earth. In April, Team L, 20 men, went to Asansol, a little to the northwest of Calcutta, to supply communications for two Royal Air Force squadrons which were operating against the Japanese in Burma. Team L at once put an SCR–188 into operation in order to maintain circuits while they began installing a 300-watt fixed transmitter. Three weeks later, before the job was done, they received orders to another Royal Air Force base, at Allahabad, halfway to New Delhi. Taking their 188 with them, they put it back on the air within a few hours of their arrival. As the Allahabad base became headquarters for the 9th Bombardment Group, demands mounted upon the team, the only communication men in the area. After they had set up the 300-watt transmitter, they were asked for wire lines. Although inexperienced in telephone and wire work generally, they learned about it, putting in and operating 30 miles of wire, 40 telephones, and 2 switchboards.[37]

Team I tossed a coin with Team J to determine which would win a comfortable assignment to Bangalore. Team I lost—and got the less desirable but the more important post, which was in Assam Province, lying on India's eastern border, next to Burma, China, and Tibet. Before the team could complete the communication installations desired there, it was ordered to move into Burma itself to provide communications for Lt. Gen. Joseph W. Stilwell, then at Lashio, the Burmese terminus of the Burma Road, which the Japanese were attacking. Team I arrived at a crucial moment in April just when the British and Chinese forces were crumbling. First the British, then the Chinese, abandoned Lashio, and retreated westward toward India as the Japanese advanced. The Signal Corps men stayed on, except for a detail of seven men who were to report to Stilwell's headquarters at Maymyo near Mandalay. Even as the detail forced its truck through the retreating hordes that flooded the highway, it found that Maymyo too was already being abandoned. But the men pushed on to Mandalay and then turned northwards, under Japanese bombing, to Schwebo, where General Stilwell halted briefly. During their four days there, the seven men set up and operated a message center. On each day came air raids, none of which quite hit the center itself. As the Burma campaign ended, Stilwell called for air transport and it was the detail from Team I that sent the call. One plane flew in. Part of the detail boarded it; the rest remained on the ground and escaped on foot with Stilwell. At first their radio truck accompanied the Stilwell party; later it had to be abandoned in the jungle along with the rest of the party's motor vehicles.[38]

[36] Hawkins, *History of the 835th Signal Service Battalion,* pp. 13–14.

[37] *Ibid.,* pp. 15–16.

[38] (1) Jack Belden, *Retreat with Stilwell* (New York: Alfred A. Knopf, Inc., 1943), pp. 267, 275, 277, 303. (2) Charles F. Romanus and Riley Sunderland, *Stilwell's Mission to China,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1953), pp. 137–38.

The remainder of Team I had stayed at Lashio, which the Japanese now cut off from the west as they pushed to Mandalay. These isolated and forgotten Signal Corps men never received orders to retreat. But obviously they could not stay where they were. They now had only one escape route left, the Burma Road itself leading into China. They loaded their equipment, including a 300-watt transmitter, into broken-down trucks. Two sergeants in one of the trucks won out against the heated misgivings of a colonel who wanted to throw off the signal supplies and load some relatively useless equipment instead. After bad moments at first when they were pursued by the enemy, they reached Kunming early in May 1942. Their transmitter was the first large Signal Corps radio in that area of China. A month later the men received orders to move on to Chungking. The transmitter and some indispensable spare parts had been repeatedly saved by the stubbornness of their keepers. The equipment was literally worth its weight in gold in that land where light sockets cost $12 in gold and where many electronic items were unavailable at any price. This BC–447–A thereafter went to work on the circuit between Chungking and New Delhi, and for over a year it transmitted allied traffic in the area, messages relating both to the Burma Road and to the air transport passing over the Hump.[39]

Last Weeks in the Philippines

In the spring of 1942, Army's last radio station in the Philippines operated on isolated Corregidor. Earlier, upon the evacuation of Manila, it had moved to Corregidor from its former location at Fort Santiago and Fort William McKinley. It did not last long in its first installation in an exposed location on Corregidor; indeed, it was bombed out rather quickly. The men then moved the station underground to Malinta Tunnel, Lateral Twelve. Two hundred feet of rock separated the equipment from the transmitting and receiving antennas atop Malinta Hill. Improvised antennas they were, which were repeatedly being knocked down by enemy fire during the final bitter weeks of siege.[40] Radio transmitters collected from amateurs and commercial firms, together with other equipment which had been brought over when Fort Santiago was abandoned, kept the Corregidor installation on the air. Circuits to Brig. Gen. William F. Sharp's headquarters on Mindanao, to Bandoeng, Darwin, and Honolulu had been quickly established. Early in February a Signal Corps officer went from Corregidor to Bataan to set up a high-speed radio station for the transmission of allotment, insurance, promotion, and casualty messages to Honolulu for relay to the United States. In two weeks he finished the installation.[41]

Signal communication on Corregidor had the task of keeping General MacArthur, the commander of the United States Army

[39] Hawkins, *History of the 835th Signal Service Battalion*, pp. 7–8. The account of Signal Corps men in CBI is continued below, pp. 303ff.

[40] (1) Interv, SigC Hist Sec with Sgt Messer (formerly radio operator at Corregidor), 17 May 44. (2) Report of Operations of USAFFE and USFIP in the Philippine Islands, 1941–1942, Annex XVII: Col Theodore T. Teague, Report of Operations, Signal Corps, United States Army, 8 December 1941–6 May 1942. 26447 98–USF 1–0.3, DRB AGO. Copy in OCMH. The basic source for this entire account of the last weeks in the Philippines is the above document, supplemented by MS comment by Colonel Teague contained in a series of letters to Dulany Terrett over the period 24 September 1949 to 14 April 1950. SigC Hist Sec File.

[41] Wagner, Army Command and Administrative Network, pp. 45–46.

Forces in the Far East (USAFFE), in touch both with the outside and with his own tactical units. Except for the Visayan-Mindanao Force and scattered resistance groups elsewhere, these units were concentrated in the Bataan peninsula. Aside from radio, their only connection with Corregidor was a telephone circuit. Between Corregidor Island and Bataan lay an old submarine telephone cable with but four good circuits remaining. Lest it fail, the USAFFE signal officer, Brig. Gen. Spencer B. Akin, ordered a new one laid. The Coast Artillery Corps owned a 26-quad cable, and, although some reels had been hit by enemy bomb fragments, enough of it was still undamaged for the job. Part of the telephone circuit followed the bay cable and the rest a pole line which slashed conspicuously through clearings on the forested peninsula. Not only because of this weak link but also because of an acute shortage of trained men, it seemed best that the island become the signals distributing point. Interisland traffic between USAFFE and its subordinate organizations, as well as the overseas station on Bataan, was controlled by the Corregidor station.

Now entunneled, with secondary communications to the troops, the headquarters on Corregidor lost direct contact with Hawaii and beyond and had to depend upon the Corregidor naval radio station for it. In a room at the rear of Lateral Twelve, three chief petty officers, succeeding each other in shifts, kept a wire telegraph circuit open to the Navy station on Corregidor, and the signal intelligence and radio operating sections moved in with them.

The signal men on Corregidor had cast about during January to see what was on hand and what communications they could establish with it. The equipment sent across the bay from Manila stood in a confusion of types, of manufacture, of size, of age, of condition, of design. Grime and salt spray had coated it. A radio electrician, William Gibson, a civilian employee of RCA who had volunteered to join the exodus, offered to take charge of it, and Colonel Teague, left without anyone better qualified, thankfully accepted the offer. Gibson did his best to put it in working order, causing sets of equipment to cohabit which had never been introduced.

This equipment was one source. For another, there were the fixed transmitters that had been used to work Honolulu. Colonel Teague, looking at them for the first time, found them to be old, and so large and heavy that they could not be removed from the buildings. Fortunately, each had a 1,500-watt exciter, and these he caused to be removed from the parent sets and transported into the Malinta Tunnel. There they were overhauled, and one of them became a transmitter to work Australia. The other was held in reserve. Two excellent and comparatively new low-powered transmitters had come from the plant of the Philippine Telephone Company. The men of the installing and maintaining crews were for the most part young and active (pain and starvation lay yet ahead of them). They were able to overhaul the good transmitters and put them to use for broadcasting southward to the Visayan-Mindanao Force. They brought the USAFFE Reserve station into the tactical net. They set up a receiving antenna by rigging a small aerial on Malinta Hill and leading it through a ventilator shaft into the operating room in Lateral Twelve. Within five days after they had arrived on Corregidor, they had used the other transmitter to set up a "Voice of Freedom" broadcasting station, placing the

aerial outside the hospital lateral of Malinta Tunnel, the transmitter just inside, and the microphone in the quietest place they could find: the rear of Ward 11.

It was when they received orders to set up a radio channel to Darwin that they showed the greatest energy and ingenuity of all. Considering the equipment available and the distance to be covered, they immediately saw that a large rhombic antenna was needed. A rhombic antenna is "directional" and provides the strongest signal with the least amount of power, and, in order to cross the thousands of miles to northern Australia, a properly oriented rhombic offered the best chance of success. Abetted by the Engineers, they determined the northern and western angles of the rhombus high along a ridge, the eastern angle in a ravine and the southern end also low, along the edge of the water. Some of the men went about seeking the four biggest poles on the island, while Teague with others attempted stopgap communications with Darwin.

During the brief period when the Manila RCA channel had worked Darwin, and just before it had to be destroyed, a call sign had been agreed upon. The men now perforated a tape with the sign, pasted the ends of the tape together to make an endless belt and then, affixing it to one of the machine transmitters, set it to issuing the call, over and over again. Feebly, the endless tape sent out its signal. It got no response on the first day of its use, or on the second; but on the third Darwin reported having heard it faintly, during the nighttime lull. What Teague wanted was something much stronger, which could be heard in the day. One by one the four heavy poles for the rhombic went up on the rocky and precipitous ground. The Engineers hauled into position a large gas engine-electric generator unit, bolted upon skids, to provide power for the transmitter should the post powerhouse be bombed out of operation. They covered it with concealing tarpaulins, directed the exhaust horizontally, and sandbagged the walls of its partial shelter.

Meanwhile, the "Australian" transmitter improved slowly, although it was still an unsatisfactory channel and, in the narrow darkness of Lateral One, was insufficiently protected even by a big "Danger—High Voltage" sign. Outside, at the new antenna, the men were rigging the wires. Weighting the end of the wire, they would heave it through branches and haul it down with a hand line. Often, it tangled and they had to climb the tree to free it. At last the rhombic was ready, the transmission lines were connected, and on the twenty-first of January the rhombic aerial tried Darwin. The result was a disappointment. For all their work, the strength of the signal was barely increased. At the other end, moreover, the Australian operators were still inexperienced, unaccustomed to worrying a weak signal along. If the rhombic were useful at all, it would be little better than what was already operating. The men had whatever satisfaction they could get from knowing that they had tried.

Corregidor, a beleaguered fortress, nevertheless maintained a broadcasting station and missed no schedules. Teague had two telegraph positions working and, counting the Australian transmitter, eight for radio.[42]

[42] The so-called patrol transmitter reached the naval inshore patrol off Cabcaben; the Bataan position maintained contact with I Corps, II Corps, and the V Interceptor Command; and the Mindanao transmitter sought to keep channels open to the Visayan-Mindanao Force.

At the beginning of February the men built a broadcasting "studio," which was doubly insulated both by Celotex and by its location at a point where Lateral One joined the main tunnel. Out of doors, the endless business of maintaining the aerials went on. Once during the course of the siege, an aerial which had been shot down by artillery fire was restored to use when an airplane bombardment threw it up over some trees: it came back into service because it happened still to be connected.

Even this limited maintenance, so concentrated as to be pinpointed on the target island, used up three and a half miles of wire. Supplies were dwindling so fast that by the middle of February a signal requisition for a whole division could be carried in the pocket of one man. Only such items as primary batteries and friction tape were on hand; there was no use in asking for anything else. For those transmitters on Bataan which depended upon gasoline-driven generators, there was always a delay in answering calls, because gas rationing made it crucial not to start up the generators until time to send out a message. The roads on Corregidor along which lay a section of the shallow-trenched submarine cable to Bataan came under enemy bombardment. The wire maintenance officer and a crew of three cable splicers worked at repairs night after night by the masked light of a lantern: 29 hits, 57 splices. At no time until the loss of Bataan, however, was either the radio channel or the wire circuit between the island and the peninsula interrupted. And throughout the ordeal, the Corregidor operators transmitted a million words a month, most of it coded, much of it sent manually, and all of it handled under what military understatement calls "adverse conditions."

By the third week in March, MacArthur's small party (including the signal officer, General Akin) had successfully escaped to Australia. Lt. Gen. Jonathan M. Wainwright assumed command in the Philippines, United States Forces in the Pacific (USFIP), with Colonel Teague as his signal officer. On Corregidor, the only alternative to work was more work and, beyond that, waiting for capture. Efforts to strengthen the communications of the Visayan-Mindanao Force met with frustration. J. E. S. Stevenot, a lieutenant colonel, who had been commissioned from his civilian occupation as president of the Philippine Telephone Company, looked like a good man to become the southern force signal officer, but General MacArthur, now establishing his headquarters in Melbourne, put him on the list of those to be evacuated. From Australia, Akin sent, by name, for ten intercept radio operators. It was important not to let them be captured and tortured. Meanwhile, the hours of duty increased for men who were already weary. Teague himself helped out, so that the regular operators might take hurried meals or even so that they might go to the latrine. In Melbourne, by this time, MacArthur's headquarters had two more men listed for departure from the island by the first means available. One of them, in civilian life the plant chief of the Manila telephone exchange, had already been captured; the second, formerly manager of the exchange, was located and evacuated.

Meanwhile, the troops on Bataan steadily weakened. As supplies dwindled, their meals were cut again so that during the month of March the men were getting barely a one-fourth ration. To the wounded were added

growing numbers of the diseased, and of the nervously fatigued, broken by the strain of bombing and by the inability to strike back. Maj. Gen. George M. Parker, commander of the II Corps, estimated by 15 March that the combat efficiency of his men was down to 20 percent. Each day it lessened.[43]

On 9 April, Bataan surrendered and the radio station of the erstwhile Luzon Force signed out of the USFIP net. The telegraph and telephone circuits between Bataan and Corregidor closed, too, and crews cut the submarine cable, first at the point where it emerged from the water on Bataan, then at the Corregidor end. They drew the cable up from the water, cut it with a hack saw, sealed it with molten lead at both ends, then buried the shore end to conceal it, and sank the seaward end as far as possible out in the bay.

Now the certainty of capture canceled the hope for relief. Habit still suggested requisitions for more supplies but discipline dictated the destruction of those on hand. On 22 April Colonel Teague asked the signal officer in the Southwest Pacific for items to be shipped to Corregidor in case the island held out; and on the same day, the message center started burning its files. On the first of May, the signal office burned more files, at the same time that everyone was wearily planning the possibility of resisting for another month—one more month being six months after December, and six months being the period for which prewar calculations had supposed that the Philippines could survive without reinforcements. Enemy bombers and shore-based artillery were steadily blowing up the aerials, and the big rhombic was now gone. Some of the older radio sets failed, and not even improvisation could repair them, although all radio channels still remained open. Transmitting tubes "gassed." Finally, a week before the fall, everything was listed on a destruction plan; the Engineers agreed to explode the permanent installation of the Philippine-Hawaii channel, and the signal officer estimated that three hours would be enough to accomplish the destruction of all the rest of the communication equipment. Just at that point, a requisition was filled: a small shipment of vacuum tubes was flown in.

In anticipation of the collapse, General Wainwright composed three messages: one, labeled "Washington No. 1," to the Chief of Staff in Washington, one to General MacArthur in Melbourne, and one to the commanding general of the Visayan-Mindanao Force at Del Monte, Mindanao. These penciled messages he handed to his signal officer, Colonel Teague, who in turn prepared two others, both to the Chief Signal Officer: a "Washington No. 2," which would report that the cryptographic machines had been demolished, and a "Washington No. 3," which would inform him of the destruction of the cipher strips. All five of these Teague taped to his chest to hold in readiness, and to guard against their transmission by accident. During the in-

[43] (1) Report of Operations of South Luzon Force, Bataan Defense Force, and II Philippine Corps in the Defense of South Luzon and Bataan. (2) Morton, *The Fall of the Philippines,* pp. 367–68; Chs. XXI–XXVI, *passim.*

terim, the men continued the transmitting of insurance and allotment authorizations. Made famous by newspaper dispatches which described it, this pathetic duty almost incredibly taxed all of the available channels. The longest message extended for more than 20,000 words. One of the men who began to send it—manually—worked at it steadily for eight hours, went off duty, returned 16 hours later, and found it still being transmitted; only a few priority messages had interrupted the sending meanwhile. All of this traffic was moved doggedly out, and none of it was ever garbled.

On 6 May 1942, Corregidor fell. Teague did not get the three hours which he had looked for. He got only one hour and 23 minutes. But it was enough. At 1037 Wainwright's chief of staff ordered Teague to send the final messages. From his chest Teague uptaped the envelope containing the coded messages. Shuttling back and forth between headquarters and the message center, telephoning, pausing for instructions, listening to other instructions, the men worked rapidly and efficiently. One by one, the final messages went to their destinations. At 1105, just as M. Sgt. Richard K. Sakakida began broadcasting in English and Japanese the first of three hourly announcements of the capitulation, "Washington No. 1," Wainwright's message to General Marshall, was brought out. It would go via Fort Shafter, the relay station at the headquarters near Honolulu. But Fort Shafter was not listening. The call tape got no response. They tried a manual call, and this time succeeded. Shafter responded, and "Washington No. 1" went on its way. "Washington No. 2" followed it at 1110. To make sure, both messages were also beamed at Del Monte; and to make trebly sure, commissioned couriers rushed them to the naval radio station, for a third transmittal by equipment which was already being systematically wrecked. Successively, the messages to Melbourne and Del Monte sped out, blind, at ten-minute intervals. Working one of the positions prior to 1037 that morning a soldier named Irving Strobing had been filling in the time with poignant if unauthorized farewells to his family.[44]

[44] Sergeant Messer, one of the Signal Corps survivors of Corregidor, recalling the events of that day in an interview on 17 May 1944, stated: "I would like to mention the Signal Corps operator who sent the last message from Corregidor. I am not sure of his name now, but I believe it was Struble. He was an old operator from WTA [age 22!] and went under the name of 'Junior.' He was quiet, reserved, courageous at all times, and took his operating seriously. In rank he held the exalted position of Private First Class, specialist second class. He held the job of trick chief as well as operator. He worked the Darwin-WTA circuit mostly and handled the traffic under the very worst conditions imaginable. Interference was always heavy and jamming by the Japs became as much a part of operating as the background noise in the receiver. The things he did and the things he said on that last day were not the remarks of some foolish wit, but were the true reflections of a battle-weary Signal Corps radio operator who had seen his world turned upside down, his friends killed and who himself was destined to step outside the tunnel and face the unknown." (1) Interv, SigC Hist Sec with Sgt Messer, 17 May 44. (2) Carl Mann, *He's in the Signal Corps Now* (New York: Robert M. McBride & Co., 1943), pp. 144–49. (3) See also Washington, D. C., *Sunday Star*, May 7, 1950, p. A–20, "Corregidor's Radio Operator is 'Paying' 8 Years Afterward."

The surrender was about to be broadcast again, and its terms allowed no destruction of equipment after noon. The men began tossing equipment into big containers. A cryptographic machine, a typewriter, and an adding machine. They swung axes, pounded the battered pieces, mixed them, and cast them into piles of wreckage already cluttering the tunnel. The Melbourne and Del Monte messages went on their way again. Now the delicate interior mechanisms of radio sets were destroyed with heavy blows. The panels were left intact, so that the Japanese could not accuse the garrison of having broken up the equipment in violation of the surrender. Chief Warrant Officer Robert L. Scearce sent out "Washington No. 3," the last word from Corregidor before it blacked out. The broadcasting transmitter repeated the capitulation for the last time; it was the only piece of equipment not demolished. The Japanese found the offices neatly swept and bare, the floors washed, and blank dials hiding gutted equipment. The surrender involved Signal Corps losses which the Operations Branch in the Office of the Chief Signal Officer set at 712: 50 officers and 662 enlisted men.[45]

[45] Memo, Col H. L. P. King, Actg Chief of Opns Br, for Exec Control Br, 22 May 42, sub: Weekly prog rpt, Item 2j. SigC (EC) 319.1 Prog Annex May–Jun 42, Evaluation Br.

CHAPTER V

Alaska Communications (January–July 1942)

The attack on Hawaii, and the losses along the island front from the Philippines to Java in succeeding weeks, had turned attention everywhere to the Pacific, and accordingly to Alaska. Military planners in Washington were doing what they could to bolster the northernmost Pacific approaches to America. Early in the war, General Marshall had warned that Japan could be expected to strike a blow in the Aleutian Islands, especially at Dutch Harbor, and possibly even to attempt an invasion of the Alaskan mainland.[1] Nevertheless, first things had to come first; strategists hoped that Alaska could meanwhile withstand an attack.

Admittedly, Alaskan defenses were weak when war began. They remained weak in the first months of war, but at the close of summer in 1942 there existed at least a string of initial outposts along a line running northward from Fort Glenn, at Otter Point on Umnak Island, to the Pribilof Islands, and thence to Nome. Spearheading American defenses in the Aleutians was the naval base at Dutch Harbor. At Fort Randall, on Cold Bay on the Alaska Peninsula east of Dutch Harbor, and at Fort Glenn, on Umnak to the west, newly established air bases guarded the Alaskan approaches. There were garrisons on the Bristol Bay side of the Alaska Peninsula at Naknek, and at Port Heiden, where Fort Morrow was located. To the westward, in the Bering Sea, St. Paul and St. George Islands of the Pribilof group were first evacuated of whites and natives engaged in sealing activities, then garrisoned against possible invasion.

The Command Network

Wherever the American forces went, specialists of the Signal Corps' Alaska Communication System (ACS) had work to do.[2] As the war progressed and the westward expansion into the Aleutians inched forward, the ACS engineered, constructed, maintained, and operated a vast radio, ocean cable, and landline communications system which knit American bases and connected them with the Alaskan mainland and with the United States. After 25 March 1942 the ACS also engineered and built almost all fixed communications: post telephone systems, harbor defense control systems, radar installations, and the Army Airways Communications System for the

[1] AAF Historical Study 4, Alaskan Air Defense and the Japanese Invasion of the Aleutians, p. 28, citing Memo, Marshall for President, 21 Jan 42, in WP II–C–1 Alaska 1. AF Archives.

[2] For a discussion of prewar organization of the ACS and its place in the Alaskan defense scheme, see Terrett, *The Emergency*, pp. 275–79.

north ferry routes. Almost as a side line, the ACS handled a substantial part of all signal security and surveillance activities.[3]

Three months before war began, the War Department's disapproval of General DeWitt's plea for a separate command radio net for the Alaska Defense Command (ADC) and its decision to substitute a supplementary command network operated by the Alaska Comunication System but controlled by the ADC had sent the Signal Corps into action gathering together the necessary men, materials, and equipment.[4] By the middle of January 1942 the veteran 1st Signal Service Company, which operated the ACS, had slowly risen almost to its maximum allowed strength.[5] It was authorized 471 men, and had 468. The state of actual warfare, however, expanded everything, and emergency tables of organization were being thrown overboard. In accord with the policy everywhere, the 1st Signal Service Company was asking to commission its most highly skilled men, and to enlist as many more as possible. One hundred and twenty-four men were currently receiving instruction at the ACS school at Seattle, and 110 recruits, basic military training.[6] Additional authorizations which followed quickly—for 150 men in February, for 50 in March, for 245 in April—brought the authorized strength to 916 men, although actual strength at the end of April totaled only 671.[7]

These men, plus a small group of civilian employees at the Seattle headquarters, comprised the operators of the ACS radio network, which with its connecting lines was already an elaborate installation by 1 January 1942, even though the expansion had barely started. There were radiotelegraph, and often radiotelephone facilities as well, at twenty-three stations besides Seattle, from Annette in southeastern Alaska to Point Barrow in the far north. In addition to those two, the stations were Ketchikan, Craig, Wrangell, Petersburg, Juneau, Sitka, Haines, Skagway, Yakutat, Cordova, Valdez, Anchorage, Seward, Kodiak, Kanakanak, Bethel, Flat, Nulato, Fairbanks, Nome, and Kotzebue. All the stations had radio channels or landlines reaching out to commercial stations or numerous other stations maintained by the Navy, the Coast Guard, the Department of Interior, the Bureau of Fisheries, the Civil Aeronautics Administration, and the Canadian Government.[8]

For the administrative network necessary to meet the wartime needs of the Alaska Defense Command, however, the existing facilities were not enough. The expansion

[3] (1) History of the Alaska Communication System (1945), Pt. II, Foreword, "The Aleutian Movement" (hereafter cited as Hist of ACS), pp. 1–4. (See Bibliographical Note.) Bound MS copy in SigC Hist Sec File. (2) Hist Sec, Alaskan Dept, Official History of the Alaskan Department, Ch. XIV, "Communications," *passim*. Bound MS copy in OCMH.

[4] (1) Ltr, CG Western Defense Comd, to TAG, 1 Aug 41, sub: Alaska Sig com; (2) 2d Ind, CSigO to TAG, 26 Aug 41; (3) 3d Ind, TAG to CSigO, 11 Sep 41; (4) 4th Ind, CSigO to TAG, 16 Sep 41; (5) 6th Ind, CG Western Defense Comd to TAG, 24 Sep 41; (6) Msg, O/C ACS to CSigO, 22 Oct 41; (7) Ltr, CG Western Defense Comd to CofS, 14 Oct 41. SigC AC–60 (676 ACS Expansion). (8) Hist of Alaskan Dept cited n. 3 (2), p. 317.

[5] The unit dated from 14 February 1918. WD GO 18, 14 Feb 18. It was redesignated the 971st Signal Service Company on 10 May 1943.

[6] Ltr, O/C ACS to CSigO, 12 Feb 42, sub: Biweekly rpt on opns and expansion of ACS. SigC AC–25.

[7] First Draft, Alaskan Communication System History (hereafter cited as First Draft, Hist of ACS), p. 175. (See Bibliographical Note.) Bound MS copy in SigC Hist Sec File.

[8] (1) O/C ACS Rpt, Radio Facilities of ACS, 25 Apr 41. SigC AC–63. (2) First Draft, Hist of ACS, p. 126, App. 38, Chart of ACS and Connecting Lines, 1 Jan 42.

plan involved setting up ten new ADC stations, and enlarging eleven existing ACS stations. One step provided for restoration of the Seattle-Seward ocean cable to permit secret communication between the Alaska Defense Command and the Western Defense Command headquarters at San Francisco. This cable was put into operation on 3 December 1941.[9]

A limited radio net, the first section of the ADC net, could be brought into being immediately, according to the November 1941 planning. It would consist of the control station at Anchorage, and substations at Kodiak, Seward, Yakutat, and possibly at Annette Island. Accordingly, the ACS placed orders for equipment to provide a carrier telegraph circuit between Anchorage and Fairbanks, and a Morse circuit between Seward and Anchorage, both to operate over the open-wire lines of the Alaska Railroad. These telegraph circuits would operate exclusively in the ADC administrative net, thus avoiding the necessity for procuring special radio transmitters for Fairbanks and Seward.

Meanwhile the ACS at Seattle overhauled all transmitters and other technical equipment available there, and prepared it for shipment to Anchorage. Before it could be shipped, war struck, and the material had to wait for the hard-pressed Navy convoy escort vessels. The project was so urgent, however, that the ACS felt compelled to get the work started at once, using such items of equipment as could be found to make temporary installations which would be replaced whenever more material became available This was the pattern that the ACS followed in every case.

[9] Msg, ACS Seattle to CG Fourth Army Presidio, 3 Dec 41. SigC 413.4 No. 1.

The Anchorage station, WXFA, came into the ADC net on 20 January. Work started in February with the new materials, but by that time new stations were coming into the net so rapidly that installations had to be made in a somewhat haphazard manner to keep ahead. Antennas went up in spots not entirely suitable. Temporary control lines had to be strung to the transmitter and receiver stations, and more operating tables moved into an already crowded operating room. The ACS made arrangements for its stations WVD, Seattle, and WXE, Anchorage, to use Civil Aeronautics Administration sending and receiving equipment. In the event that enemy action or anything else rendered the main control cables inoperative, auxiliary ultrahigh frequency equipment was installed at West Seattle and at Fort Lawton to provide three extra channels for transmitting and receiving. Anchorage was the heart of the communication system; the circuits were the arteries and veins which supplied the lifeblood. Four types of radio circuits (high-speed, manual, teletype, and radiotelephone) and landline and telegraph circuits came into Anchorage. Until late in the war, when the westward movement had pushed beyond Alaska and the Aleutians to encircle the Japanese homeland, Anchorage was always in the throes of expansion, improvement, and change. By the first of June 1942, it had progressed to the point where it could keep ahead of the new activities and accommodate additional stations as they came into the network.[10]

[10] (1) Ltrs, O/C ACS to CSigO, 9 Mar 42 and 20 May 42, sub: Biweekly rpt on opns and expansion of ACS. SigC AC–25. (2) Hist of ACS, Pt. III, "Anchorage," pp. 4–5. (3) First Draft, Hist of ACS, pp. 179–84.

Kodiak, Otter Point, Dutch Harbor

In the first weeks of war, the expansion plans moved anxiously forward toward Dutch Harbor and Otter Point on Umnak. Continuous wave transmission at both medium and high frequencies from there to ADC headquarters at Anchorage would be provided, with each of the two new stations manned by three ACS operators.[11] By the last week of December, Cold Bay and Port Heiden on the Pacific side of the Alaska Peninsula had been added to the lengthening list of ACS stations. The Seattle district engineer of the Corps of Engineers had agreed to undertake construction of buildings to house the equipment and men. At Seattle the ACS was ransacking its stores for extra equipment which could be thrown into use at the new stations temporarily, regular equipment not being expected for a matter of several months. Each of the two construction parties, with an officer at the head, was to consist of only six soldiers and five civilians. Three of the soldiers in each party were to remain behind, when temporary construction had been completed, to establish initial communications.[12]

In refurbishing and enlarging the eleven existing ACS stations included in the expansion program, there could be no thought of complete uniformity of equipment. Those stations, built in the peaceful years when the Army budget was lean, contained a collection of equipment of such variety as the budget had happened to permit during the particular year when each was built. Among the transmitters were several models of the DBR–1, put together in the ACS shop, and known as the "Damn Big Rush" because of the haste and improvisation which had gone into its construction. The new equipment to be added would all be of the same standard design used in the new Alaska Defense Command stations. It included one medium-frequency 750-watt transmitter (an obsolete marine transmitter completely rebuilt and modernized in the ACS shop at Seattle); one high-frequency 300-watt transmitter; two 15-kva auxiliary power plants; an operating table and control equipment; six combination high and medium-frequency receivers; and a complete transmitting and receiving antenna and ground system, along with Quonset huts to house both the equipment and the men.[13]

Although Anchorage held first priority in the expansion of the Alaska Communication System stations, twenty others followed closely. In order came Kodiak, Otter Point, Dutch Harbor, and Yakutat, at all of which construction was under way by April, Cordova, Sitka, Fairbanks, Juneau, and a dozen others.[14]

Mountainous Kodiak Island, which lies at the mouth of Cook Inlet and forms the irregular western shore of the Gulf of Alaska, was of particular value strategically. The Navy had its main base there; and nearby the Army had built Fort Greely and named it in honor of the Signal Corps' famed Chief Signal Officer and founder of the Alaska system, Brig. Gen. Adolphus W. Greely. When the Navy began building there in 1939, it found a small ACS station already on hand in Kodiak village, a settlement of Indian fishermen. Now in early 1942 the

[11] Ltr, O/C ACS to CSigO, 16 Dec 41, sub: Progress rpt of instls at Dutch Harbor and Otter Point. SigC AC–25.

[12] Ltr, O/C ACS to CSigO, 22 Dec 41, sub: Prog rpt on instls of new stations in ADC expansion program. SigC AC–25.

[13] First Draft, Hist of ACS, p. 180.

[14] Ltr, O/C ACS to CSigO, 7 Apr 42, sub: Biweekly rpt on opns and expansion of ACS. SigC AC–25.

station was being enlarged to include a direct Seattle-Kodiak high-speed radio circuit, an ADC tactical circuit, equipment for the aircraft warning flash radio net, and fire control circuits for harbor defenses. Freezing temperatures and high winds hampered the work, but on 11 May the Kodiak-Seattle direct circuit was established. In the same month, an ACS engineer arrived to take charge of the enlargement and installation of the Fort Greely post telephone system; a private contractor hired by the Navy had started it, but his work had been unsatisfactory to the post commander.[15]

In order of urgency after Anchorage and Kodiak ranked the Otter Point project (Fort Glenn) on Umnak Island, where an important airfield was being built, and the ACS station at Fort Mears, the Army post at Dutch Harbor on Unalaska Island. One of the small Signal Corps groups organized at Seattle and 1st Lt. Richard R. Murray had arrived in the area in February. Through contrast, the two projects pointed up the peculiar difficulties of Alaskan defense construction. Unalaska Island had fine harbors, but surrounding high hills and mountains offered little space for air facilities. Separated from Unalaska only by the twelve miles of open water constituting Umnak Pass, Umnak Island lay low and flat; its terrain invited airfield construction, but there were no harbors where ships could anchor to bring in supplies.

Since the Navy had good radio facilities already in operation at the big base at Dutch Harbor, the Otter Point station drew Murray's attention first. The base which was to become Fort Glenn was still a-building, with post headquarters temporarily located at Chernofski, the most westward point on Unalaska and the one closest to Otter Point across Umnak Pass. The only communication was a tactical radiotelephone set operated by Coast Artillery men in an abandoned Aleut Indian hut at Chernofski. This set worked the Coast Artillery set atop Mount Ballyhoo, near Dutch Harbor. Although the channel could handle both continuous wave (code) and voice, there were no code operators, so messages went out by voice, the phonetic alphabet being used for enciphered messages. Across the pass at Otter Point, a Quartermaster soldier operated a battery set borrowed from a Navy gunboat. This set weighed almost 100 pounds, but was not very powerful. The men had developed a sort of double-talk as an informal cryptographic procedure when discussing shipments on the air.

The channel of communication from the United States to what would become Fort Glenn was from Seattle to Anchorage by Alaska Communication System facilities; then by relay to NPR, the Navy station at Dutch Harbor; then (by teletype if it happened to be operating and by messenger if it was not) to Fort Mears' post headquarters; then to the post cryptographic unit for deciphering; on to the commanding general for his attention; after editing, back to the cryptographic unit to be enciphered once more; then by messenger once a day to the Coast Artillery set on Mount Ballyhoo; via that set to Chernofski; and finally, via voice radio to the old gunboat set at Otter Point. It took three or four days for messages to arrive from the United States and, because of the numerous relays and handlings, much of the message matter was badly garbled by the time it reached the ultimate recipient.[16]

Murray put three men trained in continuous wave transmission in each of the three stations at Chernofski, Otter Point,

[15] Hist of ACS, Pt. III, "Kodiak," pp. 1–4.

[16] *Ibid.*, Pt. III, "Fort Glenn," pp. 1–4.

and Mount Ballyhoo. This speeded up matters appreciably. He installed a small Intervox radiotelephone transmitter and receiver in a hut at Chernofski, and erected an antenna for use with a similar set at Otter Point. This system and a ship-to-shore radio set installed on a tug took care of ship and barge movements between Otter Point and Chernofski. Meanwhile, the radio equipment for the ACS station at Otter Point had arrived ahead of the men who would install it. They had been delayed en route by the grounding of their transport. The equipment was stored in tents on the beach at Chernofski until it could be moved by barge across Umnak Pass. There were only five barges to move material, and food and ammunition for the troops at Otter Point had first priority. In succeeding months, the ACS men were to learn much of the difficulties of transshipping to Otter Point. The number of supply ships coming in exceeded the number of tugs and barges available to haul the material across the pass. Boxes containing material which might be a part of a project shipment often got separated from other boxes of a unit. Each organization wanted its equipment moved first. The post commander finally issued an order prohibiting expediters from individual units from going to Chernofski at all, since, as an ACS liteutenant once radioed, there would be "twenty or thirty persons on the beach at Chernofski cutting each other's throats to get their equipment moved first."

Even though the material for the first project was all gathered at Chernofski, Lieutenant Murray learned that it might be several weeks before he could get it across the pass. When it was shipped to Otter Point the second week in March, the men were left at Chernofski without any immediate prospect of passage. A Navy destroyer finally took them and their baggage across, and they arrived at 1600 on 13 March, only to find that there were no living quarters or tents available to them. Before nightfall, a carpenter put up a structure known as a Yakutat hut, a windowless affair 16 by 16 feet in size. This building housed 9 men, but a month later a housing shortage developed when 6 more soldiers arrived from Seattle. Now the hut had to serve as shelter for 15 persons.

By April all the antenna poles for the radio station were up, and the wiring and equipment installed in the main building: a 20 by 20-foot frame structure erected on the flat eastern end of Umnak Island. The power plant was sheltered in a tent.[17]

When this station serving Fort Glenn opened for business on 20 March under the call letters WXFN, its messages for the United States could be relayed to Anchorage, which relayed them back to the Navy station at Dutch Harbor. Here they were turned over to the commanding general for editing, censorship, or approval, after which they were enciphered again, returned to the Navy station, and retransmitted to Anchorage and thence to the United States over ACS facilities. This awkward backtracking was far from satisfactory, but the Coast Artillery station at Dutch Harbor operated on a flash warning net of 2,092 kilocycles, and the nearest frequency on which WXFN could meet it was 3,885 kilocycles. To receive signals from WXFN the operator at Dutch Harbor had not only to listen at 3,885 kilocycles, but also had to leave the flash warning net, since the station had only one battery-operated receiver. It was impossible to use any of the ACS receivers because no 110-volt power supply was available.

[17] *Ibid.*, Pt. III, "Fort Glenn," pp. 1–5.

This meant a return to the old system of landline telephone circuits, radio stations, radiotelephones, and messengers. In an effort to eliminate the cumbersome procedure, Lieutenant Murray hurried back to Dutch Harbor to set up a temporary station there.

A temporary site on the swampy floor of Unalaska Valley offered excellent grounding possibilities, unusual in the Aleutians, where the loose, porous volcanic ash, which was the chief component of the soil, made grounding difficult. Putting in 70-foot antenna poles, built of 15-foot 4 by 4 timbers spliced together with bolts, presented numerous difficulties. Not the least of these was the problem of getting tractors, since there was a shortage of such motive power, and the tractors on hand were constantly busy hauling guns, ammunition, and supplies to points otherwise inaccessible. The men working on the antenna poles always needed at least two tractors, because one often bogged down in the swampy ground and needed the other to pull it out of the mud. Each pole had to be sunk 5 feet in the top of a 20-foot hummock of earth, for an effective height of 85 feet, and braced and steadied by guy wires attached to foot-thick piling butts buried 5 feet deep.

Despite the hazards imposed by the unpredictable Aleutian weather, including a 100-mile gale which swept through the valley while the men were checking guy wires, the temporary station went into operation within a week's time, making contact first with Kanakanak, then Fort Glenn, and finally Anchorage. On 5 April the station took over all Army traffic from the Navy station NPR, and inaugurated commercial traffic on 3 May.[18]

[18] *Ibid.*, Pt. III, "Dutch Harbor—Before and After Bombing," pp. 6–13.

The Attack on Dutch Harbor

By mid-May 1942 Army and Navy commanders had been alerted for an imminent attack in the Aleutians.[19] At the Navy base at Dutch Harbor, the Army post at Fort Mears on Unalaska Island, and the airfields at Fort Randall to the east and Fort Glenn to the west, the meager military forces were disposed as advantageously as possible to meet the attack, which intelligence sources estimated would occur the first week in June.[20] At the temporary ACS station at Dutch Harbor, Lieutenant Murray and his little crew of Signal Corps soldiers and civilians buried the spare cash and a supply of radio tubes behind the station, readied slit trenches, and rehearsed arrangements to burn the building and destroy the transmitter if the post was overrun.[21]

On the morning of 3 June, radar on board a seaplane tender in the harbor detected the approach of enemy aircraft at 0540.[22] In the ACS radio station, a sergeant tapped out a telegraph message for Anchorage: "Fort Mears is about to be bombed by enemy planes." Then he hastily sought better shelter, for by that time Japanese fighter planes were strafing the area. The two enemy air strikes at Dutch Harbor that morning destroyed or damaged a number of Army and Navy installations. The most critical blow of all, in the opinion of Air Forces' director of communications, Col-

[19] (1) Samuel Eliot Morison, *History of United States Naval Operations in World War II:* IV, *Coral Sea, Midway and Submarine Actions, May 1942–August 1942* (Boston: Little, Brown and Company, 1950), 165–74. (2) Craven and Cate, *The Army Air Forces*, I, 464.

[20] Morison, *History of U. S. Naval Operations*, IV, p. 166.

[21] Hist of ACS, Pt. III, "Dutch Harbor," p. 1.

[22] Morison, *History of U. S. Naval Operations*, IV, p. 176.

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onel Marriner, was the loss of Signal Corps equipment intended for a radar installation at Cape Wislow on Unalaska Island. This equipment and a medium-frequency radio transmitter were destroyed in a warehouse fire touched off by the bombing at Fort Mears. Replacements were not available except at the cost of sets scheduled for delivery to the South Pacific bases.[23]

The next day, when the enemy fighters, dive bombers, and high-level bombers returned for another attack, they struck repeatedly at the Navy radio station, particularly at the steel towers. They scored no direct hits, but they smashed tubes and knocked down the receiving antennas. No planes came near the ACS station, which continued to handle communications for the area while the Navy station, with its receiving antennas knocked out, could only send "blind." Apparently the Japanese did not suspect the presence of a second station at Dutch Harbor, since they concentrated their attack on the Navy towers. The ACS station no doubt escaped notice because its antenna poles were grouped inconspicuously, near a number of power poles. From the air it was difficult to detect.

Across Umnak Pass at Fort Glenn, the Japanese were unpleasantly surprised to find an American airbase at their backs. In the fog and mist which covered the islands, the Japanese did not notice the Umnak airstrip on the first raid, but found an obvious target in the Alaska Communication System station standing in the open on the flat beach, surrounded by antenna poles. Fighters strafed the station area with machine gun fire, but inflicted no damage. On the second day, the invaders did not get near the station, possibly because this time the Japanese planes from one carrier had unwittingly selected the western end of Unalaska Island as their rally point. There they were met by American fighters from Fort Glenn, P–40's which engaged the Japanese dive bombers and fighters in air battles through the 500-foot overcast.[24]

The Repercussions of Dutch Harbor

The Japanese had planned the Aleutian attack as the northward prong of a coordinated campaign reaching out into the Central Pacific toward Midway Island. The southward prong was snapped off by the naval and air battle of 3–6 June off Midway Island. Though the Japanese plan to take Midway had failed, the Aleutian attack had yielded a consolation prize. Between 7 and 21 June, the enemy forces occupied Attu and Kiska in the outer Aleutians. To prevent development of either island as a major enemy base was important. Wherever American forces garrisoned Alaska, reinforcements now moved in. Crews worked harder and longer on the Alcan Highway, the military supply road begun in March 1942 and now pushing up north on its inland route. Communication projects not yet completed assumed greater urgency, and plans for new ones were born.

At Dutch Harbor, meanwhile, Lieutenant Murray had been fretting over delays in building the permanent Alaska Communication System station. As a matter of fact, until the Japanese attack, the plans for a permanent Army communication station in the Dutch Harbor area were not firm. It was felt that perhaps the Navy station

[23] (1) Craven and Cate, *The Army Air Forces,* I, 469. (2) Hist of ACS, Pt. III, "Dutch Harbor," pp. 2–5.

[24] (1) Hist of ACS, Pt. III, "Fort Glenn," pp. 5–6. (2) Craven and Cate, *The Army Air Forces,* I, 466–67.

should handle military communications for Dutch Harbor, primarily a Navy base, while the ACS temporary station acted as an auxiliary. After the bombings, doubts about the need for more communication facilities vanished. Orders went out to erect a bombproof shelter for the permanent ACS station, and to connect Dutch Harbor and the Fort Glenn airfield by an ocean cable to provide communication privacy.

While crews blasted away a rocky hillside to provide the bombproof shelter, the cableship *Restorer* came up from her previous assignment at Petersburg in southwestern Alaska to make the Mears-Glenn lay. Still in her holds were about 120 miles of deep-sea repair stock cable belonging to a commercial company. This cable contained almost 500 pounds of copper per mile, four times as much as was contained in the cable the ACS used ordinarily. But as it turned out, it was also the only cable available anywhere on the west coast, and the ACS requisitioned it at a cost of $154,482.[25]

The actual laying of the cable proved to be uneventful. The weather was best at that time of year, and the *Restorer* made the run from Juneau to Dutch Harbor in ten days. Thick fog and high winds ate up three days' time, but within a week the 73-mile lay between Fort Mears and Fort Glenn was completed, as well as the 12-mile lay across Umnak Pass to Chernofski. The cables opened for traffic late on 1 July 1942.[26]

The cable gave trouble at first. Initially, it was a problem of different transmitting procedures; at one end of the line the ACS operators used one sort, while at the other, tactical operators used another. Then the poorly insulated field wire landlines at the end proved unable to withstand the ravages of tractor cleats, and the circuit had to be rerouted through post telephone cables located conveniently nearby. Trouble with the shore-end cables developed next. With no heavy-duty cable available, the smaller deep-sea cable had been run right up to the cable huts on the beach. But the rough, rocky beaches and the frequent storms soon damaged the shore ends of the cable, and ship anchors broke it. The *Restorer* came back in September, repaired the cable, and substituted heavier shore-end lines.[27] After that the cable operated so successfully that late in the year the commanding general of the Western Defense Command asked for a complete cable system connecting Anchorage with all stations on the Aleutian chain.[28]

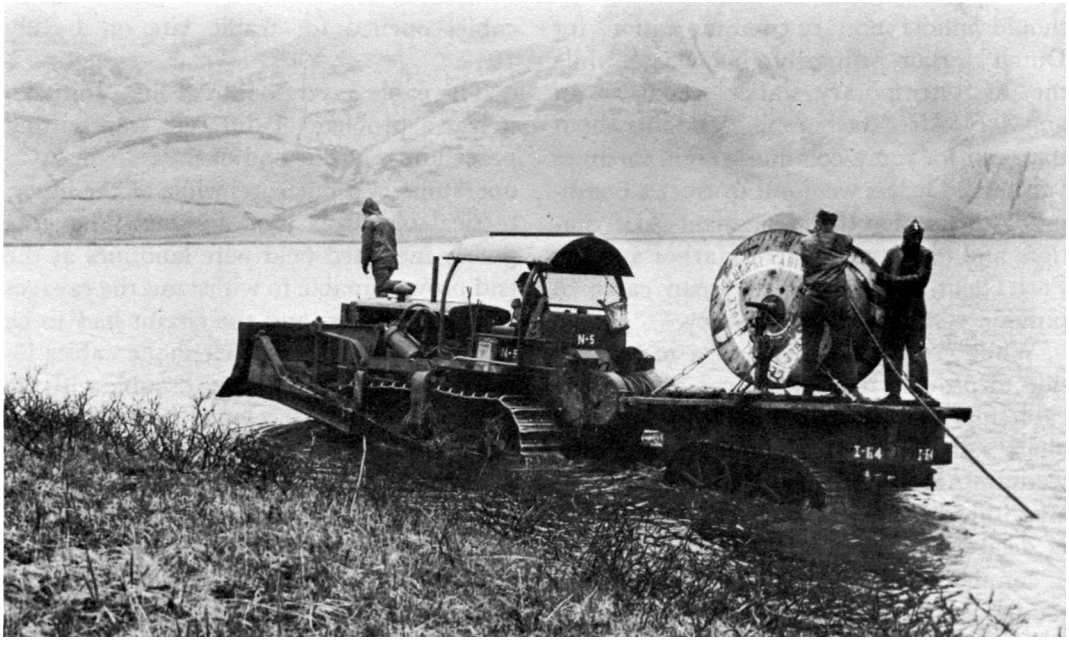
Of the ten new Alaska Defense Command stations to be built, six had not yet been started when Dutch Harbor was attacked. They were Boundary, later known as Northway, Big Delta, Gulkana, Galena, Naknek, and the Bethel airfield station. The material had been on hand in Seattle since April, but shipping space was scarce, and the ACS engineering organization which would handle the projects had not been completed. Now the matter could wait no longer. Emergency stations must go in at once. Col. Fred Andrews, chief of the Alaska Commu-

[25] Hist of ACS, Pt. III, "Dutch Harbor," p. 16, and "Foreword to Voyages of Cableships," *passim*. The lack of cable and cable machinery led directly to the development of a new American industry, cable machinery design and manufacture. Previously such equipment had always come from England, but by the close of the war, a thriving development was under way by a Seattle concern, Sundfelt Equipment Company. History of the Plant Engineering Agency, p. 214. SigC Hist Sec File.

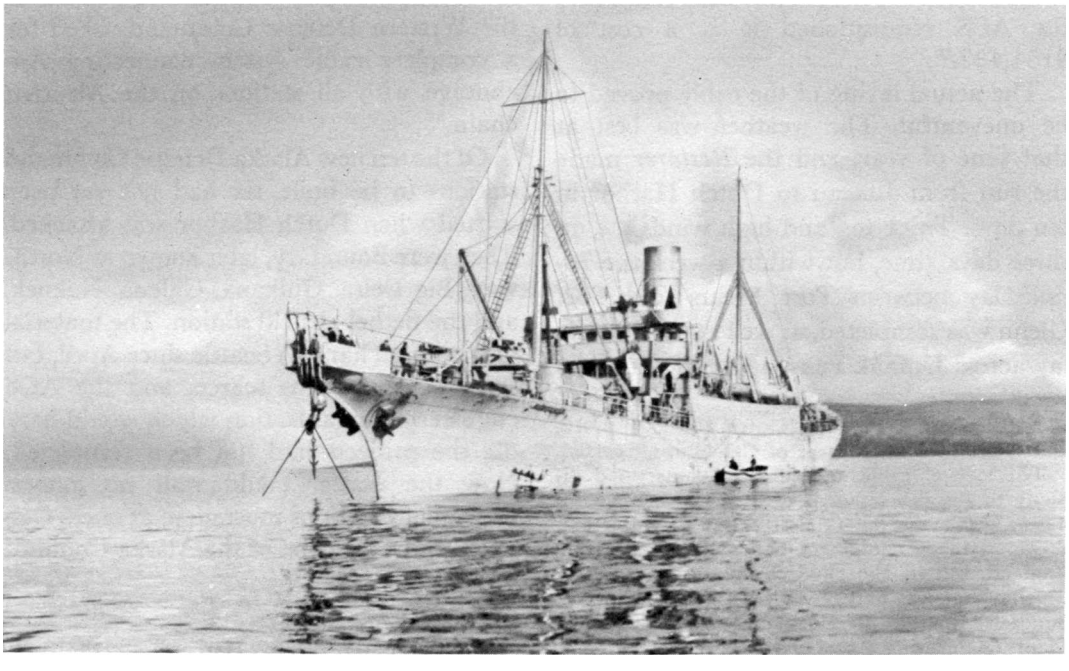
[26] Hist of ACS Pt. III, "Wartime Voyages of Cableship *Restorer*," pp. 1–13.

[27] *Ibid.*, Pt. III, "Dutch Harbor," pp. 16–18.

[28] Hist of Alaskan Dept, p. 327.



CABLE-LAYING OPERATIONS IN ALASKA. *Cable is shown being laid along the shore at Fort Mears, above. Below, the cableship Restorer.*



nication System, sent Maj. Charles F. Felstead northward to build the stations and set up the engineering organization without further delay.

Major Felstead and Alfred K. Robinson, chief civilian radio engineer for the ACS, arrived in Fairbanks on 17 June. Within twenty-four hours they had combed the town for good radio receivers and transmitters, and had bought four of each from local radio amateurs. They had located a fifth set, owned by the ACS operator at Bethel, M. Sgt. Kenneth A. Vandewater. They had commandeered six trained men from the Fairbanks ACS station, and had formed them into three two-man teams, one operator and one technician to a team. They had furnished each team with a transmitter and a receiver, a doublet antenna already cut to frequency, a telegraph key and headphones, and switches for transferring the antenna from transmitting to receiving. They had persuaded the Civil Aeronautics Administration to give the new stations temporary houseroom in CAA station buildings at each site, and to provide power from CAA power supply units.

Early on the morning of the second day, the three teams set out from Fairbanks with their radio equipment, sleeping bags, and a week's supply of C rations. They headed southeast, one team traveling by commercial airplane for Northway, near the Yukon Territory line, while the others drove ACS trucks southeast on the Richardson Highway to Big Delta, at the junction of the Tanana and Delta Rivers, and then farther south to Gulkana on the Gulkana and Copper Rivers.

Those were the longest days of the year. The sun barely dipped below the horizon for an hour each night, and the men, snatching only a few hours' sleep, worked almost around the clock. In that heavily wooded section of Alaska there was no need to set antenna poles; trees would do.

By evening of 19 June radio contact was established between Northway, Big Delta, and Fairbanks. By the next day Gulkana was on the air and in contact with Big Delta and Anchorage. Meanwhile, to the southwest of Fairbanks at the Bethel station on the Kuskokwim River, Sergeant Vandewater had sent a man across the river to the site of the proposed Army airfield to establish a temporary ADC station. It was in contact with the Bethel station on 20 June. By that time, the technical men from each of the installation teams sent to Northway and Big Delta had returned to Fairbanks, leaving the operators behind to man the stations. The technicians started out again with the last of their receivers and transmitters, this time due west for Galena. Within twelve hours that station, too, was in operation.

Thus within a space of three days and in a giant circle from Fairbanks, five of the six remaining stations of the Alaska Defense Command now were put in operation on an emergency basis. A week later Engineer troops arrived at these points to establish construction camps. The regular equipment for the permanent stations, delayed by lack of shipping space, did not arrive until July.[29]

Naknek, the site of the sixth station southeast of Fairbanks on Bristol Bay, was still partially iced in when Dutch Harbor was attacked. ACS engineers were already on the spot waiting when a task force vessel anchored off shore on 3 July and started lightering men and equipment ashore at high tide, the only time barges could ply

[29] First Draft, Hist of ACS, pp. 200–202.

the shallow river. The station went on the air the next day, 4 July, relaying through Kanakanak, and a month later made contact with Anchorage to complete the first phase of the northern chain.[30]

Of the eleven existing ACS stations originally slated for expansion, Sitka had been rather far down on the list. Now as the site of the third-ranking naval base in Alaska it acquired new importance. With a crew of eight enlisted men and one civilian engineer, 1st Lt. Charles M. Beach arrived at Sitka in mid-June to remove the transmitter from its location in the middle of town to a remote site several miles away. He was also to construct a control cable from the operation site in Sitka to the transmitter site and to rearrange the operations layout.

Because Sitka, the old Russian capital of Alaska on Baranof Island in southeastern Alaska, lies in a heavily wooded area, the Seattle headquarters had assumed that poles would be available locally. Beach found that actually there were none to be had, and there were no logging operations going on in the vicinity. He and his crew turned loggers for a few weeks and cut their own poles, including several 90-footers. This situation immediately increased their difficulties, for the weight of a green pole is three times that of a seasoned one. To add to his woes, the lieutenant found that although he had six men fresh from a three months' training course at Fort Monmouth and classified as linemen, five of them had never had on a pair of climbers, much less climbed a pole. He set out to teach his "linemen" a lineman's most fundamental requirement.[31]

Meanwhile, no one was sure what had happened in the Pribilof Islands. Rumor had it that the Japanese had occupied the tiny, isolated islands in the Bering Sea, and were preparing to move against the mainland to take Nome. In peacetime the islands operated under the jurisdiction of the Fish and Wildlife Service, but natives and government officials had been evacuated hurriedly after the Dutch Harbor attack. On Sunday morning, 7 June, ACS headquarters at Anchorage received orders to get four men ready to leave that afternoon for an unknown destination. There was no time to pick and choose; four privates were selected at random out of a group of newly arrived men, and told to get ready to leave with the Army intelligence teams, which, they eventually learned, were headed for the Pribilofs. Two ACS men were to be stationed at St. Paul, and two at St. George.

When the first pair, Privates Mackie and Phillips, arrived at their destination on St. Paul Island on 22 June, they found the area deserted but unmolested. In hurried flight after the Dutch Harbor bombings, the natives had left everything they could not carry with them. The two soldiers, furnished with emergency equipment only, had been told to make use of anything still left on the island. They established contact the first day with the other two operators at St. George, and then set about energetically taking stock of material on hand and helping to set up the outpost. They started 24-hour radio watch, insofar as the equipment would permit, rigged blasts which could destroy the radio station in case of attack, and settled down to the job of repairing and improving facilities, working usually 16 to 17 hours a day. Traffic was light; the men sent out one message a day, and few came in. During flying hours they kept continuous watch on aviation frequencies for flash information. On St. George Island, the second team led a simi-

[30] Hist of ACS, Pt. III, "Naknek," pp. 1–3.
[31] *Ibid.*, Pt. III, "Sitka," pp. 1–5.

lar existence. By August the men were apprehensive about what life would be like on the barren islands during the winter. Then came word that troops would be landed before winter, and the outposts manned.

This was the beginning of the stations in the Pribilofs: a matter-of-fact handling of a difficult and dangerous assignment that was to earn all four young soldiers praise from Colonel Andrews, who pointed out their "unusually capable solution of field engineering problems that would normally have called for engineer or non-commissioned officers of considerably greater rank and experience." [32]

Signal equipment for the Fort Morrow station at Port Heiden on Bristol Bay left Seattle in late June with the Engineer troops, and 1st Lt. Harold A. Cordes took along a portable 30-watt transmitter, receiver, generator, and antenna. When four more ACS men arrived at the station a few days after the first group, they brought with them a 100-watt transmitter capable of contact with Anchorage. The men still lacked many things they needed to build the station: several kinds of wire, fittings and couplings, insulators, cement, rope, gasoline, and oil. Ingenuity cured some shortages; for example, no bowl-type insulators were sent, so the men used two kitchen mixing bowls. Borrowing overcame other shortages. Lacking enough wooden poles for transmission lines and antennas, they borrowed wooden pilings from the Engineers. The miscellaneous shortages were funny but exasperating: there were only three legs for the operations table; a heating stove, but no cook stove; an ironing board, but no iron; ten doors for Quonset huts, but no hardware with which to hang them.[33]

[32] *Ibid.*, Pt. III, "Lonely Vigils in the Pribilofs," pp. 1–11.

[33] *Ibid.*, Pt. III, "Fort Morrow," pp. 1–11.

Hasty outfitting for the project accounted for some deficiences, but to a greater degree they reflected the universal shortage of materials and shipping space. Supply agencies had to shortchange many a requisition, sending half a supply-loaf in the hope that it would be better than none at all. Troops in Alaska lacked many items in the summer of 1942; among others, field switchboard equipment, telephones, and wire, requisitions for which remained unfilled.[34] To men living in remote posts under the threat of enemy attack and without adequate communications protection, the shortage of equipment in the early part of the war was often incomprehensible. It was natural that they should see only their own problem, and not see it in relation to the whole war situation. It was difficult for them to understand that their lack of equipment was not a malignant fault of Army red tape or negligence. Officers who might be inexperienced in military supply matters had small realization of the time involved in producing and transporting material, in mobilizing and training men, or of the greater urgency of the situation at other points on the world-wide battlefield. In April 1942, an officer stationed at Anchorage made a plea for a "small reserve" of 15 student radio operators, six emergency power units with some cable, two complete high-frequency and two low-frequency radio stations, and four complete transceivers of a type similar to the walkie-talkie sets. It was not too much to ask in order to bring about the service which the station wanted to provide. It was, however, more than a hard-pressed Signal Corps could give under the carefully con-

[34] Rpt, Lt Col W. C. Henry, SigC, to Dir of Army Com Sv, sub: SigC svs and facilities in Alaska as of 20 Aug 42. Hereafter cited as Henry Rpt. SigC 319.1, Inspec Rpts, 1.

sidered priorities of men and materials at that time.[35]

To alleviate the supply problem in Alaska was precisely the task of the Anchorage engineering and supply division which Major Felstead had been directed to set up. It could not create material where none existed, but it could solve many a problem imposed by time and distance. It could even build or improvise equipment from odds and ends of material purchased locally. Best of all, to a certain extent it could reassure the men in the field that they were not forgotten. When Major Felstead flew to Anchorage from Fairbanks on 21 June, he found the town already overflowing with war workers and government agencies. The only space available to the Alaska Communication System was a single large room in the basement of the Federal Building. There on a stool at the drafting table in the otherwise empty room Major Felstead found his office force: a single disconsolate soldier who had been assigned to occupy the room during the day to prevent its confiscation by some other government agency in the building.

During the next few weeks the engineering section grew up, its growing marked by battles for more office space, more personnel, more equipment, more motor transportation. By August warehouse space had overflowed the 25 by 100-foot chicken house, which was the only spot available at first, into a three-story building that provided 10,000 feet of floor space. The organization included a purchasing section to acquire local material, and a separate clothing section which outfitted newly arrived personnel. As time went by, the constant movement of engineering and construction men through Anchorage made the clothing section particularly valuable. Often men arrived in Anchorage without the proper clothing for the particular location where they were to be stationed. In northern Alaska, they needed heavy parkas, kerseylined trousers, and boots or overshoes, but in the Aleutian area, they required lighter clothing with rubberized parkas and trousers to keep out the perpetual dampness. The engineering organization still lacked adequate office space. In August 7 officers, 1 warrant officer, 34 enlisted men, and 6 civilians comprised the staff. The supply warehouse and motor transportation men were stationed at the warehouse, and the engineers were usually in the field, but the 27 people stationed at the main office fell over one another trying to crowd themselves in at their desks in the single basement room. Major Felstead appealed to General Buckner to intercede for an order from Washington evacuating from the building all organizations whose work was not essential to the war effort. This effort bore fruit in August.[36]

The Alcan Highway

When, in March 1942, American engineers about to begin work on the Alcan Highway jumped off into the Canadian wilderness from the railhead at Dawson Creek, British Columbia, they had to have communications, first at their base camp in Fort St. John, forty miles beyond Dawson Creek, and later at successive camps along the trail as they pushed toward Alaska.

[35] Ltr, O/C Anchorage, Alaska, to O/C ACS, 15 Apr 42, sub: Res equip, apparatus and pers, Anchorage. SigC ACS (PEA, Philadelphia).

[36] (1) Rpt 4, Army Com Br OCSigO to Prog and Stat Br, 20 Aug 42. SigC AC 319.1 Digest, 30 Jul 42–1 Dec 44. (2) First Draft, Hist of ACS, pp. 202–07.

Also their construction parties needed mobile communication units to keep contact with their bases. Three types of communications were planned to serve the pioneer tote road and later the completed highway: radio, telephone, and teletype, in that order. Radio, the most portable and easily installed, would go in first. After it would come a 2,020-mile telephone line which would also carry facilities for teletype, from Edmonton in Central Alberta to Fairbanks in interior Alaska.

Plans called for two sectors, one in the north centered at Whitehorse, in Yukon Territory, and another in the south extending from Fort St. John to Watson Lake. Operating out of each sector would be three 16-man Signal Corps teams, one for each of the six Engineer regiments on the road. Each team would have a base section of four men, who would operate a fixed 250-watt radio station to maintain contact with the other men of the detachment, who would operate mobile units of SCR–193 transmitting and receiving sets installed in command cars to accompany the construction parties on the road. In addition, there would be a railhead signal detachment of five men operating a 75-watt fixed station at Dawson Creek. While the mobile units would keep contact with their respective base section stations, the base stations in turn would communicate with each other and the railhead station, and would relay their messages to the United States through the Alaska Communication System station at Ketchikan, WXH, in the Alaskan panhandle 450 miles west of Fort St. John. At Fort Lewis, Washington, men of the 60th Signal Battalion had been training for assignment to the Alcan project. But there had been too little time to do a thorough training job. Of the sixteen men attached to the 18th Engineer Regiment, for example, ten had received very little training, and two of them only two or three hours. Before he left Seattle, the sergeant in charge of the group bought $1.98 buzzers that sounded like doorbells; when the group arrived at Whitehorse he set the men to work in code classes using these buzzers.[37]

By 22 April the detachment of five men had already set up a small 75-watt station at the railhead, Dawson Creek, to communicate with Fort St. John. The station at Fort St. John, WXCD, was scheduled to go on the air and work Ketchikan beginning 5 April, but delays and difficulties intervened. Station WXCE at Fort Nelson, 200 miles farther to the northwest, got in touch with Ketchikan on 29 April. Contact was not good, both because of high frequency fadeouts common in northern latitudes, and because the student operators were slow and inexperienced.[38]

But student operators could and did improve fast. Some of the command cars worked along supply routes. Others bumped and lurched right behind the giant bulldozers that were cutting the highway out of the virgin wilderness. Camps moved every two or three days, and the signalmen moved with them. They slept in tents or on the ground through the cold, early spring

[37] (1) Ltr, CO Ft. St. John Sector, Alcan Highway, to CO's All Units and Detachments, Ft. St. John Sector, Alcan Highway, 1 Jun 42, sub: Sig plan. SigC OT 320.2 Northwest Service Command, General 1942–43. (2) Memo, Alaska International Highway, 22 Apr 42. SigC 676.3 (CC CEB) Alaska. (3) First Draft, Hist of ACS, pp. 213–14. (4) Interv, SigC Hist Sec with 2d Lt C. V. Connellan (formerly radio operator at Whitehorse, Y. T.), 9 Nov 43.

[38] (1) Ltr, OCSigO, to O/C ACS, 2 Apr 42, sub: Estab of scheds; (2) Copy of ACS msg, 29 Apr 42; (3) Ltr, Actg O/C to Traffic Div OCSigO, sub: Tests, Ketchikan-Ft. Nelson Circuits. SigC 676.3 (CC CEB) Alaska.

weather, through the mud and mosquito-ridden late spring, the dry, dusty, insect-laden summer. Operational and routine reports formed most of the traffic, but there were life-and-death messages, too. Radio directed rescue parties seeking lost men, sought and gave medical advice, warned of forest fires and bad stretches of road that had been gulped down by the custardlike muskeg.[39]

Useful as the mobile units and base stations were, the Corps of Engineers, the Alaska Communication System, and the Army Air Forces knew that radio transmission was not entirely satisfactory in the northwest. Atmospheric and magnetic phenomena caused serious interference. Furthermore, no matter how adequate the stations and frequencies, or how regular the transmission and reception, there was no guarantee of security. The problem became even more acute as each new radio circuit was established. A wire system to supplement radio seemed the answer.[40]

In March 1942 the Chief of Engineers had asked the Chief Signal Officer to submit recommendations for wire communication along the Alcan Highway to augment radio. Without a doubt, in less trying times the Signal Corps, an old hand at telephone line construction, would have welcomed such a challenging opportunity. But signal construction units were in demand at Allied bases everywhere. None could be spared without proof that a telephone line in Alaska was a critical military necessity. Additionally preliminary estimates indicated that the pole line would require at least 3,000,000 pounds of copper. Copper was in critical supply, and what there was of it would have to be hoarded for the most urgent military uses. These were the considerations that shaped General Olmstead's reply: that the desired wire project should be based upon military necessity after the highway had been completed.

In other words, the Engineers would have to get along as best they could with only radio facilities while the pioneer road was being built, and the Signal Corps would continue to do as it had been directed, to build the minimum facilities for handling of message traffic essential to the war effort. Nevertheless, the Engineers, joined now by the Public Roads Administration, which would build the finished highway to replace the Engineer-built pioneer road, pressed the matter. The original directive on the highway was silent regarding signal communications, and the Chief Signal Officer agreed that it would be proper to carry the matter to "higher authority": to the Commanding General, Services of Supply. Tentative details set forth on 4 June in a letter from the Chief Signal Officer to the Director of Requirements proposed one phantom group, consisting of four wires placed on a pole line having 40 poles per mile, to provide two physical circuits, one phantom circuit, and four grounded telegraph legs; as well as one three-channel carrier system which would make available three talking channels, one of which would be modified to provide for five to seven telegraph channels. Such a line would cost about $1,600,000 and could be finished at the same time as the road.[41]

[39] First Draft, Hist of ACS, pp. 210–15.

[40] Capt Sidney L. Jackson, Stringing Wire Toward Tokyo: A Brief History of the Alaska Military Highway Telephone Line (1944), SigC historical monograph E–1, p. 6. SigC Hist Sec File.

[41] (1) *Ibid.*, p. 8. (2) 1st Ind, CSigO to CE, 26 Mar 42, to Ltr, CE to CSigO, 18 Mar 42, sub: Wire sv for const crews, International Highway. SigC OT 320.2 Northwest Service Command, General 1942–43.

Two weeks later the Services of Supply granted permission to build the wire line, and directed the Chief of Engineers to make the necessary funds available to the Signal Corps. Even before the project was approved, and in the next few weeks thereafter, a series of conferences got under way, in Washington, D. C., and Seattle. By August, after a long second look at the whole undertaking, the Signal Corps found that its relatively modest proposal had grown enormously in scope and estimated cost. Rather than a phantom group and one three-channel carrier circuit, the Fairbanks-Edmonton network now envisioned called for two carrier circuits to provide five carrier telephone channels, three voice-frequency circuits, twelve through telephone circuits, and two or three local telegraph circuits. Connections with the United States would be established by means of a third carrier system linking Edmonton and Helena, Montana, and including two carrier telephone channels and twelve telegraph circuits. The cost had been revised upward to about $4,300,000.[42]

A large number of organizations were concerned in some manner or another in the project. The two most important were the Corps of Engineers, which was building the pioneer road and which was responsible for construction projects for the Army, and the Western Electric Company, which contracted with the government to furnish much of the equipment and the civilian specialists who would make the actual installations.[43] But at one time or another, the Signal Corps dealt with an imposing list of government agencies and private concerns. Included were the Royal Canadian Corps of Signals, Royal Canadian Air Force, Canadian Department of Transport, Rural Electrification Administration, Public Roads Administration, Army and Navy Electronics Production Agency, War Production Board, Transportation Corps, Quartermaster Corps, Army Air Forces, Alaska Defense Command, Northwest Service Command, Northern Alberta Railways Company, Alberta Government Telephones, Canadian National Telegraphs, Bell Laboratories, Graybar Electric Corporation, Railway Express Agency, Miller Construction Company, and Onan-Smith Construction Company.[44]

The outlines of the Signal Corps' organization for the project began to take shape by the end of August 1942. Within the Office of the Chief Signal Officer, the expanded Plant Division would have primary responsibility. To Maj. Ora F. Roberts, officer in charge of the wire section of Plant Division, would fall the ticklish job of directing ACS field force construction. He was to find that his most baffling questions would be posed not by nature, but by the administrative jungle into which he was about to plunge.[45]

To relieve him of the radio installations along the highway and on the Canol pipeline, now making its entry on the northwest stage, Roberts would have the services of Capt. Burton Cole, a Western Electric engineer commissioned directly from civilian life. Since there were not enough Signal Corps construction troops to go around, civilian crews would have to be used to build the pole line. Capt. Henry H. Bartlett, who

[42] (1) Jackson, Stringing Wire Toward Tokyo, pp 9–10. (2) Memo [Army Com Div OCSigO] for Gen Stoner, 25 Aug 42. SigC AC–77 Alaska.

[43] Jackson, Stringing Wire Toward Tokyo, pp. 52–53.

[44] *Ibid.*, p. 72.

[45] (1) First Draft, Hist of ACS, pp. 231–33. (2) Rpt 4, Army Com Br OCSigO to Prog and Stat Br, 20 Aug 42. SigC AC 319.1 Digest, 30 Jul 42–1 Dec. 44.

OPEN-WIRE LINE IN ALASKA. *A section of the line between Fairbanks and Big Delta. A feeder line of the Canol pipeline is discernible parallel to the wire line on the ridge in the background.*

had made a survey of the proposed pole line for the Chief Signal Officer in the summer, was transferred from the Plant Division to take charge of the telephone line engineering and to supervise the civilian inspectors who would check the work of the contractors. Capt. Earl A. Burdick would assist.

Telephone repeater stations were to be spaced at 100-mile intervals along the highway, each at or near a military camp. To supplement the telephone line and to provide service if any part of a 100-mile section of line should go down under the assaults of the hazardous winter weather, there would be 125-watt radio stations at each of the telephone repeater stations. In an emergency a circuit could thereby be patched over from the telephone line to the radio channel from one station to the next, assuring one voice channel regardless of the condition of the telephone line. The 843d Signal Service Battalion would be organized and trained at Fort Lewis, Washington, to furnish the operating personnel.

Thus in the summer months of 1942 the plans were laid and the organization assembled for one of the most spectacular and imposing communication accomplishments of the Signal Corps in World War II. The most modern telephone equipment was rushed into an unmapped wilderness, and the longest open-wire line in the world built in the phenomenally short time of fifteen months: a feat that in normal times would have required years of effort. It was

hardly to be expected that so prodigious a task, with construction problems compounded by the time limits imposed, could have been accomplished without bickering, mistakes, and confusion. Ultimate evaluation must count the project a brilliant success. In its latter phases, the operation moved with remarkable smoothness. But the late summer months of 1942 constituted a period of uncertainty, of divided authority, and of conference table wrangling from one end of the continent to the other.[46]

Canol and the Northwest Ferry Route

Technically distinct from the Alcan Highway, but tied to it by geography and by the total defense plan, were two other undertakings: the Canol pipeline and the northwest ferry route to Alaska.[47]

The Canol project got under way in the spring of 1942. Plans called for drilling wells in the inaccessible oil country near Fort Norman on the Mackenzie River, and for building a pipeline and pumping stations to deliver the oil to a refinery to be erected near Whitehorse, Yukon Territory. The gasoline from the refinery would be used to fuel airplanes at the major airfield at Whitehorse, and at other Canadian and Alaskan fields. From the refinery at Whitehorse tank trucks would carry gasoline over the Alcan Highway south to fields at Watson Lake, Fort Nelson, and Fort St. John in Canada, and north to Northway, Big Delta, and Fairbanks in Alaska. These airfields were stepping stones of the northwest ferry route, over which aircraft from the United States were ferried first to Edmonton, Alberta, and then to Fairbanks or Nome for delivery to pilots for the USSR. The same air route served the air transport service, bringing in large quantities of supplies and men to Alaska.[48]

To provide the Corps of Engineers on the Canol route with communication at their various camp sites, ACS engineers planned and laid out communication systems, while soldiers from the 838th Signal Service Company manned the radio stations and headquarters center. At some points, the ACS built short telephone lines. By fall 1942, when it was decided to continue operations during the winter, airplane landing strips were being planned at points along the river route, and Signal Corps men were busy moving fixed radio stations to the landing strips, or constructing telephone lines from the strips to the radio stations.[49]

Meanwhile, in Alaska, the Aleutians, and Canada, the Alaska Communication System was completing the engineering, procurement, and installation of important radio equipment for the Army Airways Communication System. By Army regulations, the Signal Corps was responsible for providing the equipment, and for installing it, while the Air Corps was responsible for control and operation.[50] Although the Signal Corps in the early part of the summer of 1942 had practically relinquished its Army Airways Communications System duties in other areas to the Air Corps for want of a

[46] First Draft, Hist of ACS, p. 230. Signal Corps' share of the Alcan Highway development is discussed further, pp. 481–86, below.

[47] For a general discussion of the Alcan Highway and Canol projects, see Karl C. Dod, The Corps of Engineers: The Army Engineers in the War against Japan, a forthcoming volume in UNITED STATES ARMY IN WORLD WAR II.

[48] First Draft, Hist of ACS, pp. 220–29.

[49] *Ibid.*, p. 225.

[50] Hist Br Hq AACS AAF, The Army Airways Communications System, pp. 227–28. Hereafter cited as Hist of AACS. AF Archives 2690–1.

competent field organization, in Canada and Alaska it could depend on its experienced engineers within the Alaska Communication System.

Two nets were planned at first, extending from the panhandle of Alaska out through the Aleutians to Umnak. The north net was to consist of Ladd Field, Fairbanks, WZY; Elmendorf Field, Anchorage, WXZ; Gulkana, WXXB; Northway, WYSL; McGrath, WYSE; Galena, WYSM; and Nome, WYSG. In the south would be Fort Glenn, WYSI; Fort Randall, WYSH; Naknek, WYSD; Bethel, WYSF; Woody Island (Kodiak), WYSK; Elmendorf Field; Cordova, WYSC; Yakutat, WYZY; Juneau, WYSA; and Annette, WYZF. The north net operated on five frequencies, with four spares; the south on four frequencies and four spares. As new Aleutian and Alaskan stations were activated, they would take their places in the south net. About six weeks after Pearl Harbor, the installations at Nome, Bethel, Naknek, Kodiak, Cordova, Cold Bay, Fort Glenn, McGrath, Juneau, and Gulkana were authorized. Northway was added 12 April, and other sites were selected subsequently. By the first week in May, the station at Elmendorf was 75 percent, and the one at Ladd Field 95 percent, complete.[51]

The Army Airways Communications System complained that the Alaska Communication System was sometimes unable to supply radios. These the Air Corps proceeded to acquire however it could: from hams and from stations operated by the Civil Aeronautics Administration, by the Bureau of Indian Affairs, and by civilian airlines such as Pan American and Northwest Airlines.[52] In making the Alaskan installations, the Air Corps supplied BC–401 transmitters and receivers. The ACS supplied antenna material, pole line hardware, power plants, and other equipment, scraping it together from any source possible. Some items it took from stock on hand, others it bought locally and still others, such as operating positions, it built in the ACS shop at Seattle.[53]

In June, the Alaska Communication System became responsible for the Northwest Service Command installations in northwest Canada. By the end of the month, the ACS was busy with plans for Army Airways Communications System installations at Aishihik, Whitehorse, Upper Teslin, and Watson Lake, in the Yukon Territory; Fort Nelson and Fort St. John, British Columbia; Grande Prairie and Edmonton, Alberta; and Regina, Saskatchewan. Stations in the north at Fairbanks and Northway, Alaska, and in the south at Great Falls, Montana, were linked in the net by virtue of geographic proximity. In most cases, Northwest Airlines either had established or would build the facilities under commercial contract, while the Alaska Communication System would furnish additional equipment for control towers and weather reporting service.[54]

Communications for Ground and Air Warning Systems

On 25 March 1942 the responsibility for installation and maintenance of all fixed signal communication facilities of the Alaska Defense Command passed from the Ninth Service Command to the Alaska

[51] (1) Ltr, O/C ACS to CSigO, 7 May 42, sub: Biweekly rpt on opns and expansion of ACS. SigC AC–25. (2) Hist of ACS, Pt. II, "ACS–AACS–NWPEA," pp. 2, 7.

[52] Hist of AACS, pp. 227–28, 350.

[53] Hist of ACS, Pt. II, "Supply," pp. 14–15.

[54] Ltr, O/C ACS to CSigO, 19 Aug 42, sub: Annual rpt of opns for FY 1942. SigC AC–44.

Communication System.[55] The two most important projects, exclusive of Army Airways Communications System installations, were the harbor defense and aircraft warning systems.

Fire control systems, the tactical command communications networks which controlled the firing of the heavy guns of the Coast Artillery, comprised fixed telephone and radio communication between all elements of the harbor defense: headquarters, gun emplacements, observation posts, radars, searchlights, antiaircraft batteries, tide stations. They included also a pulse-signaling system for simultaneous sighting of targets from several widely separated stations, and radars for accurate computation of gun-firing data. Installing such complicated systems in the harbors of Alaska meant solving problems imposed by nature—rugged terrain, severe weather, waters of great depth, and precipitous, rocky shores—as well as difficulties resulting from the undeveloped civilian economy of the region and the great distances from the sources of supply and manpower.

On 21 May priorities assigned to the various fortifications were set forth, with Dutch Harbor, Kodiak, Seward, Sitka, and Yakutat high on the list. Submarine cable would form the communications backbone in each case, and the Signal Corps busied itself placing orders for the large quantity required. Altogether there would be 5,000 tons of it, equivalent to a freight train 100 cars long. Storing it posed a problem, since obviously so much could not be placed in the holds of the cable ships according to standard practice. Luckily, unlike prewar cable, it did not have to be stored under water to avoid deterioration. The Alaska Communication System solved the problem by building a series of dry-land "tanks" out of wooden pilings, at Ames Terminal.[56]

With the Japanese occupying Attu and Kiska in the Aleutians, the weakness of the aircraft warning system in Alaska appeared more threatening. Little could be done about it except to spread the limited numbers of trained men and the meager supply of available equipment exceedingly thin.[57] Under the priorities existing in March 1942, only two interceptor pursuit squadrons would go to Alaska. The five detectors (SCR's 270 and 271) on hand or en route to Alaska were all that could be allotted, and it seemed there would be no more for many months to come.[58] Aircraft warning system installations in the Alaska Defense Command in May amounted to nine under construction and six in abeyance.[59]

The greatest part of ACS's normal budget in 1942 went to aircraft warning. The allotment for installation and rehabilitation of aircraft warning systems (for purchasing equipment, for cable repairs, for buildings, and so on) was $2,315,435. An additional sum labeled simply "Aircraft Warning Service" came to $859,100.[60] At the end of June, plans called for an information center in the Fighter Command headquarters at Fort Richardson, in Anchorage, fed by ten filter centers at Fairbanks, Sitka, Annette Island, Nome, Yakutat, Cold Bay, Naknek, Bethel, Kodiak, and

[55] Ltr, O/C ACS to CSigO, 9 Mar 42, sub: Biweekly rpt on opns and expansion of ACS. SigC AC–25.

[56] Hist of ACS, Pt. II, "Fire Control," pp. 1–6, and "Ames Terminal," pp. 1–5.

[57] Henry Rpt.

[58] AG 660.2 AA (1-1-40) Sec. 5, AWS Fourth Army, *passim.*

[59] Ltr, O/C ACS to CSigO, 7 May 42, sub: Biweekly rpt on opns and expansion of the ACS. SigC AC–25.

[60] ACS Biweekly Prog Rpt, 13 Jun 42, pp. 6, 6a. SigC AC–29.

Otter Point. There would be twenty aircraft warning system radar stations scattered up and down the rugged coastline of Alaska and the Aleutian Islands. The growth of air activity in Alaska soon forced all the filter centers to become information centers for plotting targets within their regions. By midsummer some equipment had been installed at all the points named, although a full complement of equipment was not expected to be on hand for many months.[61]

In the early stages of planning for radar installations in Alaska, both the Corps of Engineers, which built the access roads, cleared the sites, and prepared the buildings, and the Signal Corps, which furnished the radars and installed them, were much too optimistic. First estimates for the SCR–271 fixed installations at Sitka and Kodiak had set August 1941 as the probable completion date. Actually, the Chiniak station on Kodiak was completed seven months behind schedule, on 1 March 1942, and the Sitka station almost a year late, on 21 July 1942.[62] It took the Engineers five to ten months, sometimes a year, to move into a selected site and prepare it for signal installation and occupancy. Engineer construction troops were scarce, and shipping was not always at hand. To make matters worse, many of the locations were so far north that vessels could land supplies and men only during a few months out of the year. Sites for fixed radars were necessarily in wild and remote spots, requiring access roads to be carved out of the wilderness, dams built to assure a water supply, camp sites converted to permanent quarters for station attendants, messing facilities installed, and power houses erected.

Satisfactory sites for radar installations were difficult to find. When the sets were located at the foot of a hill or mountain, echoes caused double images to appear on the oscilloscopes. When they were located on the summits, echoes rebounded from the distant higher mountains. The station attendants improvised reflectors out of chicken wire, and there were other examples of ingenuity. Despite the highly technical equipment, the time never came when improvisation by men in the field was no longer necessary. Yet by trial and error, radar men found that a location similar to that selected for the Sitka station was best: part way down a hill and on a slope where beams from the radar would be reflected up and away from the station.[63]

When radar equipment arrived at its selected location, it was likely to be in poor condition. The SCR–270's and 271's were fairly rugged, but nevertheless they constituted highly intricate and delicately adjusted mechanisms ill-fitted to withstand the rough handling they had to endure before reaching Alaskan outposts. In most cases portions of the equipment had to be rebuilt or reconditioned. Many parts had to be replaced. Often, needed parts were not available, and had to be requisitioned from depots in the United States. To obtain them took from three weeks by air to six months by water for the larger items. At some locations barges loaded with radar apparatus capsized in storms and sank. Even on the surviving barges the equipment was thoroughly soaked by salt water. Radar crews by necessity became very proficient

[61] (1) Ltr, O/C ACS to CSigO, 19 Aug 42, sub: Annual rpt of opns for FY 1942. SigC AC–44. (2) Henry Rpt.

[62] (1) Ltr, O/C ACS to CSigO, Aug 42, sub: Annual rpt of opns for FY 1942. SigC AC–44. (2) Hist of ACS, Pt. II, "Radar and VHF," p. 32.

[63] Henry Rpt.

at making repairs and constructing new parts from material at hand.[64]

By late summer of 1942, besides the two permanent SCR–271 stations at Sitka and Chiniak, four temporary mobile SCR–270 radars were in service: at Montague Island, Cold Bay, Cape Nome, and Fort Glenn. The installation at Cape Wislow on Unalaska Island had been badly damaged by the Japanese raid on Dutch Harbor in June, and the parts of the radar set destroyed in the burning warehouses could not be replaced before September. A broken ceramic coil had made the mobile set at Cape Rodney on the Seward Peninsula inoperative. Still another mobile set was ready for installation at Cape Tanak on the Bering Sea side of Umnak Island, and fixed SCR–271's were awaiting installation at Nikolski, Lazy Bay, Otter Island, and Prominence on Unalaska Island. Installations planned for seven other locations awaited the allotment of additional SCR–271 sets which would not be available until 1943.[65]

As the war progressed, military planners were to find that the strategic situation changed faster than the rate of progress on radar construction in Alaska. Many of the proposed stations were canceled before they were completed or even begun, their strategic importance having diminished as the focal point of warfare moved westward. At various times until the end of the war, thirty-four Aircraft Warning Service projects were approved; of these, only eleven were completed.[66]

Getting equipment to Alaska was a headache. Usually shipments went by water from Seattle, but there were seldom enough vessels available to relieve the congestion of material waiting on the docks. High-priority items that could be transported by air were sometimes crowded into the Army Air Transport Command planes, now making regular runs through Edmonton, or into the twelve Northwest Airlines planes operating from Great Falls, Montana, to Fairbanks. After supplies arrived at Alaskan ports, there remained the problem of getting them into the interior. Until mid-1943 most of the water shipments came to Seward, and had to be transshipped by rail to Anchorage or Fairbanks. At Anchorage, a 32-foot tide prevented ships from docking for longer than six hours at a time. At Bethel, St. Michael, and Nome, shallow water near shore made it necessary to transfer cargoes to lighters for unloading. Some supplies sent overland by rail to Prince Rupert were transferred to barges and towed by tugs through inside water passages to Juneau and Skagway. Such circuitous routing and the frequent rehandlings and reloadings were costly, time-consuming, and hard on signal apparatus as well. Civilian help was scarce, and inefficient. Wages were high, and turnover heavy.[67]

All these factors affected the progress rate of communications installations in Alaska. Nevertheless, as summer faded into autumn, the Signal Corps could point to a very substantial record of achievement in Alaska. That it was able to do so much in so short a time could be traced to the fact that it possessed a seasoned veteran organization in the northwest, the Alaska Communication System, as an inspector from Washington pointed out in his report in September.[68]

[64] Hist of ACS, Pt. II, "Radar and VHF," p. 34.
[65] Henry Rpt.
[66] Hist of ACS, Pt. II, "Radar and VHF," p. 33.
[67] Henry Rpt.
[68] Memo, Col. Walter T. Scott, IGD, for Gen Stoner, Chief of Army Com Div OCSigO, 11 Sep 42, sub: Data for conf, 12 Sep 42, Signal Com in Alaska. SigC AC–43.

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The Alaska Communication System itself had waxed greatly during the first half-year of war. Its civilian personnel had grown to 263 by 30 June, although 192 of these were on duty in the Seattle headquarters, and only 71 in the field in Alaska. Enlisted men on duty in connection with the operation and maintenance of the system had grown from 282 on 30 June 1941 to 1,011 by 30 June 1942. There were 38 officers. The value of the government traffic handled over the ACS network had practically doubled: from $1,207,301.95 in fiscal year 1941 to $2,339,710.20 in fiscal year 1942.[69]

[69] Ltr, O/C ACS to CSigO, 19 Aug 42, sub: Annual rpt of opns for FY 1942. SigC AC–44.

CHAPTER VI

The First Billion Dollar Signal Corps

(January–July 1942)

The Headquarters Supply Organization

Losses overseas in men and matériel, in bases and prestige, brought Americans the realization that defense preparations during recent years had fallen far short of what was now needed. The country now understood that modern wars could be won only by men using modern machines, however complex and costly. And even as the Signal Corps shared in the military losses of early 1942, it also shared in the vast outpouring of military appropriations to replenish and augment the supply of men and equipment.

When a man has been poverty-stricken all his life and unexpectedly has a million dollars dropped in his lap, he is likely to be overwhelmed not only by his affluence but also by the sudden demands, influences, and pressures that he encounters. As with men, so it is with organizations. The Signal Corps was confronted in 1942 with the sobering yet exhilarating realization that it was the supplier of communication equipment for an Army expected ultimately to comprise 8,000,000 men. The very task of expanding Signal Corps production on a gigantic scale on the foundation of the small peacetime industrial capacity was staggering. Testifying before a House of Representatives subcommittee, the Chief Signal Officer said, "I never dreamed we would have to deal with such sums, but I know you have to do the job through organization." [1]

The Soaring Signal Corps Budget

The appropriation for the fiscal year 1941 established the pattern for the war period. It reflected the greatest increase over any previous year yet made. The budget had been planned in 1939, starting out with a modest $9,447,439. After five supplemental appropriations the sum of $256,652,964 was placed at the Signal Corps' disposal. Since the computation of requirements was inextricably involved with budget estimates, each time a change occurred in one, cor-

[1] *Hearings Before Subcommittee of Committee on Appropriations,* HR, 77th Cong, 2d Sess, On the 5th Supplemental National Defense Appropriations Bill for 1942, Title I, War Department, pp. 65ff.

responding changes were necessary in the other. In addition, computation and budget might be submitted to the various War Department budget and fiscal agencies only to be rejected in whole or in part. When that happened, the budget estimates and computation of requirements had to be refigured and resubmitted. During the fiscal year 1941 thirty different budgets had been submitted. They reflected the rapid acceleration of prewar planning, with funds for radar, airplane communication, aircraft warning service, and troop equipment for the expanding Army looming large. For the fiscal year 1942 Signal Corps fiscal experts had started working in early February 1941, and the budget had been sent to Congress in May. The original budget contained twenty-seven projects, and totaled $103,577,000. Before it was passed by Congress and signed by the President, three additions had been made which amounted to twice as much as the whole of the original budget. In the succeeding months of 1941, while world events moved rapidly, the public funds that had been so lacking in the lean years just past poured into the War Department in greater and greater amounts. Before war struck, the Signal Corps had benefited by two supplemental appropriations. Now, in the closing months of fiscal year 1942, all budget estimates prepared for use "in case of war" had been swallowed up by the enormous demands of war itself. In a single suppplemental appropriation in March, the Signal Corps passed a historic milestone when it received its first billion-dollar grant of funds. Before the fiscal year ended it would have for expenditure several times that sum.[2]

What would it get for its money? For one thing, it hoped to get communications equipment for 33,233 airplanes: radio compasses, command sets, search sets, frequency meters, receivers for marker beacons, interphone equipment, and all the other complicated and expensive radio and radar items that go to make up the eyes and ears and nervous systems of airplanes. For another, it would spend an enormous sum for aircraft warning service to buy the radars to ring the shores of the nation and its territorial possessions, and to train the men to operate the radars. It would buy radios for tanks; it would build handie-talkies for foot soldiers; it would pay salaries for the thousands of civilian workers thronging into its offices and depots and warehouses. It would get millions of miles of wire, hundreds of thousands of batteries, and thousands of cameras.[3]

Throughout the period June 1940 to 7 December 1941, the Army had computed its requirements according to the exigencies of the moment and to the limit of funds that could be secured from Congress. Within the Office of the Chief Signal Officer the representatives of the using arms prepared lists of signal supplies and equipment to meet their own needs and forwarded these lists to the Supply Division. The Procurement Planning Section of the division had been busy with almost completely theoretical computations, arising from troop basis tables as they varied from year to year, and with studies looking toward the most effective use of industry in an emergency.[4] The birth of the Army Supply Program in February 1942 heralded a new kind of computation, based upon the

[2] André E. Gerard, The Story of Supply in the Signal Corps in World War II, Pt. I, Requirements, SigC historical monograph B–1, pp. 16–26, 28, 30. SigC Hist Sec File.

[3] *Ibid.*, p. 106.

[4] See Terrett, *The Emergency*, pp. 58–69, 166–78, 240–50.

requirements for a three-year period, 1942–1944, and expressed in the broadest terms, with no attention given to the problems of delivery, and no differentiation between types of equipment within a larger group. On that basis, the Signal Corps job looked even bigger than it had a few weeks before.

Basic Organization and Policies

As responsibilities and activities increased, the staff to handle them began to materialize. By March more and more reserve officers were reporting for duty, and on-the-job training together with intensified recruiting efforts was providing engineers, technicians, and clerical workers to augment the civilian staff. Within the Office of the Chief Signal Officer, the framework of the Supply Service embraced the two divisions, Radar and Materiel, responsible for the Siamese-twin nature of procurement and research and development. General Olmstead had sought to trim the fat from the procurement function, and to leave it as lean and fit as possible. That it could not run as fast as the research and development function to which it was shackled was largely due to the fact that procurement was inextricably bound to the communications industry, which for the greater part meant five large companies.

Olmstead had invited the presidents of the Big Five (General Electric, Western Electric, the Radio Corporation of America, Westinghouse, and Bendix), as well as Maj. Gen. Richard C. Moore, Deputy Chief of Staff, James L. Fly, chairman of the Defense Communications Commission, Ray C. Ellis of the Office of Production Management, and Wallace Clark, who headed his firm of administrative consultants, to meet with him on 17 January.[5] He asked the Under Secretary of War to address the meeting, and suggested that he mention "the necessity of bettering . . . stated delivery dates; the importance of blasting out bottlenecks in production; the advantages of . . . sending representatives to accomplish the same results with sub-contractors," and asked him to bring up the subject of further curtailment of the manufacture of radio sets for civilian use.[6]

The Big Five held more than 80 percent of all Signal Corps contracts. As of March 1942 the Signal Corps estimated that the military services would have $4,350,000,000 available for contract awards in the fields of radio and radar. Yet the total industrial output of the industry was only $250,000,000.[7] What was the best way to solve the problems of plant expansion, scarcity of machine tools, shortage of labor supply, inspection, spare parts, stock control, packaging, financing, critical materials, and a thousand other factors? Olmstead said that he expected the large industries to cooperate and to make their own plans for a solution of the problems; if they did not, the government would take whatever action was necessary.

The policy of the Signal Corps, he said to Lt. Gen. William S. Knudsen at about the same time, was to spread the work and

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[5] Memo, Col Colton, Chief of Materiel Br, For All Concerned, 16 Jan 42. SigC 337 (Gen) Confs 4, Jan–Jun 42.

[6] Memo, Olmstead for USW, 13 Jan 42. SigC 337 (Gen) Confs 4, Jan–Jun 42.

[7] (1) Gerard, Story of Supply in the Signal Corps, Pt. II, Procurement, SigC historical monograph B–1b, pp. 11–12. Figures are from the Bureau of Census compilation, Census of Manufacturers, Electrical Industry Division, 1939, with estimated increase to end of calendar year 1941. (2) Civ Prod Adm, Official Munitions Production of the United States, 1 July 1940—31 August 1945 (1 May 47), Chart XI, p. 373.

money throughout big and little companies. Olmstead wanted "no monopolistic aspect whatever." Knudsen replied: "If you keep on giving them more and more you will be nearly monopolistic before you get through." Olmstead explained that Signal Corps contracts provided that 30 to 40 percent must be subcontracted. That put the burden on the big companies to develop their own sources of supply.[8]

This was more easily said than done. While accepting the idea of subcontracting and building up new sources of supply, the big companies were at the same time opposing undue regimentation within the war-economy framework made necessary by the exigencies of the conflict.[9] Meanwhile, the smaller companies, freed from the competition of the Big Five, which had theretofore controlled the market, were harvesting the windfall created by civilian demands. The component situation became tighter, and threatened shortages of critical materials developed into a grim reality, while production of radios, phonographs, and musical instruments ate up the same critical materials that signal equipment required.

Nevertheless, it was impractical if not impossible to stop all production of civilian radios and related equipment at once upon the outbreak of war. It took time to place contracts, to educate smaller companies for war work, and to bring about conversion to wartime manufacturing in an orderly manner. Any drastic order immediately forbidding the manufacture of civilian radio equipment would merely have forced manufacturers out of business or into some other line of work, with a consequent loss of facilities and trained workers to the industry.[10] Even had it been considered wise in the light of these considerations to forbid the manufacture of civilian items of electronic equipment, the Chief Signal Officer lacked authority, as did the Secretary of War, to force any manufacturer to produce only military equipment. On 16 January 1942 the President created the War Production Board and centralized control of procurement and production in its chairman, Donald Nelson. The chief of WPB's Radio Division, Ray Ellis, was also a member of Brig. Gen. Roger B. Colton's Signal Corps procurement committee. As soon as Ellis and Colton deemed it advisable, the WPB began issuing a series of limitation orders to the radio industry. On 23 January 1942 it issued Limitation Order L–44, which cut radio manufacturers to 55 percent of their 1941 volume of commercial production. In March the War Production Board amended the order, prohibiting all production of commercial radios and phonographs. In May it went still further, issuing Order L–37–A, which stopped manufacture of practically all musical instruments.[11]

The limitation orders in effect constituted an ultimatum to the electronics industry to turn to military production or face the possibility of closing its factories. Of necessity the industry began converting to military production. Yet the elimination of commercial production of items which consumed critical materials, though helpful, was a palliative rather than a curative measure, of value chiefly in that it granted the government and industry a little time to get at the

[8] Office Dir of Prod WD, Meeting to Review SigC Program, 22 Jan 42. SigC EO 337 Confs.

[9] Gerard, Story of Supply in the Signal Corps, Pt. II, App. IV.

[10] Ms Comment by Maj Gen Roger B. Colton, USA, Ret., 14 Sep 53.

[11] (1) Everitt *et al.*, Industrial Summary: Signal Corps Procurement of Radio and Radar Equipment, pp. 25–26. SigC Hist Sec File. (2) MS Comment by Colton, 14 Sep 53.

root of the problem. The root was a dual shortage: of essential raw materials, and of manufacturing facilities for converting the raw materials into electronic equipment.

Solution depended upon careful co-ordination of the requirements of the various contractors and scrupulous allocation of scarce materials and the components made from them, as well as upon assistance to potential manufacturers in establishing themselves. The big companies and the Signal Corps tackled the problems together. Although eventually many smaller concerns developed into valuable sources of supply, throughout the war the ultimate responsibility for supplying electronic equipment remained with the giants of the industry. The policy enunciated by General Olmstead in June 1942 remained the official policy. He stated:

> The Signal Corps has placed the bulk of its business with a small number of large companies. At the beginning of the present emergency the large companies were "going concerns" with large resources in engineering ability, plant equipment, and skill in producing communication and radar equipment. Other firms were not able to take large orders, and required time and assistance in expanding engineering staffs and training them in the type of production required. It has been the policy of my office to place large contracts with the large firms and [to] require them to subcontract approximately 40 percent to the smaller firms. This permitted the utilization of the resources of the large firms in training the smaller firms. This policy was approved by the Under Secretary of War and the Office of Production Management.[12]

Within the Signal Corps supply headquarters a great deal more work devolved upon the Facilities and Materials Branch, which absorbed some of the functions of the old Procurement Planning Section and began reorganizing all its special studies in an intensive effort to establish maximum capacities in existing facilities, to discover new sources of supply, and to unearth substitutes for materials no longer available. Throughout the spring of 1942, the Signal Corps and industry attacked bottlenecks, reducing them at least, and sometimes eliminating them entirely.[13]

Facilities Expansion and the Problem of Components

At first, the subcontracting programs of the big companies usually involved major components, the subcontractors supplying the constituent parts of radio sets and other signal assemblies, and the prime contractors performing the assembly and shipping the items of equipment from their own plants. At a later period the work was spread still further by subcontracting for complete assemblies.[14] But in the spring of 1942, most of the subcontracting was for components, and the supply situation for these parts was unequivocally bad.

To begin with, components were of infinite variety. Such commonplace items as screws and bolts were components. So were dynamotors, essential to vehicular radios. So were the slivers of quartz crystal used to control frequencies and the steatite ceramic coils vital to high frequency sets. So too were vacuum tubes, dry cell batteries, ball bear-

[12] Supply Sv OCSigO, Review of Prod Plans, 18 Jun 42. SigC DS 337.

[13] For details, consult the weekly branch progress reports. From 1 January 1942 through 16 September 1942, these reports are contained in a series of files titled Weekly Achievement Reports, located in the Signal Corps Central Files. From 23 September 1942 through 1943, the files are titled Digest of Progress. Regardless of the file wrapper title, the individual branch reports are called Weekly Digest of Progress and Problems.

[14] Everitt *et al.*, Industrial Summary: Signal Corps Procurement of Radio and Radar Equipment, p. 26.

ings, telephone cords. These added up to just a few of the items that were actually holding back or threatening to hold back production of Signal Corps equipment either because ingredients were scarce or because manufacture was difficult and on an inadequate scale.[15]

The procurement staff, in somewhat belated recognition of the seriousness of the shortages, was taking action, but for some time made slow headway. Until production schedules suddenly began to be held up because of shortages of such items as fixed capacitors, ceramic coils, dynamotors, meters, batteries, and even certain types of cord, the Signal Corps, relying upon performance specifications and the opinion of its prime contractors, had assumed that the components industry would be equal to any emergency. Even as late as 13 January 1942 prime contractors for radio, meeting with representatives of the supply arms, had agreed that, with the possible exception of the variable capacitor industry, component producers could meet wartime demands with their existing plant capacity. This conference had scarcely adjourned before military radios began to stall on the assembly line for lack of components.[16]

One approach to the problem of securing more was to increase plant facilities producing them. Even before Pearl Harbor more than $15,000,000 in plant expansions had been sponsored by the Signal Corps through Defense Plant Corporation funds, although only one plant, producing steatite, had made much headway. By June 1942 45 government-financed expansions involving 35 companies and the sum of $45,000,000 were under way,[17] and in addition the electronics industry itself was expending sizable amounts of money to enlarge its factories. Of the plant expansions that the Signal Corps initiated during the entire war, 80 out of a total of 106 were for components. In the early months of 1942 the items for which plant expansions were recommended included tubes, stop nuts, dynamotors, steatite, quartz crystals, conductors, coils, capacitors, cordage, and transformers.

As a matter of fact, a Signal Corps supply officer stated at a later date that in the early months of the war, the Signal Corps had tended to rush into expansion at every report of an existing shortage, without much understanding of the relationship between requirements and capacity.[18] In any event, lack of plant capacity was only one part of the problem. Another part of it concerned the lack of co-ordinated procurement among the supplying arms and services. By February it had become apparent that mass production of many radio and other electronic components required by the Signal Corps, the Air Corps, and the Navy was impossible if each of the organizations persisted in procuring these items under its own specifications. All government specifications required optimum performance in components, a considerably higher standard than that ordinarily required for commercial production. In addition, there was enough variation in the specifications of the

[15] Unless otherwise indicated, the source of information on components is W. P. Worrell (Prod Div, Philadelphia SigC Proc Dist), Industrial Summary: Signal Corps Materials and Resources, 31 Jan 46. SigC Hist Sec File.

[16] Lanier Gray, Industrial Summary: Signal Corps Procurement of Selected Components, 7 Jan 46, pp. 1–3. SigC Hist Sec File.

[17] (1) Memo, Exec Officer Mat Br OCSigO for Exec Control Div, 5 Jun 42, p. 6, Item 3. Weekly Achievement Rpt, 27 Apr–8 Jun 42. SigC Central Files. (2) CSigO Annual Report, 1942, pp. 20, 92. (3) Gerard, Story of Supply in the Signal Corps, Pt III, Production, SigC historical monograph B–1c, p. 25.

[18] Rpt of SigC Prod Conf, 12 Dec. 42. SigC MB-Miscellaneous Folder 2.

three military agencies to limit sources of manufacture. For instance, a manufacturer able to make satisfactory resistors for the Signal Corps might be unable to make them for the Navy. As is the case in most other classes of industries, one or two firms known for the high quality of their products soon became overloaded with orders, while other companies were soliciting business to keep their organizations intact.[19]

To simplify specifications and make them uniform throughout the procuring services, the War Production Board asked the American Standards Association, a federation of some eighty national technical societies, trade associations, and government agencies, to work with the services to achieve standardizations. In response, the American Standards Association organized the War Committee on Radio in early March, with Maj. William M. Perkins representing the Signal Corps, and the committee began its important work of developing war standards for the critical components, observing the following priority: fixed capacitors, fixed resistors, variable resistors, connectors, dynamotors, tube sockets, crystals and holders, vibrators, and dry batteries.[20]

In some cases competition among the Navy, the Air Forces, and the Signal Corps for scarce facilities held back deliveries of components. An early case developed around the procurement of meters. The Signal Corps suggested that representatives of the three services get together and compare requirements and work out a solution. They did so, and discovered that the Signal Corps needed meters at the rate of 40,000 a month, the Air Forces at 4,500 a month, and the Navy at only 10,000 a year. The representatives were able to work out an equitable allocation of existing facilities, and thereafter each service got what it needed without difficulty.[21]

Still another basic element in the complex problem of providing enough components (and therefore enough signal assemblies) was the lack of detailed knowledge on the part of both the Signal Corps and the principal contractors as to what raw materials would be required, and in what quantities. It was necessary to learn precisely what components comprised each assembled unit of equipment, what the ingredients of each component were, and how much of each ingredient every type of component required. Then, given the over-all equipment requirements as estimated from troop tables and tables of basic allowances, statisticians could compute the amount of raw material which industry needed to meet the requirements of the armed forces.

The previous year a group of six engineers and a number of clerks in the New York Procurement District had begun the work of making material breakdowns of all components of Signal Corps equipment and compiling lists that showed not only the quantity of raw materials per item, but also size, shape, quality, and grade of materials. This group had transferred to Philadelphia shortly before the United States entered the war, and in early 1942, when the component shortages developed, it acquired four more engineers and additional clerical help. It was slow work, exacting work, and the engineers who pioneered it had to get their information for the breakdowns as best they

[19] Everitt *et al.*, Industrial Summary: Signal Corps Procurement of Radio and Radar Equipment, p. 30.

[20] Capt Charles R. Novick, The Signal Corps Policy of the Conservation of Critical and Strategic Materials (1945), SigC historical monograph B–16, pp. 44–47. SigC Hist Sec File.

[21] Interv, SigC Hist Sec with Col Elder, Asst Chief of P&D Div OCSigO, 28 Sep 49.

could and in a variety of ways: from specifications and drawings, by examining and taking apart the equipment itself, by checking with co-operative manufacturers, and by going directly to the factories. They developed detailed notes on their findings and compiled these carefully, gradually amassing an enormous bulk of exceedingly valuable information.

While the group in Philadelphia compiled statistics about the components, procurement officers in all the districts were surveying the factories that produced them, building a substantial library of factual information about the financial status, machinery, labor, quality of work, and capacity of existing plants. Until it had acquired this information, the Signal Corps had no sound basis for determining which plants merited government-financed expansion or which could convert from civilian to military production after only minor changes. Once it had this basis, its interest and sponsorship began to reach behind the subcontractor and his plant to plants where raw materials were processed, and behind those to the mining companies. If the Signal Corps happened to be the principal consumer of a scarce raw material, it sponsored the necessary expansion of mining and processing facilities, as in the case of quartz crystal, steatite, and tantalum. In the case of materials which the Signal Corps had to have but used in smaller quantities than some other service, the Signal Corps presented its requirements to higher authority and let the procurement agency that was the heaviest consumer assume responsibility for the necessary expansion.

Material Shortages

When the United States entered the war, scarcities of raw materials had already begun to vex all government procurement agencies and producers of war matériel.[22] Whether shortages were "strategic," or "critical," the result was the same: choking of production because the material to make equipment was not at hand.[23] In either case, one of two things could be done: endeavor to do away with use of the material, or failing in that, find or develop substitutes for it. This was the story in the case of copper, mica, rubber, cadmium, aluminum, and many other raw materials.[24]

The problem of the Signal Corps with respect to material shortages was in some instances no more and no less than that of the other supply services; in other cases, because of the peculiar nature of communication equipment, and the vital part communications play in modern warfare, the shortages represented a deadly threat to the whole procurement program, and through it to the security of the nation. Throughout the war, material shortages plagued the Signal Corps procurement program. Eventually, through simplification, standardization of components, redesigning of equipment, downgrading, substitution, and the use of synthetic materials, the Signal Corps overcame its material shortages. But the going was neither smooth nor easy, and in early 1942 the Signal Corps was not yet sure where the path led.

Tantalum

One of the more discouraging problems concerned the tantalum shortage. The first

[22] Terrett, *The Emergency*, pp. 244ff.

[23] *Strategic* shortages were usually defined as those resulting from the cutting off of foreign supply sources by the declaration of war and *critical* shortages as those arising from insufficient domestic production.

[24] Ltr, Gen Dev Div OCSigO to Dir of SCGDL, 12 Feb 42, sub: Program for reduction of SigC rqmts for strategic materials. SigC 410.2 Aluminum. See also other folders in Signal Corps 410.2 series for specific materials.

substantial requirements for tantalum had developed in the fall of 1941 with the increasing production of radar. Oscillator, keyer, and rectifier tubes of the SCR–268 all required tantalum sheet or wire, and the short life of the tubes created a heavy demand for spares. Early versions of the SCR–299 and SCR–399 used tantalum plates and grids in their power-amplifiers and modulator tubes, and each new development created new demands. A survey of the industry conducted by the Planning Section had revealed that there were only two producers of tantalum in the world. One of them, Siemens-Halske, was in Berlin; the other, Fansteel Metallurgical Corporation, was in North Chicago. Fansteel agreed to expand, but was very slow to act. It was not until the last day of January 1942 that arrangements were concluded for the establishment of a new unit adjacent to the existing Fansteel plant in North Chicago; the lease agreement, signed by the Defense Plant Corporation, set the total project cost at $4,170,000. The expansion provided a capacity of about 100,000 pounds of tantalum metal per year, the maximum permitted by the available quantity of ore.[25]

This quantity appeared to be enough, although the very best estimates of requirements were likely to be inaccurate because there were no material breakdowns on electron tubes available, and in addition no one could say just how many tubes or what types would be needed. The Facilities and Materials Division of the Office of the Chief Signal Officer and the War Production Board were constantly engaged in computations and recomputations of tantalum requirements. In March, just as the planners were breathing more easily, another crisis loomed. The Joint Army and Navy Munitions Board announced that a considerable quantity of potassium tantalum fluoride, an intermediate material between the ore and the pure metal, would be required as a catalyst in the production of butadiene, the synthetic rubber.

As in most war shortages, there was no single easy and dramatic solution but a combination of several: plant expansion; strict allocation of tantalum and tantalum fluoride; substitution of less critical materials; and, to a lesser degree, salvage of tantalum in unserviceable tubes. A year later, in 1943, another crucial shortage occurred, when in the midst of peak production the ore supply sank to dangerously low levels. Then came a call upon the Air Transport Command and the Naval Air Transport Service to fly shipments of ore from South Africa and the Belgian Congo to meet the situation. But in the first half of 1942 that problem was still in the future and the ones at hand were enough to wrestle with.[26]

Rubber

The rubber situation was a major source of worry to the military organization. There were too many questions that only time could answer. Japanese successes had cut off the principal supply of natural rubber. Wild rubber trees in South and Central America constituted a sure but very limited source. The United States was beginning to get plantation rubber from Liberia, but shipping lanes to that country were subject to attack by German submarines. Large-scale production of synthetics was supposed

[25] (1) Ltr, Gen Dev Div OCSigO to Dir of SCGDL, 26 Jan 42, sub and file cited n. 24. (2) I. D. Adams (Prod Div Philadelphia SigC Proc Dist), Industrial Summary: Signal Corps Procurement of Tantalum, Tungsten and Molybdenum, 18 Feb 46, pp. 16–19. SigC Hist Sec File.

[26] Adams Summary, cited n. 25 (2), pp. 15–19.

to begin in early 1943, but if there were delays or unforeseen difficulties in manufacture, synthetics could not meet the enormous demand. In the meantime conservation was the only solution.

In January, a month before the fall of Singapore, General Olmstead had been requested by Under Secretary of War Patterson to review again Signal Corps requirements for rubber "with a view to elimination or reduction of its use wherever possible to do so without adversely affecting the functioning of equipment," and to submit the report by 20 January.[27]

Because of the complexity and delicacy of its equipment, the Signal Corps was probably faced with a knottier problem than were other services in attempting to change the amount of rubber it used, or in shifting from natural rubber to synthetics. Manufacturers were experimenting with insulation and jackets made of various elastomers that were beginning to be available, but, it was pointed out, ". . . No synthetic . . . possesses as desirable . . . characteristics . . . as rubber. Synthetic insulated wires usually have been designed to excel for a special application [only]. . . ." Lowering the rubber content of insulation for W–110–B would conserve rubber and result in a better product than any synthetic yet tried could yield. Technicians of the Signal Corps Laboratories had pointed out that vinyl or other suitable thermoplastics would probably be satisfactory for telephone communication over distances required for assault wire W–130, but added that there was no known substitute for rubber for twisted pair over distances required for wire W–110–B. The research and development men also made flat pronouncement that they could not at that time eliminate latex from meteorological balloons because use of a substitute demanded a complete revision of the existing ascension-rate tables used in meteorological work.[28]

Nevertheless, substitutions must be made and conservation practised. According to the soberest estimates of the military supply organization and of the Office of Production Management, the nation was going to run short of rubber and rubber substitutes to the amount of 266,000 long tons within the next two years. Other services were able to substitute less critical materials in many instances: for example, steel wheels for rubber on certain engineering equipment, such as concrete mixers and portable air compressors, and plastics for rubber in enlisted men's combs. Rubber boots could serve their purpose if made with 47 percent rather than 62 percent rubber; it was possible that tank tracks could be made of metal instead of rubber.[29]

But the Signal Corps was left with the fact that its most important field wire required rubber, that no known synthetic could substitute, and that the new lightweight assault wire W–130 offered almost as troubling a problem. Laboratory tests with insulation made of plasticized vinylite resin or a latex made from neoprene or

[27] Memo, USW for CSigO, 12 Jan 42. SigC FM 381.3 (PP) Rubber and Rubber Goods, No. 2, Drawer 663.

[28] (1) Incl, Substitution of Synthetics for Rubber, with OCSigO R&W Action 1, Proc Plan Sec (L. H. H.), to O/C Proc Plan Sec, 14 Jan 42, sub: Rubber substitutes; (2) Msg, SigC Labs, Ft. Monmouth, to OCSigO, 16 Jan 42; (3) OCSigO R&W Action 1, Proc Plan Sec to O/C, 16 Jan 42, sub: Rubber latex. SigC FM 381.3 (PP) Rubber and Rubber Goods, No 2, Drawer 663.

[29] Erna Risch, *The Quartermaster Corps: Organization, Supply, and Services*, I, UNITED STATES ARMY IN WORLD WAR II (Washington, 1953), 66–68.

buna gave satisfactory results on W–130, but these substitutes could not be applied with the same machinery that produced natural latex coating. Government-financed units for applying liquid latex had barely come into production, and any change to substitutes which had to be applied by the extrusion process would mean different machinery. In view of the existing machine tools shortage, such a change would create a delay of from six months to a year in the delivery of the wire.[30]

Finding rubber substitutes for cable insulation also presented difficulties. In 1941 when radar production began to mount, the Signal Corps had begun what was to be a protracted search for a suitable dielectric for insulation of the ultrahigh-frequency cable required in great quantities for aircraft radar installations. There was not enough rubber to permit its use, and both the Navy and Signal Corps were trying to find a satisfactory synthetic that would be available in sufficient quantity.

A British firm had been making a satisfactory material, known as polythene or telcothene, but there were no existing facilities for its manufacture in the United States, and the British were not making enough for even their own needs. Since the Du Pont Company had been licensed to manufacture polythene under the British patents and had some knowledge of the processes involved, it offered to send some of its engineers to England to study the British method of production. Even if Du Pont succeeded in making polythene, it would be at least a year before there would be enough of it, particularly since cables insulated with the material had to be replaced every six months. So while the Du Pont engineers went to England, the Signal Corps searched for a substitute for polythene.[31]

The most promising appeared to be a material called Vistanex, a rubberlike product made entirely from petroleum. During the winter, five wire and cable companies had produced samples of cables insulated with Standard Oil Company's Vistanex compounded with filling ingredients. The Naval Research Laboratory, to which the samples had been submitted for testing, had found that three of the companies, American Phenolic Corporation, General Electric, and Simplex Wire and Cable Company, had developed a Vistanex base compound which met the Navy's tentative specifications for ultrahigh-frequency cable. Other American manufacturers experimented with other cable insulating materials. In February, when the Du Pont engineers returned to the United States with their report, officers and civilian engineers from the Office of the Chief Signal Officer and from the Bureau of Ships and Office of the Chief of Naval Operations met with representatives of the War Production Board to decide which type of insulation to use on cable. The Du Pont engineers' report on polythene was discouraging. That the British would produce their own quota of 700 tons in 1942 was highly problematical. Serious difficulties of manufacturing technique showed that it would be impractical to attempt quantity production of polythene in the United States by the English process in any reasonable

[30] (1) OCSigO R&W Action 1, R&D Div to Proc Plan Sec, 22 Jan 42, sub: Rpt of confs on the conservation of rubber and aluminum held 16 Jan 42 in OUSW. (2) WD Bureau of Public Relations, Press Release 901, 29 Jan 42. (3) Memo, Col Cuny, OCSigO, for USW, 20 Jan 42, sub: Conservation of rubber. SigC FM 381.3 (PP) Rubber and Rubber Goods, No. 2, Drawer 663.

[31] L. H. Drake and F. W. Thomas, Philadelphia SigC Proc Dist, Industrial Summary: Signal Corps Procurement of Wire and Cable, 1 Jun 46, Supplement 1, p. 20, SigC Hist Sec File.

time. Du Pont hoped to be able to work out a better method of manufacture in time, but it was clear that this source of insulation for ultrahigh-frequency cables could not be depended upon for the immediate future.

That left the Vistanex compounds. Standard Oil Company's Bayway Plant, the only producer of the material in the country, was turning out no more than 45 tons a month. A new plant under construction would not be in production until early 1943. The War Production Board had already allocated the current production, keeping 30 of the 45 tons for domestic consumption; the remaining 15 tons were allocated to the British and Russians by executive order to provide a fractional part of what they needed. The Signal Corps had an allocation of only five tons monthly for wire and cable, and this calculation had not provided for ultrahigh-frequency cable since the supply organization had counted rather heavily on the ability of Du Pont to produce polythene.

The conferees thus reached the sticking point of the meeting: how were the Army and the Navy to get the 500 tons of suitable synthetic for the 1942 production of ultrahigh-frequency cable? Before the close of the conference everyone agreed that the cable should have first priority on Vistanex; that the Joint Army and Navy Munitions Board should ask the Reconstruction Finance Corporation to acquire a 500-ton stockpile of Vistanex and reallocate it to the wire and cable companies for manufacture of the ultrahigh-frequency cable; and that Du Pont's neoprene, a special-purpose rubber, should be used as a substitute for the items on the original allocation schedule.[32]

The difficulties of the Signal Corps in its attempt to bring field wire and cable into the rubber conservation program brought about an important conference in the Office of the Chief Signal Officer on 11 February 1942. The chairman was Col. Byron A. Falk, a Signal Corps representative in the Office of the Under Secretary of War. Officers and engineers from the Procurement and Research and Development Divisions of the Signal Corps, and from the Monmouth laboratories met with the principal manufacturers of wire, cable, rubber goods, and synthetic rubbers to attempt to find a solution. How could the Signal Corps conserve rubber in wire insulation without worsening the performance of the wire? The conferees agreed that for immediate conservation, the best plan was to reduce the percentage of new rubber used in W–110–B insulation, and substitute reclaimed rubber. For the long-range program, they discussed ways of eliminating rubber entirely and substituting synthetic compounds. It was obvious that more experimental work in the use of synthetics was in order. The most recent field tests with assault wire insulated with vinyl resin plastic had been unsatisfactory: the wire had been difficult to handle, would not lie flat on the ground, and was hard to splice. Most of the suggestions for varying the amount of rubber used also involved some change in manufacturing methods which would slow down production.

[32] OCSigO Proc Div, Proc Plan Sec, Daily Hist Data, 6 Feb 42. SigC 314.7. Data sheets were maintained by all sections of the Procurement Division, OCSigO; all bear the Dewey classification number 314.7. Folders referred to in this chapter are: Proc Div, O/C, 1 Dec 41–31 Jan 42; Proc Div, Prod Exped Sec, 1 Nov 41–2 Jan 42, 1 Jan 42–16 Feb 42, 29 Mar 42–30 Apr 42, 5 May 41–21 May 42; Proc Div, Proc Plan Sec, 1 Nov 41–15 Feb 42, 1 Jan 42–4 Apr 42; Proc Div, Pur Sec, 16 Nov 41–30 Jan 42, 1 Feb 42–12 Oct 42, 1 May 42–21 May 42; Inspec Sec, 15 Oct 41–28 Feb 42. Hereafter these will be referred to as Daily Data (with appropriate section and date of report).

Nearly all of the wire and cable manufacturers thought they could use reclaimed stock to replace a part of the new rubber, and calculated the quantities of natural rubber used by their firms per mile of W–110–B, ranging from 18 to 22 pounds. A questionnaire sent out to the companies after the meeting brought more detailed statements and disclosed the fact that none of the companies had used any synthetic rubber at all, that only one had used any "reclaim," and that the variation in amount of crude rubber used (from 14.75 to 22 pounds) suggested that some manufacturers were trying harder than others to conserve the material. Western Electric, the most economical user of new rubber in the manufacture of cable, had offered to share its compounding information with its rivals.

Uneasily, the Signal Corps considered limiting the amount of rubber per twisted-pair mile. It had already revised specifications to permit 30 percent depreciation of physical properties of the insulation through aging; the standard had been 25 percent. A field engineer thought that the consumption of crude rubber could be reduced considerably by proper compounding, but warned that until the Signal Corps established a maximum weight of rubber per mile, most of the manufacturers would continue in the old pattern. He recommended immediate limitation of the amount to 18 pounds of crude rubber per mile, and in sixty days a further reduction to 15 pounds, about what Western Electric was using.[33] The general development engineers favored the proposal, but the facilities and materials men feared that some of the manufacturers lacked the technical ability as well as the necessary equipment to operate under the 18-pound limitation.[34]

Although wire and cable did not yield easily to conservation requirements, there were other types of Signal Corps equipment that proved more amenable to change. Parking wheels on trailers did not need rubber tires, and neither did reel cart wheels. Engineers estimated that nearly 5,000 pounds of rubber could be saved on these two pieces of equipment alone during the fiscal year 1943. Because radar equipment was delicate and extremely intricate, and because the vehicles on which the sets were mounted were expected to maintain the speed of antiaircraft guns on the move, both laboratory and staff specialists recommended against trying anything other than rubber tires for these vehicles. By various means the Signal Corps conserved 255 tons of crude rubber in 1942. These savings multiplied in 1943, reaching 3,500 tons.[35]

Crystal Quartz

The basic decision to adopt crystal control for vehicular radio had been firmly established late in 1940.[36] The program for

[33] Memo for File, Byron S. Anderson, SigC Fld Lab No. 2, Eatontown, N. J., 1 Apr 42, sub: Recommendation for immediate curtailment of crude rubber consumption in manufacture of wire W–110–B, Incl with Memo, Maj Norman I. Adams, Jr., O/C Fld Lab No. 2, for CSigO, 1 Apr 42, sub: Rubber conservation in wire W–110–B. SigC FM: Rubber Conservation 1942.

[34] OCSigO R&W Action 1, Gen Dev Div to Proc Plan Sec Proc Div, 7 Apr 42, sub: Rubber Conserv in wire W–110–B; Action 2, Fac and Mat Div to Gen Dev Div, 14 Apr 42. SigC FM: Rubber Conservation 1942.

[35] (1) Msg, SigC Labs, Ft. Monmouth, to OCSigO, 11 Apr 42; (2) OCSigO R&W Action 2, R&AC Br to Scheduling Div, 16 Apr 42, sub: Conservation of rubber. SigC FM 400.12 Conservation of Rubber. (3) Novick, The Signal Corps Policy of the Conservation of Critical and Strategic Materials, p. 12.

[36] Terrett, *The Emergency*, p. 182.

increasing the number of crystals by a more economical use of the insufficient supply of raw quartz immediately became inadequate, once war was declared. The Signal Corps had to act swiftly and effectively. An enormous increase in production had to come about and before that could be realized, the crystal-cutting handicraft had to be transformed into an industry; a manufacturing art had to shift from laboratory to mass production. Prospective manufacturers of oscillator plates had been hard to find prior to 7 December 1941, but by the turn of the year they were presenting themselves at district offices and in the Office of the Chief Signal Officer in large numbers. It was clear that many new factories would have to be established to provide for the wartime needs of the armed forces, but it was equally clear that any new manufacturer of crystal plates was going to have a hard time finding skilled workers and tools for his plant.

On the recommendation of the Army Communications and Equipment Coordination Board and the Civilian Advisory Board, following a February survey of the crystal situation, the Chief Signal Officer established a Quartz Crystal Coordination Section in the Materiel Division under the direction of Lt. Col. James D. O'Connell to get "the rapid disorderly growth of the industry under control" and to clear the way for mass production of crystal units.[37] The new section had its own problem of personnel shortage, but beginning with 2 officers and 11 civilians, it developed a nucleus of highly qualified engineers, physicists, and crystallographers. By June, the staff had grown to 40, but the work load increased far more rapidly.

To realize the primary objective, which was to help the manufacturers build up their facilities to the point where production could meet requirements, the section devised an extensive technical program, dividing it into three phases. First, the technical staff visited the old-line crystal manufacturers, observed their techniques, obtained full descriptions of methods, processes, and equipment used, including blueprints, diagrams, instruction booklets, and photographs, and with this material established an information pool to provide the latest technical information. Thus the newcomer to the field and the small manufacturer of longer standing could profit by the most up-to-date developments worked out within the shops of Western Electric, Bendix, and other large companies. Second, this section established an equipment pool, with the Defense Supplies Corporation providing $1,500,000 in contracts for mass production of the equipment. As long as machine tools remained critical, the section allocated them from the pool. Third, staff members made field trips to the factories to help the manufacturers not only with technical information and equipment from the pools, but also with financial and priority problems. Basic to this educational program for the industry was a handbook issued by the section, which established a standard terminology so that for the first time a given term had the same meaning throughout the industry.

The Signal Corps selected prospective manufacturers on the basis of demonstrated ability to produce acceptable crystals at the minimum rate of 500 per week. To encourage promising applicants, there were educational orders and development contracts. At the same time the Signal Corps urged firms with prewar experience in crystal fabrication to expand and to develop sub-

[37] Memo, Col Crawford, Com Coord Br OCSigO, for CSigO, 28 Feb 42, sub: Case 23—Crystal rqmts. SigC C&E Case 23 Crystal Rqmts.

HAND-FINISHING A CRYSTAL. *Crystals so finished were then checked electronically by the beat frequency method for accuracy.*

contractors, making government funds available to those who were unable to finance their own expansions. Gradually the number of facilities increased. At the outbreak of war there had been only twenty-nine; by the end of the fiscal year there were thirty-five, and most of the original number had effected expansions. To combat the shortage of skilled workers, the Signal Corps carried on a training program for engineers at Camp Coles during this period and then sent the graduates to the plants to conduct training programs among workers.

While the Signal Corps was getting the situation in hand with respect to facilities, techniques, tools, and skilled workers, another problem arose in the form of a price dispute that for some months interrupted the flow of raw quartz from Brazil to the United States. Despite the precariousness of basic supply, some good came of it. The shortage of raw quartz made the manufacturers more willing to accede to the Signal Corps' proposals for smaller, thinner crystals for economy's sake.[38] Until the wartime shortage confronted them, crystal manufacturers had made oscillator plates with a surface measurement of about a square inch and a thickness of about a sixteenth of an inch. There had been no insistent reason for this practice; it was merely that the manufacturers always had made plates that

[38] Terrett, *The Emergency*, pp. 181–82.

size. Now, by a process of predimensioning, they were able to reduce the size till the plates averaged less than 3/10 of a square inch in area, with a thickness of 15/1000 to 18/1000 of an inch.

Also, the sudden need for crystal units by the millions stimulated some major developments in manufacturing techniques. First in order of importance was the adoption of X-ray diffraction equipment for control of cutting angles, the first instance of using X-ray diffraction in a production line as part of a manufacturing procedure in this country, and the key to mass production of crystal units. Bell Telephone Laboratories had pioneered this work before the war. In the first spring of the war, the Signal Corps encouraged the work and spread the technical information throughout the industry. North American Phillips X-Ray Company and the General Electric X-Ray Corporation designed and manufactured the equipment. Another Bell Telephone contribution was the process of etching to frequency as a means of retarding deterioration of the oscillator plate. Working with the Signal Corps Laboratories, Bendix developed improved cutting techniques and contributed to the design of crystal lapping equipment. G. C. Hunt and P. R. Hoffman Companies developed the precision planetary lap. Galvin Manufacturing Company perfected the milling method of finishing crystals. Reeves Sound Laboratories applied X-ray irradiation procedures to adjusting crystal frequency and developed safe etching compounds.[39]

Steatite

As in the case of quartz crystal, the shortage of steatite threatened to upset Signal Corps wartime procurement. Just as high frequency radio and radar performance depended on the piezoelectric property of crystal wafers for holding a desired frequency, it depended upon the dielectric property of fired steatite parts for providing the means of high frequency operation. Fired shapes of steatite with their remarkable imperviousness to extremes of temperature, moisture, dryness, and acids, were used for insulators, such as grid spacers in high frequency transmitter tubes, and for cores, bushings, and resistors in radio, radar, and other electronic equipment. Steatite was critical throughout the war, but it was especially precarious during the first year and a half.

The Army could thank its Signal Corps procurement planners that the situation was not even more desperate. For more than a year, the Signal Corps had done what it could to increase steatite production despite industrial indifference, special problems of manufacture, and distance between the source of supply of raw material and the manufacturing plants. It had sparked the industrial expansions in six companies that were expected to increase dollar value of production by about $9,000,000 by the end of the year. Now, with armament estimates rising relentlessly, and with hundreds of steatite parts required for every airplane, every tank, every aircraft warning installa-

[39] (1) Mary-louise Melia, The Quartz Crystal Program of the Signal Corps, 1941–1945 (1945), SigC historical monograph B–15, pp. 61–63; (2) Quartz Crystal Coord Sec, Gen Dev Br OCSigO, Handbook for the Manufacture of Quartz Oscillator Plates, 20 Aug 42, pp. 72–74. SigC Hist Sec File. (3) Daily Data, Proc Plan Sec, 12 Mar 42. SigC 314.7. In 1943, the Camp Coles Signal Laboratory developed a standard test oscillator to test a crystal under a great variety of conditions, resulting in improved quality of the crystal units produced, and the various laboratories devised holders for the crystals that would withstand tropical heat and humidity.

tion, it seemed likely that the best it could do was not going to be good enough.

The Joint Army and Navy Munitions Board took official cognizance of the seriousness of the problem in February by creating a special steatite committee. Thereafter all military needs could be figured and dealt with through co-operative effort. The first estimates of the committee in February showed that Army and Navy requirements for steatite would reach a value of $27,000,000 during the year; corresponding estimates of possible production, taking into account all known plant expansions to be made, stopped short of $20,000,000, and it was expected that the year 1943 would bring a 100-percent rise in requirements.[40]

With the declaration of war, the manufacturers lost much of their fear of large-scale expansion, but the existing plants could not be expanded much further because of the critical shortage of machinery and machine tools and the difficulty of getting additional supplies of them manufactured. The established manufacturers began to co-operate much more closely with the Signal Corps. For instance, they volunteered to survey tile and porcelain manufacturing plants to see whether any could convert to steatite manufacture.[41] They also undertook research to develop substitutes of plastic or glass, though neither proved satisfactory. A valuable contribution by the industry was its experimentation with substitutes for steatite talc, which demonstrated that other materials or the lower grades of talc could be used for a number of commodities needed by the military organization thus releasing some of the steatite grade talc for electronic purposes. No substitute for steatite talc could be found for insulators.[42]

Disturbed by the Army and Navy Munitions Board Steatite Committee figures, the director of the Signal Supply Service, General Colton, asked Col. Louis B. Bender to make a special study of Signal Corps steatite requirements. The steatite crisis delayed Signal Corps equipment deliveries during April and May, even though total steatite production in those months was 15 percent and 19 percent greater than the combined requirements of all users. Behind this seeming anomaly lay a notable lack of systematic scheduling of production on the manufacturers' part to obtain a proper balance between the hundreds of types of parts needed. Signal Corps contractors were provided with enough of the simple, easily produced parts to last for months, but had none at all of other types needed for current production. The steatite manufacturers, faced with schedules they considered impossible to meet anyway, often chose to neglect certain items ordered and kept on making large quantities of others, particularly the simple parts on which newly hired employees could be trained. Buyers had to share the blame because they often neglected to place their orders early enough. They ordered other components as soon as they got their contracts, but steatite parts seemed so simple, so innocuous, that they neglected them, then were distressed when they could not get delivery within two to four weeks.

[40] OCSigO R&W, Capt K. M. Soukaras to Col Rives, 5 Mar 43, sub: Steatite insulation. SigC 413.44 (Ceramics).

[41] Daily Data, Proc Plan Sec, 8 Feb 42.

[42] (1) John B. DeMille, *Strategic Minerals, A Summary of Uses, World Output, Stockpiles, Procurement* (New York and London: McGraw-Hill 1947), pp. 468–78. (2) I. D. Adams, Industrial Summary: Signal Corps Procurement of Radio-Grade Insulation with Recommended Operating Procedures, 15 Feb 46, p. 16. SigC Hist Sec File.

Bender pointed out these things in his report of 1 July. He also estimated that the Signal Corps would not require as much steatite as the Army and Navy Munitions Board report had indicated. But he warned that the crisis would come in July, when steatite production would be only 87 percent of the amount required, with the next two months too close for comfort. He cited what could be done: redouble efforts to complete expansions, particularly in the matter of providing machine tools; make more use of substitutes; institute a less rigid inspection of steatite parts, accepting parts with chips, bubbles, discolored spots, ridges, and warpage so long as the defects did not affect the performance, reliability, or life of the part; and last, institute closer control over steatite production schedules and distribution to assure that only essential products were made, and that they went where they were needed most.[43]

Shortly after the opening of hostilities, the Signal Corps enlisted the aid of the Bureau of Mines and the Geological Survey to locate new sources of steatite talc. The search was to continue throughout the year, but already there were indications of new sources in California, Georgia, New York, Maryland, Montana, New Mexico, and North Carolina.[44] Altogether, General Olmstead was not entirely whistling in the dark when he reported at a conference on supply problems on 18 June: "The steatite problem looks brighter for the future. . . ." [45]

[43] Adams Summary cited n. 42(2), Exhibit 2, Memo, Dir of Sig Supply Sv OCSigO for O/C Fac and Mat Br OCSigO, 3 Jul 42, sub: Study of SigC rqmts for steatite products and outlook for meeting them, with Incl, Rpt by Col Bender, 1 Jul 42, same sub.

[44] DeMille, *Strategic Minerals,* p. 472.

[45] Supply Sv OCSigO, Review of Prod Plans, 18 Jun 42. SigC DS 337.

Aluminum

Aluminum was one of the materials that procurement planners had known to be critical well before the opening of hostilities. It was not that deposits of bauxite, from which aluminum is extracted, were scant, for the United States is rich in bauxite; but as soon as the President launched the 50,000-airplane construction program in May 1940 the sudden demand for the enormous quantities of aluminum that would be needed taxed productive capacity. In spite of great expansion on the part of the Aluminum Company of America, the only major manufacturer of the metal either before or during the war, it took several years of production of aluminum to catch up with the vast requirements of global warfare. In February 1942 Maj. Norris G. Kenny, in opening a meeting in the Office of the Under Secretary of War to consider aluminum in relation to Signal Corps requirements, stated that although production of aluminum was doubling and redoubling (60,000,000 pounds a month in 1941, 120,000,000 pounds a month in 1942, and an expected 250,000,000 a month in 1943) there still would not be enough to meet the requirements of the war. At this time the Air Corps was using two thirds of the Army's entire allocation; of the remaining third, the Signal Corps received 10 percent.[46]

The Signal Corps, as a substantial user of primary grade aluminum, had lost no time in developing a conservation program. Its development engineers made a thorough study of all signal items that contained

[46] (1) Ltr, Gen Dev Div, OCSigO, to Dir of SCGDL, 12 Feb 42, sub: Program for reduction of SigC rqmts for strategic materials; (2) Gen Dev Div OCSigO, Preliminary Rpt on Aluminum for SigC Rqmts, 20 Feb 42. SigC 410.2 (Aluminum).

aluminum, experimented with them, tested them, recommended savings in quantity or quality, and in many cases substituted steel, bakelite, paper, plastics, zinc, or brass for aluminum parts. They had to advance cautiously; the substitutions could not be allowed to interfere with the performance of the equipment or to require such excessive redesign of the equipment as would call for retooling and so result in delayed production.

Redesigning the SCR–245 radio offered an opportunity to substitute steel for 12 percent of the aluminum needed for the set, which was being adapted for use in tanks, where lightness was not an essential characteristic. Revising the specifications for the ML–510 timing device used with the ML–47 theodolite permitted a saving of three and a half pounds of aluminum for each timer; on the order for 500 placed in February this change represented a saving of 1,750 pounds of aluminum. Substituting steel for aluminum in the mast of the medium-range ground radio SCR–177–B saved 30 pounds a set. In certain items, such as the paratroop set SCR–536, the handie-talkie of a later period, where lightness was imperative, it was impracticable to use heavier substitutes, but in many of the lightweight items it was possible to substitute a cheaper or more easily obtainable aluminum alloy for a scarcer one.[47]

These and other substitutions saved 1,500 tons of aluminum in the fiscal years 1942 and 1943. By the end of 1943, aluminum was in plentiful supply.

[47] Memo, Prod Exped Sec for O/C Proc Div OCSigO, 31 Jan 42, sub: Daily hist rcd of important SigC proc proceedings, with 1 Attachment, Aluminum Conservation in Sig C. SigC 314.7–OCSigO Proc Div, Prod Exped Sec, 1 Jan–16 Feb. 42.

Production Expediting

It was inevitable that the effort to expand production so rapidly in the face of new war-born restrictions and controls, the shortage of materials, and the lack of experienced suppliers, should call for a corps of industrial trouble shooters from the military agencies. Within the Signal Corps, this duty fell to the Production Expediting Section of the Office of the Chief Signal Officer. Probably no other section was more immediately affected by the enormous expansion of the production effort. The section had been organized in August 1941, one of the first of such units to be established in the War Department although big business employed expediters regularly.[48]

Foreseeing two months before Pearl Harbor that office administration might become chaotic, General Olmstead had called in a firm of consulting management engineers, Wallace Clark and Company, to assist the Signal Corps in setting up administrative procedures to keep pace with the military preparations. He hoped that their services would compensate in part for the lack of a tightly knit, experienced management organization of adequate size, and for the newness and greenness of administrative units which overnight had expanded from a handful of workers experienced in Army ways to hundreds and thousands who were inexperienced. It was an innovation in management practice, and the Services of Supply had scarcely been established when General Somervell was called upon to explain why the Signal Corps could not run its own business. Why, asked Congressman Andrew Edmiston of West Virginia, was

[48] Min of Coord Committee of Com Prod Advisory Bd, 26 Jan 42, remarks of Dr. W. R. G. Baker, vice president GE Co. SigC 334 Com Prod Advisory Bd, Vol. 3, 1942.

it necessary for the Signal Corps to hire Wallace Clark and Company to manage it at the rate of $53,000 a year? Somervell, who had known the company for "many years," replied that he thought it "excellent" and was confident that it could perform management services "in a much more economical manner" than the Army could.[49]

The management engineers served as fact-finders and advisers only. Many of the Clark studies were directed toward simplifying the flow of work through the supply organization with a view to expediting industrial production. They noted a number of obstacles in the way but admitted there was little the Signal Corps could do about some of them. They pointed to the yearly basis of the Army Supply Program, to the quarterly basis of the Training and Mobilization Plan, which in turn was predicated on a different troop basis from that used for the Supply Program, and to the Expenditure Programs which matched neither. Here was confusion, but confusion that was the order laid down by the War Department for the Signal Corps to follow.

The Wallace Clark methods included the design of suitable flow charts and executive control charts and the planning of efficient techniques of management. The firm examined and synchronized delivery schedules and precedence lists, proposed new ways of doing things, and recommended procedures for carrying out the proposals. They suggested shifts in responsibility; in some cases decentralization of functions from the Office of the Chief Signal Officer to the field and the establishment of new field agencies. In some instances their recommendations seem to have stressed routine to the point of losing sight of purpose, that is, centralized control but decentralized operation. The Chief Signal Officer gave the firm complete freedom to peer into all functions and procedures, to work with employees and management at all levels, and to move its consultants about, within, and between installations, in order that they might get a complete picture of the interrelationships of Signal Corps agencies and in order that the entire Corps might benefit from the surveys. The Production Expediting Section was one of the first to come under the scrutiny of the Wallace Clark firm, whose experts felt that the unit was weak. They found that as many as six Signal Corps representatives from different units had upon occasion descended upon a factory with no agreement among them as to what expediting involved. The Signal Corps, lacking a united front, was fair game for the contractor who wanted to play off one expediter against another.[50]

The Wallace Clark production engineers set up a plan that divided the continental United States into 100 areas, each with an expediter attached to the Procurement District in which the area was located, but merely "for matters of discipline and for cooperation." The expediters would be free to come and go and to use the facilities of the district offices, but they would be under the functional supervision of the Production Expediting Section of the Office of the Chief Signal Officer. The field expediter for an area would triumph over cross-purposes and duplication by making sure that he accompanied any officer or employee sent to a factory in his area. So argued the Wallace Clark experts, and the Chief Signal Officer

[49] (1) Memo, Brig Gen Wilhelm D. Styer, CofS ASF, for Gen Code, Asst CSigO, 30 Mar 42; (2) Ltr, Somervell to Hon. Andrew Edmiston, HR, 30 Mar 42. Hq ASF CofS File.

[50] Ltr, Wallace Clark and Co. to Olmstead, 6 Oct 42, sub: Summary rpt 11. Summary Rpt 11, Wallace Clark and Co., Review of Progress. SigC Hist Sec File.

agreed. They accordingly set up a training program for the initial 100 expediters. It covered one week of indoctrination, a visit to Fort Monmouth, instruction in factory scheduling, and one week in actual field work. The Clark firm prepared a comprehensive manual covering the points to be considered by an expediter on visits to a contractor, such as checking his bills of material, raw materials, tools and fixtures, labor supply, plant load, production control methods, and factory organization.[51]

The Signal Corps expediters worked in a very broad field. They were concerned with production problems of the entire communications industry, not with those of just one company. Their duties took them into many plants; they had to have a working knowledge of the industry as a whole, and of many factors affecting production: facilities, materials, shortages, personnel, equipment types and standardization, packaging, sources of supply, transportation, storage, and others. Above all, they had to have constantly in mind the broad outlines of Signal Corps procurement policy and the production goals that were to be reached. In many ways, their duties touched and overlapped those of other sections, especially in the field of procurement planning, despite the fact that their concern was mainly with what happened each day, or the next day, or the next week, while the planning sections dealt with the projection of the large procurement plan into the months and years ahead. Yet at the same time, the expediters could not ignore the distant goal nor take actions that would seriously affect future programs. They had to be men of great versatility and expert knowledge, with a very sure touch. Such men were not easy to find.

[51] Ltr, Wallace Clark and Co. to Olmstead, 4 Feb 42, sub: Summary rpt 1. Summary Rpt 1, Wallace Clark and Co. SigC Hist Sec File.

Both the War Department and the Civil Service Commission had believed that the many applications on file with the commission would yield an ample supply of qualified engineers. But the application forms were out of date. Many of the men could not be located, and of those who could be, many were not qualified. No precise classification for the expediters existed in Civil Service records. Job descriptions were set up after numerous conferences and consultations between the Civil Service Commission and the Signal Corps. There remained the salary problem. Numerous men whose abilities were just what the Signal Corps wanted refused to work at the Civil Service salary levels. Eventually an agreement to base the annual salary offer on the average of the applicant's preceding five-year period of earnings proved successful.[52]

Civil Service channels alone could not dredge up enough qualified men. Officers and civilians carried on their own recruiting campaigns. Letters went to likely candidates all over the country. Industry spread the news. Procurement district officials kept their eyes open for candidates. So did other Signal Corps agencies, the War Production Board, and the Office of the Under Secretary of War. One group of men came on duty because the motor industry was languishing under the shut down of the pleasure-car trade.[53]

By March 1942 the Expediting Section within the Office of the Chief Signal Officer had twenty-five men, including a group of engineers who worked with particular industrial materials such as ceramics,

[52] Ralph H. Clark, Expediting Activities of the Office of the Chief Signal Officer, August 1941–June 1944 (1945), SigC historical monograph B–14, p. 12. SigC Hist Sec File.

[53] Daily Data, Prod Exped Sec, 29 Mar–30 Apr 42.

quartz crystals, and tantalum. There was also a section handling machine tools, jigs, and equipment programs on new contracts. Assigned from the procurement districts to plants of the principal Signal Corps contractors and subcontractors were thirty engineers, with others being added at the rate of ten per week. Each of these men had to master an intensive training course in the Washington section before he moved out to a field location, taking with him the formidable 150-page Wallace Clark manual of instructions and information.[54]

The months from March to June 1942 were grueling for the men in Production Expediting. The urgency to get out equipment overwhelmed them; for each problem solved, a dozen rose to take its place. Time became the most precious commodity in the world. Every stenographer typed "Tomorrow Won't Be Good Enough" onto letters. Letters were not good enough, as a matter of fact; the telephone and the wireless were the accepted tools of trade. Especially in the procurement districts, the men went into factories to see for themselves what was needed. Half their time was spent in field contacts, and, in many cases, an expediter was assigned to a single plant as a resident trouble shooter. Their activities touched upon many a sore spot in the procurement body. By following a field engineer or a staff expediter around for a couple of days, a man from Mars would have had a fairly comprehensive idea of where the chokepoints in the procurement program lay.

For example, smaller plants converting to war work needed help. The Fred M. Link Company was making tank radio sets SCR–293 and 294 for the Signal Corps. At the same time, peacetime orders for police and plant protection equipment clogged the company's books. Expediters found companies that could not make Signal Corps equipment, but could turn out the civilian sets, and arranged to have these concerns subcontract them, leaving the Link Company free to get out the tank radios on schedule. Again, the Connecticut Telephone & Electric Company had a contract for 15,000 EE–8 telephones, and a very short time in which to produce them. At first it looked hopeless, but expediters helped out by getting materials, following up deliveries, and suggesting ways of speeding and smoothing the manufacturing processes. The telephones were delivered three days ahead of schedule.

Often the delivery of a small part or a piece of machinery used in a manufacturing process saved weeks or months of time. Expediters got air-blast cleaning equipment needed in the manufacture of radio receiver BC–312 on 1 April instead of 1 June. They saved six weeks on the delivery of five radio transmitters to the British. They provided four X-ray machines for Western Electric for crystal grinding test equipment a month ahead of time. They secured a small reserve of spring copper for a company that could not fabricate cutting blades for the quartz crystal trade without it. They saved three weeks' time by speeding up the delivery of binding head screws which threatened to delay Gilfillan Brothers on the interphone RC–27. With their help, Hewlett-Packard saved four weeks' time in delivering parts for filter equipment used by their prime contractor, Airadio, Incorporated. A speed-up of three weeks on delivery of brass shells from the Ramsdell Tool Company permitted the Lundquist Tool and

[54] Memo, Dir of Supply Sv to Deputy CSigO, 8 Mar 42, sub: Prod schedules. SigC 400.192, Prod Exped 6, 1–20 Mar 42.

Manufacturing Company to deliver certain items to its contractor, A. J. Ulmer. Westinghouse was building switchboard BD–57, but a subcontractor delivered faulty commutators. Expediters arranged to have the commutators sent back and reworked, shipped to Westinghouse by air express, and assembled and inspected on Sunday in order not to stop the Westinghouse production line. Teletype Corporation needed small motors, but could not specify exactly how many, nor when it would need them. Expediters worked out an arrangement with General Electric to build up a bank of these motors so that they would be on hand when Teletype needed them. When Lapp Insulator was reduced to a three-day supply of mast subassemblies, secured from the American Phenolic Corporation, expediters had two hundred of them on hand within twenty-four hours, and a promise from American Phenolic to deliver future requirements on schedule.

The production expediters were not primarily concerned with the problems of substitution of materials, but their work brought them into contact with the matter, and they sometimes acted as liaison men between firms and the other offices of the Signal Corps. They succeeded in getting a satisfactory substitute for sheet aluminum that Crosley Radio Corporation needed for the 13,000 sets of radio SCR–284 it was building. They got a different type of 200-watt transmitter for a radio station, and saved a month's time. They interceded to win permission for Bendix to replace steatite resistors and switch bodies with porcelain.

Sometimes it seemed that every firm in America wanted a higher priority rating, and wanted the Production Expediting Section's help in getting it. Everybody needed nickel, mica, aluminum, steatite, tantalum, copper, or some other scarce material. Expediters often interceded with the War Production Board to get allocations of material. Quite naturally, every firm engaged in war work felt that the order it was fabricating was more important than any held by another firm. It was part of the expediters' ticklish problem to know which actually did have precedence and to help those firms most critically in need of assistance. For example, the Murdock Manufacturing Company's threatened shutdown in its production of headset HS–39 was averted when expediters obtained a release of 6,000 pounds of crude and 6,500 pounds of reclaimed rubber. Lapp Insulator Company could not get the cone-pointed machine screws it needed from Rochester Machine Screw Company because that company had a large bank of other orders, all carrying the same A–1–A priority rating. Stromberg-Carlson could make the screws but did not have the steel. Rochester turned over part of its steel to Stromberg-Carlson, and Lapp Insulator got the screws it needed on time.

Expediters got the consent of the Department of Interior to refine American crude oil into penetration asphalt for electrical cables to replace asphalt previously received from Colombia, Mexico, and Venezuela. They got a WPB release for typewriters with special type and spacing, which Philco needed to type calibration charts for the SCR–211 frequency meter set, as well as 10,600 rubber bushings for aircraft shock absorbers. They found mycalex hub insulators required for assembling antenna reels and shipped them air express to Aircraft Accessories Corp. They arranged with the Air Corps to divert enough aluminum to Western Electric to finish up the command sets, SCR–274. Westinghouse got the steel tubing it needed

for SCR–270 towers, and saved a month's time.

Crystals were in short supply everywhere. At Bendix, the resident expediter checking the crystal stock found it so low that inspection of SCR–211's would soon have been stopped. He got enough crystals to keep the production and inspection lines going smoothly. Both Cardwell Manufacturing Company and Zenith Radio got their crystals from General Electric. Cardwell had enough; Zenith had almost none on hand. Expediters arranged to divert a Cardwell order to Zenith to keep both turning out SCR–211's. A Signal Corps resident expediter at RCA earned a commendation for his assistance in expediting shipment of tubes and crystals for a radio transmitter at Generalissimo Chiang Kai-shek's headquarters in China. The Donald M. Murray Company, one of the principal suppliers of quartz crystal, chartered a freighter airplane to transport quartz from Rio de Janeiro to relieve the desperate shortage of quartz. Through co-ordination with the Air Priorities Section of the Department of Commerce, Signal Corps expediters arranged air freight to replace the ballast customarily used on the chartered plane, thus bringing the price of the quartz down from a dollar and a half to a dollar a pound. The White House signal detachment needed twelve special radio crystals. To get them, it looked as if production lines from regular crystal suppliers would have to be disrupted. Expediters found two sources of supply, which together could furnish the required crystals. They were shipped the same day the order was placed.

There were other problems that did not fall into any convenient category, but which were important in their effect on the war effort. Expediters developed a method for drying the generator cases of the SCR–284 in four hours instead of the original forty. On the west coast, they persuaded officials of the Southern Pacific Railroad to change train schedules so that a number of commuting employees of the Eitel-McCullough Company in San Bruno, California, could get to work on time. In the east, they arranged a meeting between executives of the Bliley Electric Company and the New York Central Railroad, and worked out an agreement for additional space from the railroad to house Bliley's office and engineering department, for which Bliley had been negotiating unsuccessfully for months. At Erie, Pennsylvania, not only Bliley but also the Burke Electric Company had been trying to effect simple changes. For two years Burke had wanted a traffic light installed at a busy intersection. An expediter visited the mayor of Erie and worked out an arrangement whereby the city stationed a traffic policeman at the intersection during the rush hours.[55]

By April small business was beginning to get the hang of things. Production Expediting engineers felt proud of Consolidated Radio Products Company, in Chicago, a firm they had sponsored as a potential manufacturer of headsets. Consolidated went about the job energetically, asked for and got contracts from the procurement districts at both Wright Field and Philadelphia, tooled up, and was delivering sets within four weeks' time. Consolidated also supplied headsets to Signal and Air Corps schools in emergencies when the schools found themselves without equipment because their routine requisitions had

[55] Memo, O/C Proc Div for Chief of Mat Br OCSigO, sub: Weekly prog rpt (throughout RP–319.1, Weekly Digest, 1941–42. Digests of the same materials are in Weekly Achievement Reports for periods mentioned.

been diverted to meet more urgent needs. Signal Corps inspectors at the Belmont Radio Company agreed that the BC–348's which Belmont was building were of considerably better quality than the same sets being turned out by one of the Big Five concerns. They cited the Rauland Corporation as an example of active, progressive management. Rauland had gathered together a supply of most of the critical materials and items under its own roof or at nearby plants. Unable to get critically short variable air condensers for the SCR–211's it was building, Rauland built its own condensers, and had enough to supply Zenith Radio Corporation as well, relieving the strain on the principal supplier.[56]

There were fumbles and failures as well as successes. Scheduling was not yet smooth enough for production lines to keep going without interruptions. For example, the Stromberg-Carlson Telephone Manufacturing Company, building BD–96 and BD–97 switchboards, got an additional order too late to prevent an interruption to the production line. Shutting down meant a two months' delay. Crosley Corporation was slow in getting the SCR–284 into production. Five expediters stationed at the plant to assist on various components had not succeeded in prying a single set out of the plant by the middle of April. The increasingly tight supply of steatite meant slowing down or closing numerous plants.

The expediters, buzzing over the whole procurement clover patch, sometimes got in the way of other sections working on the same problems. The fault often lay with overbroad or ambiguously worded directives. In May both Production Expediting Section and Facilities and Materials Division men were going to the Joint Army and Navy Munitions Board and the War Production Board whenever additional allocations of raw materials were needed on contracts.[57] Other sections were similarly confused. The Purchase Section made cross-country calls for information which it could have obtained by picking up an extension phone and dialing Production Expediting.[58] The expediters' field manual instructed the engineers to make plant surveys on their first visit to a plant. It appeared that much of this material was a duplication of information already on file or available to the procurement planners.[59]

Yet if the expediters were sometimes overeager, or trod on too-sensitive toes, or intruded in fields held sacred by other activities and organizations, they nonetheless had a very solid record of accomplishment behind them as the fiscal year drew to a close. When the section was organized in August 1941, out of 65 selected critical items, only 46 percent were on schedule or ahead of schedule and the rest lagged far behind. By the middle of May 1942, a survey of a similar selected group of critical items showed that 74 percent were on schedule or ahead of schedule. The remaining 26 percent were behind schedule by only a small amount of time. This very marked improvement had been made in the face of an eight-fold increase in contract awards: from $235,000,000, to $1,832,000,000. Not only that, but in August 1941 materials had been easy to get, and now manufacturers faced shortages on every hand. Yet production schedules had bettered materially in the face of all the war-

[56] Daily Data, Prod Exped Sec, 29 Mar–30 Apr 42.

[57] Daily Data, Pur Sec, 13 May 42.

[58] *Ibid.*, 12 May 42.

[59] Memo, O/C Evaluation and Correction Div OCSigO to Deputy CSigO, 25 Mar 42, sub: Conversion of radio mfg industry for war prod. SigC 400.192, Prod Exped 7, 21–31 Mar 42.

born problems that plagued the industry. That this was in great part a result of the efforts of the expediters can hardly be questioned.[60]

The centralized plan was not without its defects, however. The procurement districts were dissatisfied with the arrangement. Their most potent argument was the entirely logical view that since the district contracting officer made the contracts and was responsible for the manufacturers' performance under them, his office and not Washington should have direct control over all matters affecting contractual arrangements. Expediting was supposed to be a tool by means of which the contracting officer met his obligation for keeping deliveries on schedule on contracts placed by him. Under the existing organization, direct control of this tool was denied the contracting officer. Furthermore, the procurement district felt that the "salesmen" employed by the Office of the Chief Signal Officer for the work were unsatisfactory. Expediting, they felt, was was not sales work, but production engineering. They preferred the previous arrangement under which inspectors working out of the procurement districts' contracting offices had handled expediting. The inspectors were engineers, competent to make decisions on technical questions, and to consult with manufacturers on engineering problems.[61]

A reorganization in June was intended to meet some of these objections. The area expediting offices were consolidated into ten regional offices set up in ten major cities, and the procurement districts established expediting sections to work through the geographically appropriate regional office. The Production Expediting Section in the Office of the Chief Signal Officer relinquished direct control except in the case of dispute.[62] The effect was to give the procurement districts greater control over the expediting function as it concerned contracts, and at the same time to provide a separate agency to co-ordinate the expediting activities in manufacturers' plants. By the end of the fiscal year, the staff totaled twelve officers and 385 civilians, including both field expediters and regional officers.[63]

In the meantime, the Navy was finding itself at a disadvantage when it sought to place communication equipment orders that were relatively small compared to those of the Signal Corps. A system of priorities intended to determine the needs of contractors for raw materials and component parts had been set up under the control of the Joint Army and Navy Munitions Board and operated among the Army, the Navy, and the War Production Board. The Navy had a force of about twenty-five expediters in the field and, in an effort to escape the overwhelming production requirements of the Signal Corps, had resorted to AA and later AAA blanket priority orders. This ruse had not proved altogether successful, and there was evidence that neither the Signal Corps nor the manufacturers liked it because quite often it forced manufacturers to interrupt their production lines on mass-produced Signal Corps items to take care of small quantities of Navy equipment of slightly different design.

Even the best efforts of the Munitions Board proved unable to effect equalization of production for the Army and the Navy.

[60] Daily Data, Prod Exped Sec, 5–21 May 42.

[61] James J. Cerruti, Historical Narrative of the Philadelphia Signal Corps Procurement District (1945), pp. 206–09. SigC Hist Sec File.

[62] (1) *Ibid.*, pp. 209–11. (2) O/C Proc Div OCSigO, Weekly Prog Rpt, 25 Jun 42. SigC RP 319.1, Weekly Digest, 1941–42.

[63] CSigO, Annual Report, 1942, p. 87.

A series of studies by General Code and General Colton for the Army and by representatives of the Navy and the War Production Board pointed the way for a closer union. On 21 July 1942 the Munitions Board issued a directive providing for a merger of the Army and Navy expediting procedure. The Production Expediting Section of the Signal Corps as such passed out of existence and, with the attachment of Navy officers to the headquarters and regional expediting offices, became the Army-Navy Communications Production Expediting Agency (ANCPEA). None of the functions of expediting were to be changed; the efforts of both the Army and Navy were merely combined in an attempt to eliminate the confusion and competition between the two. Col. George P. Bush was relieved from duty in the Materiel Division, and assigned as director of ANCPEA with Comdr. Mortimer R. Loewi, who had directed the Navy's expediters, as alternate director. The Army and Navy Munitions Board would act as referee and arbiter in case the weather got rough.[64]

The Field Organization

By mid-spring of 1942, the field organization necessary to carry out the Signal Corps' supply mission was evolving. Responsibility for placing the infinite variety and unprecedented number of war contracts rested with the Signal Corps' procurement districts. Inspection was still regarded as a part of the procurement district functions, on the theory that the contracting officer who placed the contract for material was responsible for seeing that he got what he had ordered. The biggest supply job was to place orders, to start production lines rolling, to build up a mass of supplies to equip the expanding Army. As soon as the orders were translated into terms of wire, radios, or vehicles, the equipment had to be stored, classified, packaged, marked, and made ready for shipment. This was the function of the Signal Corps depots. Increasingly, as functions were decentralized to field organizations and new complexes of related field agencies came into being at locations remote from Washington, there had to be administrative headquarters to supervise them. All these agencies were rapidly assuming shape in the field organization by the spring of 1942.

The Procurement Districts

Prewar planning had assumed that the procurement districts would take over the handling of contracts almost entirely once war started, but it was not possible to free the districts completely until after the Army reorganization of March 1942 and the organization of the War Production Board.[65] On 16 March the Under Secretary of War delegated to the chiefs of the operating services of SOS authority to approve contract awards in amounts up to $5,000,000 as well

[64] (1) Clark, Expediting Activities of the Office of the Chief Signal Officer, pp. 31–38. (2) Memo, Exec Officer Mat Br OCSigO for Exec Control Div, 21 Aug 42, p. 6, Sec. IV, Item 1. Weekly Achievement Rpts, 15 Jun–16 Jul 42, SigC Central Files.
ANCPEA became the Army-Navy Electronics Production Agency (ANEPA) on 28 October 1942. Clark, Expediting Activities, p. 37; Exhibit K, p. 76.

[65] Gerard, Story of Supply in the Signal Corps, Pt. II, p. 17.

as authority to redelegate this function to their contracting officers.[66] Now the legal machinery was set up to permit the Signal Corps' procurement districts to move ahead at a greatly accelerated pace.

The procurement districts were organized upon a horizontal structure. Each centralized its purchases to deal with the sort of equipment most needed in its field.[67] The measures and directives which conferred more and more authority upon the districts brought about administrative reorganizations to handle new responsibilities. The district contracting officers enjoyed a new freedom both in signing and in amending contracts and in making advance payments without reference to higher authority, but the privilege of independent judgment carried with it heavy responsibilities. Increases in the price of labor and materials and delays in the delivery of essential raw products complicated the contractors' problems and required legal counsel and auditing facilities to be close at hand. Orders multiplied dizzily, contracting officers placed them faster, deliveries arrived more quickly and in greater quantity, and depots overflowed their warehouses. All installations needed more workers than they could get and, except in Philadelphia, double or treble the office space on hand.

The new Wright Field Signal Corps Procurement District (soon to be renamed the Dayton Signal Corps Procurement District) had been in a whirl of activity from the very first and now, in addition to its great weight of new orders for aircraft radio equipment, was struggling with a backlog of contracts, requisitions, and orders pertaining to aircraft radio inherited from the Philadelphia district. The Chicago district bore the brunt of the requirements for wire and cable and in addition was responsible for the procurement of all dry batteries for the entire Army, estimates for which were leaping upward by the million. The San Francisco district was less affected than others simply because there was little manufacturing of Signal Corps items in its vicinity.

The busiest of the lot, the Philadelphia district, was new in name and in location but derived in fact from the transfer of people and functions from the oldest district, the New York office. It bought ground radio and radar equipment and all sorts of associated and miscellaneous items. Philadelphia was the approximate center of the area in which the radio and communications industry plants were located. And it was placed halfway between Washington, whence came the broad policy decisions, and New York, the major east coast shipping point for overseas operations.

In the sprawling quarters at 5000 Wissahickon Avenue, Col. Archie A. Farmer held sway as commanding officer of the Philadelphia Signal Depot, of which the procurement district was technically a division even though it functioned as a separate agency. Its chief and contracting officer was Lt. Col. G. L. Thompson, who had moved with the agency from New York. He had been with it since 1937, in the days when he had two civilian assistants, one for procurement operations and one for inspection functions. The number of civilian employees in that bygone period had fluctuated between 8 and 20. By late 1941 the staff had grown to 14 officers and 450 civilians. In mid-1942 Colonel Thompson's force was multiplying so rapidly that it was

[66] CD Gen Dir 29, 16 Mar 42, sub: Clearance of contract awards.

[67] Gerard, Story of Supply in the Signal Corps, Pt. II, p. 18.

hard to quote exact figures for any given day.[68]

The district functions still divided roughly into the dual patterns of procurement and inspection. Obviously, if more equipment were purchased, more inspectors would be needed to check it before the Signal Corps accepted it. Each district hired and trained its own inspectors, and there were never enough of them. Philadelphia set up a training school and went aggressively about the business of hiring men. To recruit applicants for the nine months' course at this school, it arranged for a civil service representative to be located at the depot so that applicants could be interviewed and examined on the spot.[69]

"Speed, not cost, is the dominant factor," said the Under Secretary of War in his memorandum to the supply chiefs on 29 December 1941.[70] Speed was the objective at Philadelphia. Try as a man might, there was more to placing a contract than a simple matter of offer and acceptance. In all conscience, the contracting officers had to assure themselves that prices were fair and reasonable and that contracts were in the best interests of the government. In case of doubt, they called for a cost analysis. For the benefit of smaller plants, they negotiated contracts at prices 15 percent above the lowest quotation received. They eliminated bid bonds and performance bonds, broke up large requirements in order to spread production, and gave great weight to earlier delivery dates in evaluating bids.[71]

Contracting officers had at hand booklets prepared by the district, containing contract and purchase request clauses, samples of contractual instruments, and other information useful so long as the contract fell within the usual legal framework. As often as not, though, the manufacturer raised special objections. Signal Corps letters of intent, for example, set a limit of 10 to 25 percent of the cost of the material on the amount of funds that could be spent before the formal contract was executed. Contractors felt that this was too severe. If the reason for making a letter of intent was to permit contractors to place orders and tool up to start work immediately, then there should be no restriction of funds, they argued. They cited the letters of intent issued by the Navy, which bore no such limitation.[72]

Especially in the early months of 1942, when industry was converting to war work, the contracting officers found firms bidding too optimistically. The Office of the Chief Signal Officer had a Facilities and Materials Branch formed from the remnants of the Procurement Planning Section; so did the Philadelphia district. These groups knew a great deal about the productive capacity and capabilities of various manufacturers and were constantly surveying plants, noting idle capacity, and assisting industry in various ways. Between them, they could usually supplement the contracting officers' own information about any given firm. Another difficulty in making a contract centered in equipment specifications. Particularly for the newer equipment, there existed only rather sketchy performance specifications. Contractors found them ambiguous, or inadequate, or impossible to meet. In such cases, they either refused to bid, or bid with exceptions to the specifications, with result-

[68] Cerruti, Historical Narrative of the Philadelphia Signal Corps Procurement District, 18–21.

[69] Ltr, OCSigO Proc Sv, Inspec Sec, to Dir of ARL, 15 Jan 42, sub: Tng of Inspec Pers. SigC 400.163 Inspec 1, Jan–Mar 42.

[70] PC–P 400.13, Broadening the Base of Defense Prod, 29 Dec 41.

[71] Cerruti, Historical Narrative of Philadelphia Signal Corps Procurement District, p. 141.

[72] *Ibid.*, pp. 180–81.

A SECTION OF THE PHILADELPHIA SIGNAL DEPOT, AUGUST 1942

ing long-drawn-out negotiations. Other contractors objected to subcontracting, accounting, renegotiation, or patent clauses. All these things drained off the time allowed for placing a contract: in an emergency it had to be placed immediately, on small items within 24 to 48 hours and on large procurements within 12 to 20 days.[73]

In spite of these confusions, by summer the Philadelphia district had tripled its procurements for the preceding year, and Chicago had placed five times and San Francisco nine times as many orders as in 1941. Wright Field, the youngest of the lot, grew the fastest. Its volume was nearly twenty times that of the previous year, and in dollar value surpassed that of Philadelphia.[74] Late in June one last modification of the procurement organization took place. The geographical restrictions that had long ceased to have any practical significance were removed. The Philadelphia, Chicago, and San Francisco districts were merged at Philadelphia.[75]

Difficulties Within the Signal Corps Inspection Service

By spring 1942 danger signals were flying above the Signal Corps inspection service. Peacetime planning had anticipated wartime recruiting and training of more inspectors, and setting up more inspection districts within the procurement districts, but had not provided any basic changes in the pattern of procedure. The first few months of war proved that changes would have to

[73] *Ibid.*, pp. 168–77.
[74] CSigO, Annual Report, 1942, p. 79.
[75] *Ibid.*, p. 97.

be made. The volume of procurement, and particularly procurement of those items specially designed and therefore subject to inspection by laboratory personnel, exceeded all prewar estimates. Subcontracting, essential to conversion of industry to a wartime basis, meant spreading a contract over the country without regard to geographical boundaries. Yet, except for Wright Field, the procurement districts which handled all production inspection were supposed to keep their men within the geographical areas assigned to them.[76]

The problem could be met by transferring inspection responsibility from one district to another.[77] This was satisfactory, provided that the district placing the contract informed the one in which the plant was located in time so that an inspector could be on hand, and provided that the inspecting district had enough men to do the job. The Philadelphia district awarded a contract to a small plant in Portland, Oregon, for 7,000 telephone crossarms to be delivered at the rate of 1,000 per week. The San Francisco district was short of men, and had no resident inspector at Portland. It had to send an inspector to Portland for seven weeks, with no other work to do except to inspect 1,000 crossarms per week. In another case, the San Francisco district was asked to send a man to Texas to inspect orders amounting to $425. In that instance, factory inspection was finally waived.[78]

In other cases the procurement district sent its men into the territory of another. Plans to lend inspectors from one district to another were discarded because of the difficulties of maintaining time and pay records. Besides, each district feared that if it lent its inspectors it would never get them back.[79] The laboratory inspectors, operating without geographical restrictions, could go anywhere in the country, and laboratory inspection was growing phenomenally. By 15 June the General Development Laboratory had 105 inspectors, the Radar Laboratory 110, and the Aircraft Radio Laboratory 1,288.[80]

As a result of these operating differences, there were numerous instances of multiple inspection. In the Chicago Procurement District in June, resident inspectors included 433 from the Aircraft Radio Laboratory, 38 from the General Development Laboratory, 10 from the Radar Laboratory, 173 from the Chicago district itself, and 164 from the Philadelphia district. Twenty-five plants in the district had from two to four separate Signal Corps inspection organizations. If inspections performed by nonresident inspectors were added to these figures, the number of multiple inspections rose sharply.[81] In April the Kearny plant of the Western Electric Company harbored more than 40 Signal Corps inspectors from the Philadelphia, Chicago, San Francisco, and Wright Field districts, and from the Aircraft Radio Laboratory. Though they did not inspect the same equipment, or deal with the same contracts, the presence of so many separate inspectors caused confusion

[76] History of Signal Corps Inspection Agency, 5 October 1942 to 2 September 1945, pp. 1–2. SigC Hist Sec File.

[77] WD Cir 1–5, CSigO, par. 5.

[78] 1st Ind, O/C San Francisco SigC Proc Dist to CSigO, 8 Apr 42, on Ltr, Cuny to O/C SFSCPD, 1 Apr 42, sub: Inspec of material mfg in other proc dists. SigC 400.163 Inspec 2, Apr–May 42.

[79] Ist Ind, Exec Officer Philadelphia SigC Proc Dist to CSigO, 17 Apr 42, on Ltr, Cuny to O/C PSCPD, 1 Apr 42, sub: Inspec of Material mfg in other proc dists. SigC 400.163 Inspec 2, Apr–May 42.

[80] History of Signal Corps Inspection Agency, p. 2.

[81] *Ibid.*, pp. 2–3.

and exasperated the manufacturer, who supplied office space for them. Such duplication also wasted critically short inspection manpower.

There were other cases of inefficiency. Distance between an inspection unit at a plant and the headquarters to which it was attached meant delays in handling papers and reports by mail, high costs for telephone and telegraph communication, and excessive travel time and cost. The differences in organizational structures between the laboratory and district inspection units, and between the districts themselves, provided a perfect breeding ground for variations in inspection policies and procedures. Inspection was a stepchild organizationally, since the agency to which it was attached had a primary function other than inspection. Inspectors complained that they had too little supervision and no close contact, and did not have a chance to present their side of arguments with the manufacturers. Both prestige and morale of the inspection forces were low.[82]

The Inspection Section within the Office of the Chief Signal Officer had to fight for its existence from the very moment of its inception in the closing days of 1941. Three months passed before its officer in charge was able to spend his full time on his assigned duties. It was another month before any engineers were assigned, and in April 1942 the section had only three at its peak strength. Only one of these had any extensive inspection experience. Its strength in May consisted of six officers, only two of whom had direct inspection experience.[83]

Although the section drew up an ambitious organization chart with places for sixty-three officers and produced a plan to transform the section into a division, with numerous sections and subsections, nothing came of it. The firm of Wallace Clark, industrial consultants to the Chief Signal Officer, confessed that it had no experts qualified to pass on the merits of the plan, and suggested that such an expert be employed. Again General Olmstead turned to business for help. He asked Western Electric to release George L. Schnable, who had been the assistant superintendent of inspection at Western Electric's Hawthorne plant. On 4 May, Schnable and Stanley Woolman, an engineer from the Inspection Section, Office of the Chief Signal Officer, started on a tour of the country which would take them to plants, inspection units within districts and laboratories, and for talks with individual inspectors.[84] Out of the mass of information which they expected to accumulate would come a plan for betterment of the inspection service. Their report would not be laid on General Olmstead's desk for several months to come, but as the fiscal year drew to a close, preliminary information trickling back indicated that a general reorganization of the inspection structure could be expected. Inspection would be separated from the procurement districts and set up in housekeeping for itself as an independent agency with systematized procedures.

The Expansion of Signal Corps Depots

In the prewar period of emergency, the Signal Corps depot system consisted of only five signal sections in Army general depots. with warehouse space amounting to ap-

[82] *Ibid.*, p. 4.
[83] *Ibid.*, pp. 5–6.

[84] Memo, Exec Officer Mat Br OCSigO for Exec Control Div, 15 May 42, p. 9, Item 15. Weekly Achievement Rpts, 27 Apr–8 Jun 42. SigC Central Files. For the story of inspection activities from June 1942 to June 1943, see pages 509–13, below.

proximately 350,000 square feet.[85] By 7 December 1941 the distribution facilities of the Signal Corps in the United States had grown to seven signal depots with total floor space of 2,019,000 square feet, 1,500,000 of it actually used as storage.[86] Six and a half months after Pearl Harbor, there were depots or depot space in 32 areas in the United States, Alaska, Hawaii, Panama, and Puerto Rico, with a total of 7,776,214 square feet of space available, or in the process of being made available.[87]

This increase in depot facilities had not come about easily or all at once. Neither did it all represent space administratively under Signal Corps control and devoted to the basic functions of a depot: receipt, storage, and issue. Part of it had to do with the repair, inspection, salvage, maintenance, procurement, training, defense aid storage, and manufacturing functions assigned to many of the depots as contributory duties. As a rule, the troops using the equipment would take care of first echelon maintenance; second echelon would be a function of maintenance platoons; signal depot companies would accomplish repair at the third stage; and beyond that, the equipment would be sent to the nearest depot. If even this failed to meet the need, fifth echelon maintenance might involve moving the equipment to a signal depot or signal section of a general depot where civilian technicians, trained in knowledge of the set, would take over.[88] Within the continental United States in early spring 1942 the Signal Corps had only the depot at Philadelphia, with another under construction at Lexington, Kentucky. It had also signal sections within the Chicago Quartermaster Depot, and the general depots at New Cumberland, Pennsylvania, Atlanta, San Antonio, Ogden, and San Francisco.[89]

When unlimited emergency gave place to war, the supply section of Utah General Depot at Ogden was still in the throes of organization and hiring, and already outgrowing the 108,000 square feet of closed warehouse space and 3,600 square feet of closed shed space that had been assigned to it. It estimated future requirements at about 432,000 square feet of the former and 40,000 feet of the latter. In January, prior to removal of the signal section from the San Francisco General Depot in the Presidio to new quarters at the Oakland Army Air Base across the bay, 50 percent of all signal stocks in San Francisco were shipped to the signal supply section in Utah. At the same time, substantial deliveries of wire and cable were arriving. The warehouse and closed shed space was hopelessly inadequate and no additional shelter was available. More than 1,000,000 pounds of cable on reels lay out in the open; crating materials piled up in the yards. The labor shortage was acute and the depot had to compete with three major military installations for personnel: the Naval Supply Depot, the Ogden Arsenal, and the Ogden Air Technical Service Command. Early in the year the Utah General Depot began to transport several hundred high school and

[85] Capt Charles R. Novick, The Story of Supply in the Signal Corps in World War II, Pt. IV, Distribution (1945), SigC historical monograph B–1d, p. 21. SigC Hist Sec File.

[86] SOS Staff Conf, 16 Feb 43, remarks of Olmstead on duties and functions of Sig Supply Sv, OCSigO. SigC EO 36–337 Staff Confs (SOS) Misc 9-2-42 to 6-2-43.

[87] OCSigO S&I Br, Rpt of James L. Dixon, Depot Bldgs and Grounds Sec, sub: SigC storage space rpt, 1 Jul 42. SigC 400.242 Storage Space 2, May–Jul 42.

[88] OCSigO Cir 11–2, par. 4, 14 Feb 42.

[89] Novick, Story of Supply in the Signal Corps, Pt. IV, App. D.

college students from northern Utah and southern Idaho by train or bus to and from the depot on Saturdays and Sundays, distances of 74 to 160 miles the round trip. The students unloaded the accumulation of incoming carloads that the regular labor force had not been able to handle during the week.[90]

Storage and issue functions in the Dayton area had originally been performed by the Wright Field Signal Corps Procurement District in a building constructed for the purpose at Fairfield Air Depot. In addition, the Air Service Command had designated the signal section of the Fairfield Air Depot as a backup facility and storage reservoir for signal equipment already turned over to the Air Corps. This depot at the beginning of 1942 stocked some 6,000 items of airborne radio equipment. The need for more space became desperate when shipments of aircraft radio material began to arrive from the Philadelphia Signal Depot, which relinquished that class of equipment when it moved from New York late in 1941. The volume of work increased so rapidly, to an average of 50 shipments a day by early January, that Lt. Col. William J. Daw, officer in charge of the district, took steps to acquire space in the first of several buildings in downtown Dayton. But as quickly as he obtained more space, the multiplying functions of the organization outgrew it.[91]

On 5 June, the War Department approved the recommendation that the signal storage activity in Dayton be designated as the Dayton Signal Depot.[92]

The same month, the Chief Signal Officer ordered procurement, storage, and issue of meteorological equipment transferred from Philadelphia to Dayton. Its procurement would thereafter be carried on by the Wright Field Signal Corps Procurement District; its storage and issue by the Dayton Signal Depot.[93] The new depot in its first month of operation stocked almost 16,000 different items of aircraft radio equipment, a figure that rose before the end of the year to just under 50,000 items. By the end of June, there was no empty space, nor was it expected that there would be any space at the end of December, although still more was being sought.[94]

As the pace of procurement quickened, the lines of authority had to be shortened, and then shortened again, especially at Wright and Patterson Fields. In dollar value, aircraft radio and radar equipment was rapidly approaching the point where it would exceed all other Signal Corps supply activities combined. The Aircraft Radio Laboratory was responsible for research, development, and inspection of this equipment. The Wright Field Signal Corps Procurement District bought, stored, and issued it. Yet these two agencies, located only a few miles apart, had to consult Washington for most major decisions regarding

[90] Utah ASF Depot, Ogden, Utah, History of the Signal Supply Section, 30 September 1941–1 November 1945. Sig Supply Sec File, Utah Gen Depot, Ogden.

[91] (1) History and Activities, Signal Corps Aircraft Signal Service, 1 Jul 43, p. 6. (Hereafter referred to as Hist of SCASS, 1 Jul 43. SigC Hist Sec File. (2) History of Dayton Signal Corps Supply Agency. WFSCPD File 314.7—Hist of Proc Dist.

[92] AG Ltr AG 681 Dayton Sig Dept (5-25-42) MR-M-SP, 5 Jun 42.

[93] 1st Ind [basic ltr lacking], Dir of Sig Supply Sv to O/C Wright Fld SigC Proc Dist, 4 Jun 42. SigC 413.6 (5-12-42). S&I Agency Info File, Philadelphia.

[94] (1) Hist of SCASS, 1 Jul 43, p. 6. (2) Ltr, S&I Br OCSigO to Opns Div Hq SOS, 2 Jul 42, sub: Storage space. S&I Agency Info File, Philadelphia.

their own activities, and had very limited fields of authority in making commitments to the Air Forces.[95] Accordingly, in May 1942, with the concurrence of the Army Air Forces and the SOS, the Chief Signal Officer activated a Signal Corps Aircraft Signal Service (SCASS), and appointed Colonel Gardner director.

The new fiscal year had not yet begun before the new superagency added two more agencies to its domain. On 4 June the Chief Signal Officer established the Signal Maintenance Section, and on 5 June The Adjutant General designated the storage facilities of the Signal Corps in Dayton as the Dayton Signal Depot.[96]

Philadelphia in early 1942 was still having housekeeping troubles. The combined depot and procurement district created from the old signal section and procurement district of the Brooklyn Army Base at the New York Port of Embarkation was not yet comfortably settled in its new quarters, but it was making progress. One by one the frustrations and annoyances of the move were dissipated as the Signal Corps began to make the place more habitable, but building operations and office work had to proceed together and they did not mix well. Cables were strung over the heads of workers and fluorescent lights installed; radiators were suspended below the skylights around the walls of the offices; beaverboard partitions were set in place to provide a small measure of privacy for a few officials. While this was going on, steamfitters with their hammers, pipes, and welding torches, painters and carpenters with ladders and saws, all mingled with clerks and stenographers, who complained bitterly about their working conditions. Restrictions clamped down after the coming of war suspended the Saturday half holiday, added an hour to the work day, and spread the six-day week over weekends on a rotating basis; holidays were abandoned; leave curtailed.[97] All depots had begun operating on a 24-hour a day basis late in December,[98] and night shifts were not popular. All of these things added to employee dissatisfaction.

Only a part of the New York force had moved to Philadelphia with the depot and some of these only temporarily until their positions could be filled by new employees. These workers and others who had originally intended to stay returned to New York where they could live more comfortably at home and find other positions with industry as good if not better than the depot could offer, even taking into consideration the pay for overtime which became effective on 1 March.[99] Some of the New Yorkers formed the nucleus of the new Lexington Signal Depot in Kentucky. The Philadelphia Depot suffered a heavy loss in experienced workers. Turnover was high, even among the newcomers. During the first four months of 1942 over 3,300 men and women were employed and almost one third as many were lost through resignations and military furloughs. The depot recruited local labor, but in this case an untrained Philadelphian could not immediately fill the shoes

[95] Ltr, CSigO to CG AAF, 20 Apr 42, sub: SigC reorgn at Wright-Patterson Flds. SigC 320.2 Gen.
[96] Hist of SCASS, 1 Jul 43, pp. 1–11.

[97] (1) EO 9018, 12 Jan 42. (2) WD Cir 16, 20 Jan 42.
[98] OCSigO R&W, S&I Div to Exec Control Div, 24 Dec 41. S&I Agency Info File, Philadelphia.
[99] Acts of 21 Oct 40, PL 873, 76th Cong, and 3 Jun 41, PL 100, 77th Cong. Computations of pay under these acts became so complicated that hundreds of errors resulted. The Act of 22 December 1942, Public Law 821, 77th Congress, placed overtime pay on a yearly basis and made it applicable to all employees. This greatly improved the situation.

of a trained Brooklynite. Meanwhile, the demands of the draft boards cut deeper every day into the supply of male labor. Women began to take over jobs heretofore reserved for men, serving as chauffeurs, welders, assemblers, laborers, fork-lift operators, tractor drivers, machinists, crystal grinders, and checkers. For these and other jobs, the depot launched extensive training programs.[100]

On jobs requiring precision and patience, such as picking items from bin stock for packing, assembly work, and crystal grinding, women performed excellently. Radio crystals, for example, had to be ground to extremely close tolerances for use in teletype machines and other fixed plant installations. Commercial concerns did not want to undertake the work, but the women depot workers handled it "beautifully." [101]

Depot space had seemed limitless when the Atwater Kent plant had been acquired and the first items had arrived for storage: the trucks and trailers comprising ten SCR–197 radio sets.[102] But by February the depot was filled to within 5 percent of capacity, and the space problem again loomed. To ease the strain, the maintenance and repair group had moved out into a new building acquired from the Frankford Arsenal. In April 1942 the Signal Corps leased the first of five annexes: two buildings owned by the Quaker Hosiery Company and to be known collectively as Annex No. 1, located about a mile from the main depot. One building contained three stories and a basement, and the other seven stories. Together they provided 354,000 square feet of space, to house some 8,000 items of photographic equipment and over 9,000 items of pigeon supplies.[103] During the next month a small force of depot personnel moved in, but most of the building was still occupied, and would not be available for several months.

On 16 May the Signal Corps took over Annex No. II, a building to be shared by the Reading Railroad, and gained 333,183 square feet of space.[104] The equipment bought on early orders was rolling in; later on, larger orders would mean a further straining of warehouse seams. Colonel Farmer had the uneasy feeling that if he did not keep constant vigil, the flood of equipment would engulf him. Incoming material rose from an estimated 10,757,747 pounds in January to 14,005,850 in April, and the outgoing from 7,015,062 to 9,-295,406.[105] To handle and process this amount, he had a labor and office force of 4,987 in April, compared to 3,520 in January. Tonnage figures alone did not reflect the infinite variety and complexity of depot operations at Philadelphia. Of the 100,000 items, some were so large it required a crane to move them. Others, such as hair springs for repairing meters, were so tiny that they would disappear with a gust of wind.[106]

Meanwhile, at Avon, Kentucky, the Lexington Signal Depot, destined to rival the Philadelphia Depot in size and volume of tonnage, was rising in record time. Begun in May 1941, it was handling shipments of radar equipment by fall and became deeply immersed in extensive training programs by winter and early spring. By May 1942 the second phase of the construction was complete. An administration building and guard

[100] History of the Philadelphia Signal Depot (hereafter referred to as Hist of Philadelphia Sig Depot), II, 131. SigC Hist Sec File.

[101] MS Comment, Brig Gen Archie A. Farmer, Ret., 15 Mar 52. SigC Hist Sec File.

[102] Hist of Philadelphia Sig Depot, I, 146.

[103] *Ibid.*, I, 67.

[104] *Ibid.*, I, 70.

[105] *Ibid.*, II, 157.

[106] MS Comment, Farmer, 15 Mar 52.

gate, three warehouses, service station, garage and motor repair shop, a paint and oil shop, central heating plant, fences, and utilities added a somewhat more finished look to the establishment. It was time for official recognition of the depot's existence.

General Olmstead journeyed to Lexington to deliver the principal address at the formal dedication ceremonies before an open-air assemblage of over 3,000 persons on 29 May. He and the depot's commanding officer, Col. Laurence Watts, had reason to welcome the new establishment. The reservation covered 785 acres of land; the buildings were expected to provide over 1,400,000 square feet of storage and office space. At the end of February the total of employees, not counting those in training, had been about 500. Before the end of June it was four times that number, a little over 2,000. In September 1941 the first 22 tons of equipment had been more than enough for the few workers then employed to handle. Now in May 8,262,000 pounds were processed with ease and dispatch.[107]

To some extent, the depots in this period specialized in the stock they carried. The Chicago depot housed large stocks of telephone, telegraph and teletype, and vehicular radio items. New Cumberland stored field wire and bulky machine items. Dayton catered to the Air Corps, with airborne radio and radar and meteorological equipment for its stock in trade. Lexington was the repository for ground radar, and the special vehicular equipment needed for transporting radars. All other signal items found a home at the Philadelphia depot.[108] In June a new signal section was set up at Memphis. It was to act as a backup to the New Orleans Port of Embarkation, and would furnish emergency supplies to points in the Fifth, Sixth, Seventh, and Eighth Corps Areas.[109]

Totting up the figures at the end of June 1942, the Signal Corps found itself in possession of 5,342,214 square feet of gross area space actually completed, 920,000 under construction, 625,000 authorized, and 889,000 requested. At second glance, however, the figures were not so impressive. Only 3,324,515 square feet of completed space was actually usable for storage, and about 60 percent of it, 2,071,283, was in the three big warehouses at Lexington, Dayton, and Philadelphia. The rest was in general depots, air depots, at ports of embarkation, and war aid depots.[110] At the Dayton, Chicago, and Ogden depots and at the Middletown and San Antonio air depots, there was no vacant space at all. Col. Raymond C. Hildreth of the Storage and Issue Branch estimated that for the rest of the calendar year the average percentage of idle storage space in all signal depots would not exceed 15 percent at any time.[111]

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[107] Elizabeth Simpson, Narrative History of Lexington Signal Depot (1945), Chs. 2, 3, 8; Graph Items 22, 25, 35. SigC Hist Sec File.

[108] 4th Ind (basic ltr missing) S&I Div to SigC Supply Sv, 27 Jun 42, sub: Master depots. S&I Agency Info File, Philadelphia.

[109] Ltr, S&I Div OCSigO to Sig Officer Fourth Corps Area, 3 June 42, sub: Activation of Sig Sec of Memphis Gen Depot. S&I Agency Info File, Philadelphia.

[110] These figures were extracted from Chart of Space Distribution and Chart of Signal Corps Gross Warehouse Area, prepared by the Supply Service, Storage and Issue Branch, 1 July 1942. SigC 400.242 Storage Space 2, May–Jul 42.

[111] Ltr, S&I Br OCSigO to Opns Div Hq SOS, 2 Jul 42, sub: Storage space. S&I Agency Info File, Philadelphia. See pages 515–20, below, for depot operations from late 1942 to mid-1943.

Procurement Growth in the First Six Months of War

Thus in the field, and within the Washington headquarters, the Signal Corps laid the groundwork for the effort ahead. While the war in the Pacific went from bad to worse, the organization at home was steadily strengthened, weak spots explored, and solutions devised. This building of a strong supply organization was fundamental to the eventual solution of the supply problem, but to produce reserves took time, and to get the equipment to remote outposts took more.

Signal Corps business was now big business. Only a year before, procurement officers had been impressed when they could place an order for a million dollars' worth of equipment. In the three months from 10 March till 2 June, by contrast, the Awards Committee, a part of the Legal Branch which reviewed certain contracts for legal sufficiency, approved 39 contracts, each in excess of a million dollars and totaling well over $410,000,000. This sum did not include the thousands of smaller contracts which were not required to go to the Awards Committee for review. Indeed, by midsummer the Committee would no longer concern itself with contracts involving a mere $1,000,000. From that time on, it reviewed only those in excess of $5,000,000.

The biggest orders naturally went to the biggest companies, which possessed the necessary organization and facilities to handle them. Western Electric's bid of $49,000,000 to build 2,400 sets of the ASV radar, SCR–517, was approved 1 May. Its award for the command radio set, SCR–274 and SCR–274–N, came to almost twice as much, $97,000,000. Western Electric also contracted to build 10,053 FM sets for Field Artillery use (SCR–608's and 628's) for $40,000,000. Bendix Aviation had two awards totaling more than $16,000,000 to supply SCR–578's, the Gibson Girl emergency air-sea rescue equipment; a $43,000,000 contract for radio compasses SCR–269; and $42,000,000 for VHF command sets SCR–522. General Electric was given the job of building liaison sets SCR–187 and SCR–287, by which aircraft could communicate with their bases, at a price exceeding $74,000,000.[112]

The names of the lesser companies were appearing on the more-than-a-million list, too. The Galvin Manufacturing Company was building small radios; it had contracts totaling more than $26,000,000 for the SCR–536 handie-talkie; the SCR–610 and 510, FM vehicular sets; and the SCR–511, a portable set. The Aircraft Accessories Corporation got a million and a half for building wire reels; Onan Brothers over a million to furnish the self-contained power units, PE–95; Gray Manufacturing Company for telegraph repeater equipment; and Klise Manufacturing Company, Kroehler Manufacturing Company, and Hubbard Spool for making drum cable. Anaconda Wire and Cable, Whitney-Blake, and Western Electric each had contracts for more than a million dollars' worth of long range wire, W–110–B. Simplex and U. S. Rubber were building cable.[113]

In the four weeks between the middle of May and the middle of June, big and little contracts for Signal Corps equipment reached a billion dollars.[114] And as the fiscal year drew to a close, the Signal Corps

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[112] Sums quoted are to nearest round figure.

[113] OCSigO, Awards Committee Rpt, 1942–43. SigC RP–1029.

[114] Supply Sv, OCSigO, Review of Prod Plans, 18 Jun 42. SigC DS 337.

saw its expenditures for equipment rise to a figure that would have been considered fantastic in the days of peacetime planning. More than $2,693,360,736 worth of contracts had been placed with American and Canadian manufacturers of Signal Corps equipment, and $3,000,000,000 more was soon to be available to the procurement division for additional equipment. Approximately 75 percent of this sum had been expended after the attack on Pearl Harbor.[115] Deliveries were pouring into depots in ever increasing waves. By 30 June, 1942 deliveries of signal equipment, the larger part of which would have required months or even years to get into production under peacetime conditions, totaled more than $315,595,473, and the acceptance of completed items had reached a rate of more than $3,000,000 a day.[116]

Perhaps more than any other, this figure pointed up the growth of the Signal Corps procurement function and its importance to the new Army. For now, in June 1942, the Signal Corps was accepting every two weeks as much signal equipment as the amount procured during the entire course of World War I.[117] This was an impressive and encouraging statistic. Still, procurement measured in terms of dollars did not by any means tell the whole story. The real measure of success or failure of Signal Corps supply lay in producing the right kinds of equipment, in sufficient quantity, and on time. By that standard, it still had a long way to go.[118]

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[115] CSigO, Annual Report, 1942, p. 78.

[116] *Ibid.*, p. 79.

[117] In World War I, a total of $45,000,000 was authorized for Signal Corps material. CSigO, Annual Report, 1943, p. 232.

[118] See pages 322ff., below, for an account of procurement problems during the second half of 1942.

CHAPTER VII

Signal Schooling (January–July 1942)

The Training Structure

The Chief Signal Officer's responsibility for the technical military training of Signal Corps enlisted men and officers was exercised, after 9 March 1942, under the delegated authority and the nominal supervision of the Commanding General, Services of Supply. From General Olmstead the line of authority descended through the chief of the Signal Corps Field Services, General Milliken, and through him to Col. J. D. B. Lattin, at the head of the Military Training Division.[1]

Although the Signal Corps was bound by the manpower allotments and the training policies of the War Department General Staff and the Services of Supply, the Chief Signal Officer had direct jurisdiction over the operation of Signal Corps replacement training centers and schools, which were exempt from corps area control, and over the technical aspects of the training of Signal Corps military and civilian personnel in civilian institutions. In technical communications training, the Chief Signal Officer called the plays provided he could get the practice field and the players.[2]

The scope of technical signal training was broader than ever before. It had penetrated a field of study hitherto occupied only by scientists and confined to highly scientific institutions such as research laboratories. The Signal Corps student body was made up of officers, enlisted men, enlisted reservists, and civilians, and it ranged from men with doctorates in engineering or philosophy to illiterates. Geographically, training extended from the single prewar training facility at Fort Monmouth, New Jersey, to Signal Corps training centers newly established in Florida, Missouri, and California; to civilian institutions throughout the land; and to the British military schools in the United Kingdom. The Chief Signal Officer and his staff viewed the burgeoning training centers with pride, encouraged by the advances they represented. Nevertheless, six months of war had sent signal training requirements far beyond the expanded military facilities and the increased capacities which, indeed, had seemed to the Signal Corps to be cramped even in the planning stage.

[1] Signal Corps Administrative Log, 1939–1945, OCSigO Orgn Chart 14, 9 Mar 42, p. 35. SigC Hist Sec File. For troop and training difficulties in January and February, 1942, see above, Chapter II.

[2] AR 350–800, 1 February 1938, covering Signal Corps training, specifically stated that the regulation was only "general in nature."

As yet the calls for men had been confined to activation needs except for the tragic loss requirements of the forces in the Philippines, and even these had been erased with the fall of Bataan in April. Training demands were arising, however, from factors quite apart from activation needs. For example, new types of equipment under production and about to come into use necessitated the enrollment of more officers and men in advanced electronics courses. General Colton had urged the Coast Artillery Corps to send men to be trained in the use of the new radar developments and, upon finding that the Coast Artillery planned to send only six, had said: "I think you had better make arrangements on the basis of the number being increased, because of course they will want more than six, but they don't know it yet." [3] Upkeep and maintenance of equipment in the hands of troops posed additional training problems. General Olmstead sought to learn whether using arms were making satisfactory progress in first echelon repair; whether the Signal Corps should provide repair units in division signal companies; and what should be done about training depot troops in repair, especially of airborne equipment in the hands of troops.[4] Paradoxically, the shortening of technical courses also created a demand for more training facilities. By this time all courses had been abbreviated to the point where they produced soldiers skilled in only a segment of a subject. Thus several men might be required to perform a job which could have been done by a single soldier thoroughly trained in all aspects of the work. The time saved by shortening the training period was offset by the uneconomical use of manpower.

Factors which made it difficult for the Signal Corps to reach its self-set training objective were no less compelling because some applied alike to all other services. Training capacity allotments were based on the assumption that troop basis units would be furnished only trained cadres of Signal Corps specialists and technicians who would, in turn, teach the new men received directly from reception centers.[5] Before the end of July, however, Signal Corps training centers had supplied entire complements of Signal Corps men—618 officers, 24 warrant officers, and 11,120 enlisted men in all—for units hurriedly added to the 1942 troop basis or activated outside its provisions for immediate dispatch overseas with task forces.[6]

A survey of twenty-eight units organized in the early summer showed the average time between activation and alert for movement to be less than a month. In one extraordinary case, movement orders for the 811th Signal Port Service Company were issued four days ahead of its activation orders.[7] Obviously, this did not permit units

[3] OCSigO R&W Action 1, Colton to Radar and Air Com Div, 27 May 42, sub: Tng of CA soldiers at Western Electric School. SigC SPSTP 33.

[4] Memo, Olmstead for Milliken and Crawford, 27 Mar 42. SigC SPSTP 33.

[5] OCSigO R&W Action 1, Capt F. R. Franzoni for Lt Col Francis H. Lanahan, Jr., War Plans Div OCSigO, 3 Apr 42, sub: Cadres to provide complete tng of all pers within the unit. SigC 320.2 Activation of Units, Jan–Jun 42.

[6] Brig. Gen. Idwal H. Edwards, Assistant Chief of Staff, G–3, War Department General Staff, acknowledged that the troop basis was "a little cockeyed," but pointed out that there was no better guess. (1) Recorded telephone conversation, Col King with Gen Edwards, 1 Jun 42. SigC 352 OCS 1942–44. (2) Memo, Milliken for Opns Div WDGS, 29 Jul 42, sub: Expansion of SigC RTC and SigC school facilities. SigC 381 Preparation for War. SigC MT–182.

[7] (1) Memo, Milliken [OCSigO] for Dir of Tng SOS, 19 Aug 42, sub: Orgns to be filled 100 percent from RTCs and schools; (2) Memo, Lt Col S. M. Thomas, OCSigO, for Dir of Sig Opns Sv OCSigO, 22 Jul 42, sub: 811th Sig Port Sv Co. SigC SPSMT–12 War Plans Br.

to draw men from reception centers and train them to be even simple signal technicians. The burden of supplying trained men therefore devolved more heavily upon the Signal Corps replacement training centers and schools than General Staff or even Signal Corps planning had contemplated. With little co-ordination of the outside elements affecting training, it was scarcely to be expected that the training program would mesh smoothly with troop activations. Yet commanders who were already carrying heavy combat responsibilities saw no reason why they should be expected to train their communications specialists, whatever the regulations said. Commenting on the training of Signal Corps men received in the European theater in the summer, Lt. Col. Francis E. Kidwell, at Allied Force Headquarters, said that as far as he could judge "there was nothing wrong with communications training, except that the men in the signal aviation units in Europe had had none of it." [8]

The most pressing training project, and one of the most vexing, was that of preparing men to serve with the Army Air Forces. It was still difficult to get information as to the specialists the AAF would need because many air units had not yet settled into standard types, and there was little co-ordination within the Air Forces of its requirements for communications men. Instead, there was a disposition to operate independently of the Signal Corps. For example in July, upon receiving informal notice that it would be required to train 45,000 radio operators for the Army Air Forces, the Signal Corps immediately initiated a wide survey to determine the extent of facilities available for the purpose, only to be told later that the AAF would do its own training.[9]

Where Tables of Organization existed at all, they were unrealistic for both air and ground units.[10] Several new tables, ready for issue at the beginning of June, indicated strengths greater than those authorized for such units at that time, but the War Department had announced no policy for bringing existing units to the new strength. It was small comfort to a unit commander to be told that his efficiency might be measured by the manner in which he employed the personnel in a table of organization when he had been unable to get the men.[11] There was little more comfort in the knowledge that when such units were alerted for overseas movement, commanders would expect the specialists allowed in the tables even though Signal Corps training capacity had not been authorized with the new strength in mind. Tables covering schools and replacement training centers had been rescinded before Pearl Harbor and the Signal Corps there-

[8] Ltr, Lt Col Stuart K. Baker, OCSigO, to Dir of Planning OCSigO, 16 Jul 42, sub: SigC matters for investigation and rpt—BOLERO. SigC 319.1 Inspec Rpts 3.

[9] (1) Memo, Chief of Mil Pers Div OCSigO for CSigO, 8 Jul 42, sub: Responsibilities, Hq AAF; (2) Memo, Lattin for Milliken, n.d., sub: Necessity for SigC Sec on staff of CG AAF. SigC SPSTP 6. (3) Memo for File, Lattin, 11 June 42. SigC 353 Gen 14, Jun 42.

[10] See above, pp. 35ff. For example, T/O's included no repairmen for very high frequency equipment. It was August 1942 before a course to train them was instituted in the Signal Corps School at Fort Monmouth and at the Signal Corps Radar School, Camp Murphy, Florida. (1) 2d Ind, OCSigO to Comdt ESCS, Ft. Monmouth, 13 Aug 42. SigC SPSMT 352 SCS Ft. Monmouth (7-21-42). (2) OCSigO R&W Action 1, Lattin to Mil Pers Div, 19 Aug 42, sub: Tng schedule, Eastern SigC School. SigC 353 Ft. Monmouth 2 (RTC) May–Aug 42. (3) Memo, Milliken for Exec Control Div, 17 Jul 42, sub: Weekly Prog Rpt. Weekly Achievement Rpts, 15 Jun–16 Jul 42. SigC Central Files.

[11] Signal Corps Information Letter, No. 7 (1 Jun 42), pp. 41ff.

fore had to defend each need for instructors, and usually got fewer than it had asked for. Then the only men available were likely to be recent graduates of the courses they were called upon to teach. Moreover, men capable of teaching were the sort in demand everywhere. Filling one gap created another.

There was also the difficulty of getting the training equipment needed when there was not enough coming off the production lines to supply combat requirements.[12] The lack of training equipment plagued all communications instructors for many months.

It was difficulties of this sort which beset the military training program. The faults and the failures lay not so much in the classroom as at planning levels, in the element of time, and in the general unreadiness of the nation for war. In the summer of 1942, with plans in the making for a large offensive operation in North Africa, the immediate concern of the Signal Corps was the technical training of the thousands of recruits pouring into its replacement training centers at Fort Monmouth, at Camp Crowder, and soon at Camp Kohler; the development of qualities of leadership in the candidates enrolled in the Signal Corps Officer Candidate School at Fort Monmouth; and the technical training of officers and enlisted men for the Aircraft Warning Service at Camp Murphy.

Camp Crowder

The largest concentration of Signal Corps recruits was at the Camp Crowder Replacement Training Center in Missouri, although it had been in operation less than four months. By the middle of June 1942 the whole area of Camp Crowder, overrun by men in khaki, hummed with activity; 352 new buildings stood on the post, but that was not enough and more wartime construction was going up. Already the Signal Corps, not the sole occupant of the camp, needed elbow room. The Army Ground Forces still retained housing for 4,300 Engineer troops. In April General Milliken had pointed out that joint use of the facilities by the Signal Corps and the four Engineer regiments to be activated in early summer would not serve the training purposes of either service. But Col. Walter L. Weible, Deputy Director of Training of the Services of Supply, had declined to reserve the area exclusively for the Signal Corps and had insisted upon "equitable use" of certain of its facilities by both services. On 10 June General Olmstead again opened the subject, asking that when the Engineer regiments should have completed their training cycle, Camp Crowder be assigned wholly to the Signal Corps for use as a "large Signal Corps training center." It was already that.[13]

By the end of June over 10,000 technicians had gone out from Crowder to troop units; more than 12,000 were still studying in the replacement training center; about 2,000 men had been sent to ci-

[12] (1) OCSigO R&W Action 7, Lt Col Victor A. Conrad, AFT Com Div OCSigO, to S&I Div, 18 Mar 42, sub: Spare parts and components of SCR-268, 270, 271 sets for school training; (2) Ltr, CSigO to CO SigC Radar Lab, Camp Evans, N. J., 6 Apr 42, sub: Shipment of spare parts for SCR-270-B, with 1st Ind, CO SigC Radar Lab, to CSigO, 11 Apr 42. SigC MT-413.44 Radio Equip. MT-198.

[13] (1) Memo, Milliken for Dir of Tng SOS, 20 Apr 42, sub: Expansion of SigC activities at Camp Crowder, and 1st Ind, Hq SOS to CSigO, 6 May 42; (2) Ltr, Olmstead to CG AGF through CofE and CG SOS, 10 Jun 42, sub: Utilization of Camp Crowder for tng of SigC pers and SigC units only. SigC 353 Camp Crowder 1, Jan–Apr 42 and 2, May–Jul 42.

vilian schools and another 2,000 to the Signal Corps School at Fort Monmouth for specialist instruction. The aircraft warning course alone had turned out 1,548 plotters. By mid-July more than 32,400 recruits had been received.[14] The RTC had passed through its shakedown period and was on a firm footing when, on 1 July 1942, General Rumbough, who had been in command since its beginning, left and turned the command over to Col. Robert A. Willard, another Regular Army Signal Corps officer. Willard had served as executive officer of the RTC since his arrival from Fort Monmouth in the preceding December and was well acquainted with the problems. Rumbough soon became the signal officer of the great force building up in the United Kingdom, intended to take a million men across the Atlantic in the next six months.[15]

Camp Crowder was a veritable boom town sprung out of the wilderness in Newton County, Missouri. Its area was computed in miles, not acres—seventy-five square miles in traditional guerrilla country, the scene of some of the raids of the desperado Jesse James and his gang. The commander, Maj. Gen. Walter E. Prosser, called it the layout of his dreams. The reservation did, indeed, provide a wide variety of facilities for simulating battle conditions, even deserted farm buildings which were utilized as command posts and signal centers in real combat fashion. Wide, rolling fields, green with grass until the heat seared them brown, steep cliffs, rivers, and dense woods constituted the theater for combat training. Recruits who had come with the first contingents in February had floundered in mud or slipped about on the ice, but in these summer days "Red Hot and Dusty" was the name they gave the camp.

The recruits streaming into Camp Crowder to be converted into signalmen found few distractions. The nearest town, Neosho, had a population of only 5,000. It had been the Confederate capital of Missouri and now it was a strict Mennonite community. Many of the houses had two doors, side by side—one for weekdays and the other for Sundays. It was a dry town to the extent that liquor could be purchased only in packages, and drier than that in attitude. But this caused little dissatisfaction. Although camp punishment for drunkenness was severe, commanders had need to mete out little of it. "No nonsense in Neosho" was the soldiers' slogan for the town.

What the nearby community offered the recruit was not important, for what Crowder demanded left him little time to enjoy outside distractions. The three weeks of basic training in Signal Corps replacement training centers was much the same as that given recruits at any post. It was the course prescribed by the War Department to effect a man's transition from civilian life to military routine; much of it was strenuous physical conditioning. On his arrival, the recruit was given a few tests and orientation lectures and this curriculum: drill; equipment, clothing, and tent pitching; first aid; defense against chemical attack; articles of war; basic signal communication; interior guard duty; military discipline; and rifle marksmanship. No effort was made in the early summer to qualify men in marksmanship at either Camp Crowder or Fort Monmouth. Each post had only 400 rifles, all of the period of World War I, and neither had any carbines, the approved Sig-

[14] (1) CSigO, Annual Report, 1942, p. 168. (2) Signal Corps Information Letter, No. 9 (1 Aug 42), pp. 15–16.

[15] Notes for Conf on BOLERO, 3 Jun 42. SigC ET 322 BOLERO—Col Rives, 1942.

nal Corps weapon. Toward the end of the year, however, and with no increase in arms, over 80 percent of the men in the RTC had qualified in marksmanship and the percentage was almost as high at Fort Monmouth.[16]

The recruit found that to be a lineman he had to be six feet tall, and that if he lost his grip and slid down the pole, he picked up splinters all the way. He discovered that no man with a marked accent was eligible for switchboard duty, no matter how apt he might be at operating the contraption. Probably the most demanding thing he learned was to live peacefully with his fellowmen. Army training was the welding together of men from every walk of life into a common pattern of behavior which bore little resemblance to most peacetime experience.

Unlike basic military training, more or less uniform throughout the Army, the technical courses at Camp Crowder were related closely to the communications duties of the Signal Corps. The curriculum was substantially the same as at Fort Monmouth. The manuals and textbooks used were those prepared at the eastern school and at least a nucleus of the training staff had come from Fort Monmouth. Camp Crowder was the heir to Fort Monmouth's training experience, although far from an identical copy of the eastern post.

The schedule in effect at the Camp Crowder Replacement Training Center on 1 July provided for the concurrent training of between 13,000 and 14,000 men in 6- to 13-week cycles, which included the time devoted to basic military instruction and processing. The 6-week cycle had a capacity of 800 men, but there was no stress on filling this course because most of the men assigned would be recruits without the mental ability or aptitude for signal training, who would be shipped out as basics at its end. In the 8-week aircraft warning plotter course, with a capacity of 400 per cycle, the primary phase emphasized map-reading, aircraft identification, organization, and information center personnel matters. The combined phase taught discipline in all message center functions; and in the final phase the student practiced on real field sets, rotating from position to position. The 9-week courses were for personnel and supply clerks, truck drivers, and typists, with the allotment of men totaling 2,300. A man acquiring a speed of 30 words per minute in 30 hours of instruction in the typing course was eligible for teletypewriter instruction. The 11-week cycle included courses for message center clerks, linemen, messengers, telegraph printer operators, and local battery telephone switchboard operators, and could accommodate 1,705 students. The 13-week courses, with 5,395 men assigned, were for automobile mechanics, cooks, pole linemen, common-battery switchboard operators, pigeoneers, and slow-speed radio operators.

Thus, almost half of the total enrollment at Crowder was in the 13-week courses. And of that group 3,000 were in the course for radio operators. Some of these would later receive additional instruction in high-speed or fixed-station operating. The first weeks of the radio operator course were devoted to sending and receiving International Morse code, and to studying radio procedure and radio circuits. After that the students worked a month in the field with simulated tactical nets, and climaxed their

[16] Memo, Milliken for Exec Officer OCSigO, 17 Nov 42. SigC SPSTP 474 Gen (Small Arms).

TRAINING AT CAMP CROWDER. *Basic infantry instruction (exemplified above) and field radio operation (below).*

TRAINING AT CAMP CROWDER. *Cable splicing (above) and message center operation (below).*

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training with a week of operating vehicular radio sets in the Ozark Mountains.[17]

About 2,600 of the better qualified basics were assigned to a Signal Corps school or a civilian institution for specialist training of a higher order. Until 1 July Camp Crowder had not been able to give advanced specialist instruction, but on that date the Midwestern Signal Corps School, an institution similar to the original Signal Corps School at Fort Monmouth, opened its doors to the first 400 students from the RTC. Thereafter the only students the RTC sent regularly to Fort Monmouth were those for the cable splicer and telegraph printer maintenance courses for which Crowder as yet had no training equipment.

The Camp Crowder school was the outgrowth of plans laid months before the RTC had opened.[18] It had been obvious even then that the single Signal Corps School at Fort Monmouth could not long provide specialist training for the increased intake of recruits. On the last day of December 1941 the Signal Corps had laid a concrete plan for the school, with a capacity of 2,500 (1,450 had originally been contemplated), before the G–3 Section of the War Department General Staff. A month later the War Department had authorized its establishment. Before the school opened, its capacity had been raised to 6,000 and the additional construction entailed had been authorized, although the buildings had yet to be put up.[19]

With his executive, Lt. Col. Edward A. Allen, General Prosser had devoted much time and energy to planning. Lt. Col. Paul L. Neal could not be relieved of his duties as director of the Officers' Department of the Monmouth school until June, in order to become assistant commandant. Until that time Maj. R. G. Swift, who had come from the Wire Division of the Enlisted Men's Department at Monmouth, acted in his stead.[20] The order activating the school had failed to exempt it from corps area control, and although General Prosser had been designated to command the institution, it was officially under the jurisdiction of the post commander, an Infantry colonel. The lines of authority were untangled late in May when the school and the 800th Signal Service Regiment, activated to administer the instructors and students of the school, were declared exempt units under the control of the Chief Signal Officer.[21]

On the opening of the school, the scarcity of instructors was the number one problem, and in mid-July a recruiting party, including a Civil Service representative from St. Louis, started out to find 142 civilians capable of teaching communications subjects. The National Education Association lent its assistance while the press and radio broadcasters gave publicity to the need.[22]

[17] Incl 1, Training Schedule, 9 June 1942, to Ltr, CSigO to CO SCRTC, Camp Crowder, 13 Jun 42, sub: Prescribed tng of SigC specialists at SigC RTC, Camp Crowder. SigC 353 Camp Crowder 2, May–Jul 42.

[18] Activated 25 March 1942 as the Signal Corps School, the institution was redesignated the Midwestern Signal Corps School on 3 June 1942. Later, it became the Central Signal Corps School.

[19] CSigO, Annual Report, 1942, p. 4.

[20] Col Robert G. Swift, "The Crowder Story," *Signals*, II:2 (November–December, 1947), 25.

[21] (1) Notes taken at conference between Milliken and Neal, 12 May 42 (unsigned); (2) Memo, CSigO for Dir of Tng SOS, 12 May 42, and 1st Memo Ind, Deputy Dir of Tng SOS for CG Seventh Corps Area, 21 May 42. SigC 353 Camp Crowder 2, May–Jul 42. The Army Ground Forces, the Army Air Forces, and the Services of Supply agreed to avoid duplicate training facilities as much as possible.

[22] (1) Memo, CSigO for Comdt MWSCS, 15 Jul 42, sub: Recruiting for civ tech instructors for SigC school; (2) Ltr, Jesse D. Myers, U.S. CSC to Col C. J. McIntyre, Chief of Spec Activities Br OCSigO, 15 Jul 42; (3) Ltr, Lt Col E. M. Kirby,

Although the new school drew heavily on the experience of the older institution at Fort Monmouth, it was not restricted to the training patterns established there. An early innovation was the Common Subjects Division, in which all new students except radio operators were instructed in basic shop work and the principles of electricity before undertaking the specialist courses.[23] When facilities should be available to accommodate the full number authorized, it was planned to divide student strength between the school's three departments: 2,705 to the 13-week wire courses; 2,625 to the 17-week radio courses; and 670 to the 20-week aircraft warning courses. Meanwhile, two shifts were employed in order to utilize fully the scarce training equipment and the limited classroom space.[24]

The combined output of Camp Crowder and Fort Monmouth was still not enough to meet the requirements for skilled communications men. There was a critical scarcity of radio and radar repairmen, high-speed radio operators, and telegraph printer installer-repairmen, to name but a few of the categories in short supply. The Chief Signal Officer directed that these critical courses be filled; if men meeting the standards for this type of training were not available, then those who showed any promise of making acceptable students would be enrolled.[25]

The RTC, main source of students for the school, was still receiving many men not qualified for signal training. The Inspector General's Department, following an inspection of Camp Crowder, had supported the Chief Signal Officer in his efforts to get men of higher intelligence. But the Commanding General, Services of Supply, had rejected all proposals to this end because Signal Corps replacement training centers were then already receiving a higher average of Grade I, II, and III recruits by 4.15, 4.66, and .56 percent, respectively, than were the other technical services.[26]

G–1 of the General Staff had informally promised that men for the Signal Corps' replacement training centers would be drawn, as far as possible, from the northeast, north central, and Pacific coast reception centers, in areas where the general level of education was higher. But an examination of the records of 338 recruits received at Camp Crowder on two days in midsummer revealed that they had come from Fort Bliss, Texas, and that fewer than one percent were college men; about 17 percent were high school graduates; 45 percent had completed grade school or had had "some schooling." Over 36 percent were illiterates. Most of the last were of Mexican descent and were unable to speak English.[27]

Despite the dearth of qualified students, before the school had been in operation a full month the commandant had received orders to activate the second priority elements of the 850th Signal Service Battalion, the 209th Signal Depot Company, and the 183d Signal Repair Company for duty with

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Chief of Radio Br, Bureau of Public Relations WD, to McIntyre, 22 Jul 42, sub: Civ instructors for Camp Crowder. SigC 353 Camp Crowder 2, May–Jul 42.

[23] Swift, "The Crowder Story," *Signals*, II, 24 ff.

[24] (1) Memo for File (unsigned), 3 Jul 42, sub: Equip MWSCS. SigC SPSMT 353 Camp Crowder. (2) Central Signal Corps School Annual Report, 1942.

[25] Ltr, CSigO to CO SCRTC, Camp Crowder, 26 May 42, sub: Filling to capacity critical courses of instruction. SigC 353 Camp Crowder 2, May–Jul 42.

[26] IGs Dept Spec Inspec Rpt, SCRTC, Camp Crowder, 8 May 42. SigC Special Inspec File.

[27] Memo, Milliken for Dir of Tng SOS, 14 Aug 42, sub: Classification rcds of inductees at Ft. Bliss, Texas. SigC 353 Camp Crowder.

the North African Service Command. Thus at Camp Crowder, as at Fort Monmouth, calls for technicians and specialists would not await their production, and the men would lack instruction and practice in teamwork. And signal training, unless it developed teamwork as well as individual skill, would be effort wasted on the forging of strong links for a chain which, unlinked, would be no chain at all.

More and more signalmen were working in small units on highly specialized projects where the success of their operations depended upon their ability to work successfully together. Too often the new soldier was catapulted into combat without any experience in the duties which he would perform as a member of such a group, because early in the war emphasis was on the training of the individual soldier. At Camp Crowder there were sixteen tactical units, Signal Corps troops administered by the Second Army all badly in need of technical instruction in teamwork, which the replacement training center and school were not set up to give. To meet the needs of these and other units at a similar stage of training, General Prosser proposed to establish a unit training center at Camp Crowder, and General Olmstead heartily indorsed his proposal.[28] Not waiting for War Department approval, Prosser straightway organized the new activity as a subsidiary of the Midwestern Signal Corps School, placing Col. James Lawrence in command. He then sought recognition of it as an organization separate from the school.

With Camp Crowder now comprising three practically independent projects, General Prosser saw the need for a single supervisory staff agency which would represent the Chief Signal Officer in administering and co-ordinating all training activities. Accordingly he sent a second recommendation to Washington on 30 June, proposing the establishment of such an agency, the Midwestern Signal Corps Training Center.[29] In the meantime, types of organizations to carry out the missions of these already active but as yet unauthorized agencies evolved through trial and error, and Camp Crowder, like Fort Monmouth, began to feel the pinch of crowding as it reached the limits of its training capacity.

Camp Kohler

In June 1942 the Signal Corps had a training capacity for about 20,000 men at its two replacement training centers—14,000 at Crowder and 6,000 at Fort Monmouth. Allowing for differences in the 6- to 13-week training cycles of the various courses, the Signal Corps estimated that it could produce some 58,000 technicians in the two centers by the end of the year. But that figure still fell 12,000 short of meeting the Army's already computed requirements for 70,000 signalmen.[30] There was no room for further expansion of the Fort Monmouth center, and any expansion at Camp Crowder would first necessitate additional construction. A third replacement training center, Camp Kohler, near Sacramento, California, was therefore created.[31]

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[28] (1) Memo, Gen Edwards, ACofS G–3, for CG's AGF, AAF, and SOS, 30 May 42, sub: Responsibility for tng. SigC 353 Fort Monmouth 2 (RTC) May–Aug 42; (2) Ltr, Milliken to Prosser, 1 Jul 42. SigC 353 Camp Crowder 2, May–Jul 42.

[29] Ltr, Comdt MWSCS Camp Crowder to CSigO, 30 Jun 42. SigC 353 Camp Crowder 2, May–Jul 42.

[30] Ltr, CSigO to CG SOS, 19 Jun 42. SigC 353 Camp Crowder 2, May–Jul 42.

[31] Named for 1st Lt. Frederick L. Kohler, of Oakland, California, who had been killed in action in March while serving with General Stilwell's Mili-

The Walerga Collection Center, about twelve miles northeast of Sacramento, appeared to be the most appropriate site available. It had space for 5,000 men and it could be made available quickly, having been vacated recently by the transfer inland of the Japanese-Americans concentrated there on the outbreak of war. It seemingly met General Olmstead's specifications for an existing facility on the west coast which could be in readiness to receive recruits within a month. On 2 July the War Department authorized its acquisition, cautioning the Signal Corps at the same time that the proposed center would be only a temporary expedient. Either it must be discontinued by 31 December or the capacity of the other replacement training centers must be reduced accordingly.[32]

The Signal Corps took possession on 8 July, but the plan for quickly getting 5,000 men under training at Camp Kohler did not work out as contemplated. It soon became apparent that although there was housing for that number, the sanitary and hospital facilities were adequate for no more than 2,000. The initial capacity was therefore set at that figure, pending the additional construction which would be required here as at other training centers. It was decided to limit training to the basic courses and to send the qualified men on to Camp Crowder for technical instruction. As yet there was no provision at Camp Kohler for a target range, obstacle course, parade ground, or gas chamber to give reality to basic training, and like Fort Monmouth, the new camp was located in a populous area.[33]

tary Mission to China. (1) CSigO, Annual Report, 1943, p. 360. (2) Signal Corps Information Letter, No. 13 (1 December 1942).

[32] Memo, Edwards for CG SOS, 2 Jul 42. OCS WDGOT 600.12 (6–19–42).

[33] (1) Ltr, CSigO to CO SCRTC Camp Crowder, 5 Sep 42, sub: Prescribed quotas for tng of SigC specs, Camp Crowder. SigC SPSMT 353 RTC Camp Crowder. (2) Memo, CSigO for Dir of Tng, SOS, 18 Aug 42, sub: Tng aids for new SigC RTC, Camp Kohler. SigC 353 RTC Sacramento, Calif.

Fort Monmouth

The newer training centers at Camp Crowder, at Camp Kohler, and at still another new project, Camp Murphy, had each been organized for a specific type of training, but Fort Monmouth remained many-sided. It had been the Signal Corps' proving ground for both officer and enlisted schooling. Until the newer training centers were ready to accept students, Fort Monmouth had to carry the burden of a wide variety of courses. By the summer of 1942 Monmouth was reverting to its original mission of producing wire and radio specialists. Radar training was being established at Camp Murphy. Photographic training had been concentrated at the Signal Corps Photographic Center at Astoria, Long Island.[34]

The exodus of the RTC from the New Jersey post was well under way. Basic military training was concentrated at Camp Edison, where the recruit found no open countryside such as greeted men sent to Camp Crowder. On the contrary, the New Jersey community teemed with civilian workers and with the families of men in the nearby camps. The technician classes of the RTC also had begun to move away from the post proper to Camp Charles Wood, at nearby Eatontown, New Jersey.[35]

Monmouth developed most of the train-

[34] Signal Corps Information Letter, No. 7 (1 June 1942), p. 52.

[35] Camp Charles Wood was officially inaugurated 14 July 1942 and named in honor of Lt. Col. Charles Wesley Wood, a Signal Corps Regular Army officer who had retired in 1937 because of illness but who had been recalled to active duty in 1940 and had died 1 June 1942. Signal Corps Information Letter, No. 9 (1 August 1942), p. 34.

ing procedures and training doctrine used throughout the Signal Corps' training institutions. The methods of teaching in the Signal Corps School and in the RTC were similar; the curriculum of the RTC was limited to the simpler technical subjects, while the school conducted the more difficult courses. To a great extent the students were self-taught. They studied and took quizzes on mimeographed information sheets. Periodic examinations made sure that students did not lag behind the steady pace required.

Films and film strips were used widely. Components of equipment were displayed on breadboards or were reproduced on a large scale.[36] There were telephone circuits to be dismantled and rebuilt by students in the wire courses. Linemen learned trouble shooting from an ingenious device—a model city with complete dial telephone circuits and a central exchange. By throwing any one of a large number of switches, unseen by the student, the instructor could cause a breakdown for the student to locate and correct.[37] A diorama for teaching blinker lights, accurately drawn to scale and taking into account the factor of distance, was the work of Maj. Reuben Abramowitz, who had been an enlisted instructor in the Signal Corps School before the war. Many other training aids used at Monmouth and elsewhere were the developments of instructors forced to improvise when equipment was unobtainable.

In the radio maintenance course a student was taught radio theory, then given a month's training in testing and repairing field equipment of commercial design. In the fixed-station radio operator course, open only to those who had attained a receiving speed of 15 words per minute in International Morse code, students were taught high-speed Morse transmitting and how to read and transcribe messages from ink-recorded tape at a typing speed of 35 words per minute. Teletypewriter operators studied, among other things, the new Army-Navy Civil Aeronautics procedures which had been issued in May. There were a hundred things that could go wrong with a teletypewriter machine; a student in the maintenance course had to learn to break down, reassemble, and adjust its complicated mechanism.[38]

Monmouth's training administrators endeavored to keep methods of instruction as up to date and training doctrine as progressive as the new developments in warfare. To this end, for the teaching of radio operators, the faculty introduced a code learning and touch typing system developed by Dr. Fred Keller, a Columbia University psychologist. It divided the alphabet and the ten cardinal numbers into five groups, according to their positions on the keyboard of a typewriter, and the student mastered the characters for each group before proceeding to the next. The use of phonograph records for the reproduction of the characters and their phonetic equivalents, which were played on turntables in a master control room and piped through switchboards to the headsets of the individual students, made it possible for 140 men to work simultaneously without mutual interference. It was too early to estimate the system's value

[36] A breadboard display of electronic circuits presents the wiring and components spread out over a flat surface, so that a novice can readily see the connections, trace individual wires, and study the assembly.

[37] CSigO, Annual Report, 1942, pp. 148, 150, 153.

[38] Ltr, CSigO to CG SCRTC Ft. Monmouth, 14 May 42, sub: Amplified instruction of teletypewriter operators. SigC 353 Ft. Monmouth 2 (RTC) May–Aug 42.

as a training aid, but it showed promise.[39] Monmouth's instructors visited troops in maneuver areas, observing divisional training methods and needs.[40] They studied the communications requirements of new types of units and of new commands to determine what should be added to technical courses: for example, the communications tactics and techniques to be applied in landing operations.

Training administrators in Washington co-operated to keep instructions up to date. They interviewed many observers returning from overseas, and when they learned of combat developments which might have a bearing on training doctrine or methods, they arranged for these officers to visit Fort Monmouth and acquaint the faculty with them.[41]

In the early summer of 1942 Washington and Monmouth considered the advisability of adding rapid-pole-line construction (RPL) to the curriculum of the RTC. While the Signal Corps weighed the merits of establishing such a course, the General Staff explored the pros and cons of making additional troops available to institute the new technique.[42] Thus one action hinged on another. General Milliken urged that training emphasize the proper laying of field wire, because in maneuvers the criticism was heard frequently that signal troops did not keep field wire out of traffic lanes. New training films on laying field wire neglected to give this point any weight, nor did training literature stress it sufficiently.[43]

In July the Enlisted Men's Department of the Signal Corps School added two new courses: repeater-carrier and very high frequency. The RTC inaugurated an instructors' training course to replace the officer candidate preparatory and first sergeants' courses, and established a Training Standards and Service Division to consider and recommend means for raising efficiency. Among the earliest achievements was the development of the text, "Training of the Army Instructor." The instructors' course consisted of about nine weeks of specialty training and four weeks of instruction in leadership and company administration.[44]

The most serious weakness in teaching was the inexperience of most of the instructors. Even the few experienced mentors lacked firsthand information of the unusual demands made on signal troops in theaters of war. All plans for returning officers or enlisted men from overseas in order to utilize their experience in training had failed be-

[39] History of Eastern Signal Corps Training Center, 30 Oct 43, p. 42. SigC Control Approval Symbol SPSEO–100.

[40] Ltr, Comdt SigC School to CSigO, 8 Jul 42, sub: Visit of instructors to divs, with 2 Inds. SigC 353 Ft. Monmouth 2 (RTC) May–Aug 42.

[41] Memo, Gen Code, Deputy CSigO, for Sig Opns Sv, 19 July 42, sub: Assistance to instruction staffs at Ft. Monmouth. SigC 352 Ft. Monmouth 2, Jun–Dec 42.

[42] OCSigO R&W Actions 1 to 10, between C&E Div, Mil Tng Div, Opns Div, War Plans Div, Com Coord Br OCSigO, 19 Feb 42 through 22 May 42, sub: Instruction in cross frame semipermanent const at SCRTC Ft. Monmouth. SigC 676.1 Gen 12.

[43] Ltrs, CSigO to CG SCRTCs Ft. Monmouth and Camp Crowder, 9 Apr 42, sub: Tng directive with reference to keeping fld wire out of traffic lanes. SigC 353 Gen 13, Apr–May 42.

[44] The officer candidate preparatory course had been established pursuant to War Department Circular 48, 19 February 1942; the first sergeants' course, officially inaugurated on 6 April 1942, had been initiated months before by General Stoner. (1) Signal Corps Information Letter, No. 9, (1 Aug 42), p. 32. (2) Ltr, Milliken to Comdt ESCS Ft. Monmouth, 13 Jun 42, sub: Officer candidate preparatory school. SigC 352 Ft. Monmouth 2, Jun–Dec 42. (3) Ltr, Col Clewell, SCRTC Ft. Monmouth, to Col. Lattin, OCSigO, 30 Jul 42. SigC 353 Ft. Monmouth 2 (RTC) May–Aug 42.

cause commanders had too few specialists to release.[45]

There were formidable shortages in many categories of signal specialists. In June the RTC at Fort Monmouth was assigning 60 percent of the incoming recruits to courses in the school at the end of basic training, as compared with 40 percent in March, and was assigning another 6 percent to be trained as oscilloscope operators in the Aircraft Warning Department. This represented about 85 percent in the first three classification grades.[46] Computations of requirements were increasingly calling for men possessing unusual skills, such, for example, as would be needed for the new radio intercept units and for the Enemy Equipment Identification Service (EEIS).[47]

By now even simple technicians were becoming scarce. It was estimated that the shortage of watchmen to guard valuable equipment would reach almost 2,000 by the end of 1942, and of field telephone operators, almost 1,000. Col. James S. Willis of the Military Training Branch felt that the Fort Monmouth RTC had been prone to put all of the men with low scores into the classes for linemen and truck drivers, and he insisted that both of the RTC's give recruits in classification Grades IV and V a chance to learn a wide range of the simpler skills. On the other hand, Colonel Lattin, in the same office, cautioned that requirements for more than 13,000 drivers for light trucks alone indicated that more men, not fewer, should be trained as truck drivers. Word from Lt. Gen. Dwight D. Eisenhower added weight to this belief.[48]

At both Fort Monmouth and Camp Crowder, the RTC's singled out promising recruits to be message center clerks and code clerks. Many were accepted for the Signal Corps Officer Candidate School (OCS), wherefore gaps in the enlisted ranks could be expected to continue until the requirements for Signal Corps officers had been met. The shortage of radio operators was acute. The ability to send and receive Morse code is a natural gift. It was a waste of time and manpower to attempt to make radio operators of men who, however intelligent, had no aptitude for the work. Men who attained Army General Classification Test scores of 90 to 109 were usually able to pass the code aptitude test with a score of 50 or better and to develop into good operators. To discover those talented in this speciality, the Signal Corps therefore urged that reception centers give the code aptitude test to all recruits intended for the Signal Corps replacement training centers. Reception centers were

[45] OCSigO R&W Action 2, Brig Gen Henry L. P. King for Chief of Mil Tng Br OCSigO, 24 Dec 42, sub: Instructors with combat experience. SigC 352 Ft. Monmouth 2, Jun–Dec 42.

[46] The RTC averaged 8.1 percent Class I, 33.5 percent Class II, and 35.5 percent Class III men. Of the men admitted over a period of 15 months, fewer than 5 percent possessed occupational skills in communications, and most of these went into the school regardless of classification. Ltr, CSigO to CG SCRTC Ft. Monmouth, 26 May 42, sub: Filling to capacity critical courses of instruction, and 1st Ind, Hq SCRTC Ft. Monmouth to CSigO, 24 Jan 42. SigC 353 Ft. Monmouth 2 (RTC) May–Aug 42.

[47] (1) Ltr, CO Equip Coord Br OCSigO to CG SOS, 11 Aug 42, sub: Intercept broadcast unit and 1st Ind, Hq SOS to CSigO, 15 Aug 42. SigC 413.44 No. 1 (RB 2265). (2) OCSigO R&W Action 1, Stat and Reference Div, to Mil Pers Div, 28 May 42, sub: EEIS, selection and tng of pers. SigC 353 Gen 13, Apr–May 42.

[48] (1) OCSigO R&W Action 3, Mil Tng Div to Mil Pers Div, 9 Jul 42, sub: Truck drivers and basics; (2) 1st Ind (without basic), CSigO to CO SCRTC Camp Crowder, 29 Sep 42. SigC SPSMT 353 RTC Camp Crowder (9–17–42). (3) Memo, Stoner for Milliken, 8 Oct 42, sub: Tng of motor maint pers. SigC AC 333.1 Trip, Gen Stoner (ETO) Oct 42.

supplied with commercial recorders which could play recordings of Signal Corps code aptitute tests to 250 men at a time. But it was a slow business getting the equipment into use.[49]

The caliber of men received from reception centers for signal training remained a cause for concern in the first half of 1942, although the situation had improved a little after Colonel King broadened the base for selection by lowering the requirements upon which the Signal Corps had previously insisted, and by directing that inept recruits be quickly reported and made available for reassignment. His aim was to accelerate the training of the best men obtainable in order "to provide the largest possible number of acceptably trained specialists . . . not . . . any smaller number of perfectly trained individuals." [50]

It was necessary, however, that every man not entirely incapable of communications study be developed to the full of his ability to learn. To this end the Mental Hygiene Unit,[51] organized as a part of the Fort Monmouth RTC and duplicated later at Crowder and Kohler, rendered valuable aid. Its primary function was to salvage the men received from reception centers who for some reason failed to fit into the life of the replacement training center. Attached to the headquarters of the RTC, the unit operated more or less independently, entirely separate from the so-called morale activities of the Special Services Division. It was composed of enlisted clinical teams, each made up of a psychiatrist, a psychiatric social worker, and a psychologist, who sought first to uncover the causes of inaptitude, unusual behavior, or mental stress in a recruit and then to correct the situation before it had become serious. Team workers also interviewed each man absent without leave for more than twenty-four hours upon his return to the post. Often it was possible to guide a man to an understanding of his abnormal actions or attitudes, so that he could work out a satisfactory adjustment for himself. Failing that, the unit initiated his reassignment or reclassification, or some other measure designed to utilize his skill and aptitude to better advantage. Many of those interviewed were assigned to the Special Training Section of the basic school, where the Mental Hygiene Unit continued to test their progress.[52]

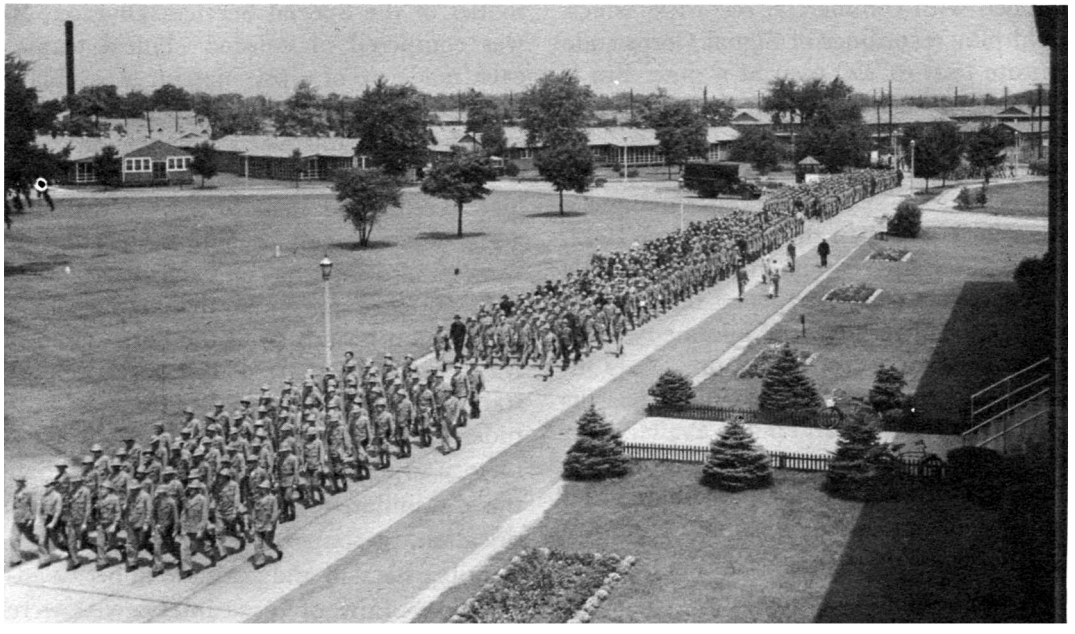
There came under the ministrations of this unit men who were brilliant and valuable, but who nevertheless showed mental instability; men who were willing but slow-witted, physically strong but unlearned; men of low mentality; or men who were unable to speak or understand the English language. In short, the unit dealt with any man unable to fit into the training schedules in a normal way, and many of these it saved for the Army. When the Monmouth unit had been in operation for only six months, a Washington newspaper declared: "The success of the Fort Monmouth clinic has been so noteworthy that the War Department should establish similar clinics

[49] Memo, Lattin for Tng Div SOS, 15 Aug 42, sub: Tng SigC pers for Air Corps. ASF 353 Mil Tng.

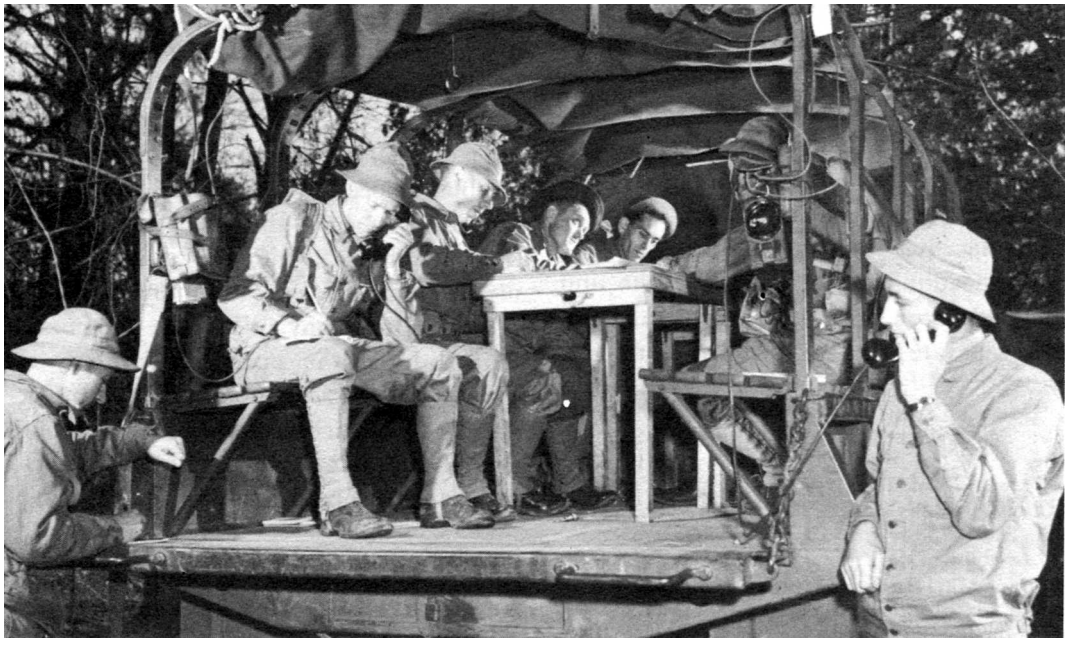
[50] Memo, Col King, Actg Chief of Opns Br OCSigO, for Div Chiefs of Opns Br, 11 Mar 42. SigC SPSTP 33.

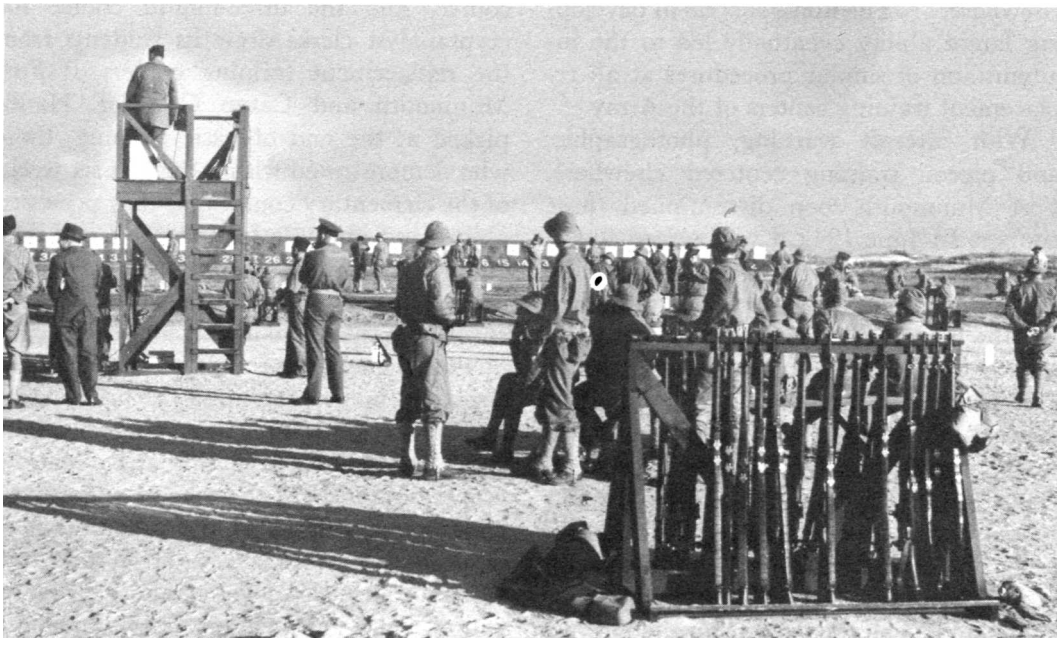
[51] Established on 1 January 1942 under the leadership of Maj. Harry L. Freedman, Medical Corps, as the Classification Clinic, the unit was redesignated the Mental Hygiene Unit on 28 October 1942.

[52] The Special Training Section, organized 26 March 1942, preceded the Special Training Unit, activated in November 1942, which served the same purpose.



TRAINING AT FORT MONMOUTH. *Long lines of men marching to classes, like those above, were a common sight at Fort Monmouth. Below are signal trainees manning a mobile message center.*





TRAINING AT FORT MONMOUTH. *Rifle marksmanship (above) was as much a part of signal training as was cryptography (below).*

elsewhere." [53] The unit's success in developing latent ability eventually led to the inauguration of similar procedures at all replacement training centers of the Army.

With aircraft warning, photographic, and pigeon training centered elsewhere, Fort Monmouth soon discontinued those courses. In June 1942 it was agreed that a separate signal intelligence school would be established under the supervision of the Signal Intelligence Service (SIS) at Washington. At that time the cryptographic courses also were discontinued at Monmouth.[54] Fort Hunt, Virginia, virtually abandoned to the weeds after World War I, first received consideration as the site for the new school, but instead Arlington Hall, a girls' school in Arlington County, Virginia, was eventually selected and the name remained as the unofficial designation for the new activity.

Following Pearl Harbor, students had been withdrawn one by one from the year-long cryptanalysis course at Fort Monmouth before they had gained even the meager knowledge of the highly specialized subject that could be acquired within that time. The length of the course had then been cut almost in half and the allotment of students almost doubled. Selected enlisted men and officers, including some Air Corps officers, were enrolled in the four-month cryptanalyst or signal intelligence course, and the three-month course for cryptanalyst clerks drew its students from the replacement training centers at Fort Monmouth and Camp Crowder. Hand-picked at the end of basic training, those who demonstrated within the first six weeks of the elementary course that they possessed ability and aptitude for the work and who could meet other requirements approximating those for OCS were immediately enrolled in the signal intelligence course.[55]

The elementary course consisted of instruction in cryptographic security, army and staff organization from a signal intelligence viewpoint, elementary and advanced cryptography, IBM theory and operation,[56] code compilation, and the preparation of cryptanalytic work sheets. The more advanced course also covered security, organization, and elementary and advanced cryptography, and in addition language instruction in Japanese, German, Italian, French, Spanish, and Portuguese (limited to the ability to distinguish one tongue from another and to recognize the more common words), and military cryptanalysis.[57]

The Cryptographic Division, like other specialist training activities, faced an alarming shortage of trainable men. Needless to say, the men assigned to the highly secret work had to be the sort whose background and character would indicate loyalty, integrity, and discretion. A convenient rule of thumb was that a man should be a native son of a native son—certainly not anyone

[53] (1) Memo 41, Hq ESCRTC, 6 May 43, sub: Mental Hygiene Unit. SigC 353 Ft. Monmouth (RTC) 1, Jan–May 43. (2) Capt Frederick Reinstein, Study of Signal Corps Replacement and Filler Training, 1941–1944 (1945), SigC historical monograph C–9, pp. 64, 100. SigC Hist Sec File. (3) *The Washington Post*, July 17, 1942. (4) Ltr, Gen Code, Deputy CSigO, to Comdt ESCS Ft. Monmouth, 21 Jul 42, sub: Army clinics. SigC 352 Ft. Monmouth 2, Jun–Dec 42.

[54] Daily Data, Mil Tng Div OCSigO, 8 Jun 42. SigC Hist Sec Card File.

[55] Incl 1, Cryptographic Training at Fort Monmouth, to Ltr, Dir of ESCTC Ft. Monmouth to Hist Sec Fld Office OCSigO, 23 Feb 44, sub: Hist of cryptographic school at Ft. Monmouth. SigC Hist Sec File.

[56] International Business Machines were employed in cryptographic work.

[57] (1) Daily Data, Sv School Subsec Mil Tng Div OCSigO, 20 Feb 42. SigC Hist Sec Card File. (2) SigC Hq Ft. Monmouth File 311.5, *passim*.

of known Axis association or even of extensive foreign acquaintance. Because of the nature of the work it was desirable that the man be at least a high school graduate, have some competence in mathematics, and possess reasonable speed in typing. His eyesight should be good. So should his rating at the bank or with the first sergeant, for a man whose credit standing was open to the slightest question was insecure, a man too vulnerable to be trusted with a secret. In every case, before a potential cryptographic student could be assigned, a Military Intelligence Division clearance was necessary.[58] In July the Signal Corps School was having difficulty in filling its small quota of 125 for this training as well as the quotas for other critical courses.[59] In the six months following Pearl Harbor the Signal Corps School had graduated 3,617 enlisted specialists, 1,293 officer candidates, 779 officers from the company officers' and advanced officers' courses, 1,287 officers and enlisted men from the aircraft warning courses, but none at all from the cryptographic courses.[60]

It was the demand for officers that caused the greatest expansion and drew the most attention at Monmouth in the summer of 1942.[61] All officer candidate schools were under fire that summer, mainly because of the mediocrity of many candidates, and especially those accepted for the technical services. The War Department gave wide distribution to a circular which said flatly that "proper attention is not being given to the selection of highly qualified applicants for the technical services . . ." [62]

In July the War Department again called attention to the poor selection of candidates, and urged a canvass of surplus applicants for the schools of nontechnical arms to determine their suitability for the technical services. Examining boards were directed to encourage qualified applicants to at least name a technical service as an alternate choice.[63] The Signal Corps welcomed the action, for it had long felt that the selection practices in vogue drew too heavily from the small fraction of the Army which the Signal Corps represented, while many enlisted men who were qualified for Signal Corps commissions were left in the ranks of other arms. Drawing officer candidates from within the Signal Corps itself also impoverished the Corps in its enlisted specialists. For example, the 556th Signal Aircraft Warning Battalion in Iceland had sent 26 candidates, about 8 percent of its strength, to OCS by midsummer.[64] Colonel Powell, in the Hawaiian Department, protested that OCS and enlisted pilot schools were getting his experienced teletype maintenance men in such numbers as to create a serious shortage there.[65]

In the spring of 1942 still another problem focused the attention of training officers on the Signal Corps Officer Candidate

[58] SigC Hq Ft. Monmouth File 311.5, *passim*.

[59] Daily Data, Mil Tng Div OCSigO, 3 Jul 42. SigC Hist Sec Card File.

[60] (1) Signal Corps Information Letter, No. 8 (1 July 1942), p. 26. (2) History of the Eastern Signal Corps Replacement Training Center, 30 Oct 43, p. 36. Control Approved Symbol SPSEO–100. (3) Memo, Deputy Dir of Tng SOS for Dir of Tng SOS, 3 Jul 42, sub: Tng inspec of SCRTC Ft. Monmouth. SigC 352 Ft. Monmouth 2, Jun–Dec 42.

[61] Brig Gen W. O. Reeder, "Training at Fort Monmouth, World War II," *Signals*, I:5 (May–June 1947), 9.

[62] WD Cir 187, Sec. II, 13 Jun 42.

[63] WD Cir 247, 28 Jul 42.

[64] 1st Ind, CO 556th AW Bn to CSigO, 11 Aug 42, on Ltr, CSigO to Lt Col Kenneth F. March, 14 May 42, sub: Applicants for OCS. SigC 352 OCS 2, Apr–May 42.

[65] Msg, Sig Officer Hawaiian Dept to CSigO, CM–IN 1753, 7 Apr 42. SigC 311.23 Gen, Cablegrams, MT–206.

School. The Chief of Staff had adopted the policy of greatly reducing the direct commissioning of civilians, relying instead on the various officer candidate schools to supply the necessary commissioned personnel. If the officer candidate schools were to be the only source of supply, it was important that there should be a low rate of failure. A rate of 20 percent could be considered normal, but at Fort Monmouth the rate was slightly more than 30 percent for the first four classes. Late in April Col. Reuben E. Jenkins of the G–1 staff and Brig. Gen. Clarence R. Huebner, Director of Training, SOS, had gone to Fort Monmouth to find out why such a high percentage of candidates had failed to receive commissions.[66]

The Chief Signal Officer had already taken action designed to reduce the failure rate.[67] To keep the attrition down even to 30 percent, it had been necessary to restrict the scope of the course to the capabilities of the candidates. Field commanders had sent many applicants with ratings below the required AGCT score of 110. These men had little chance of success in the course. Yet the demand for electronics officers was growing. The percentage strength of the Signal Corps in relation to total Army strength was increasing; by the end of the year it would comprise 4½ percent instead of 3 percent of the Army.[68] To give instruction in communications to the graduates of OCS and to other officers needing technical training, General Van Deusen, the commandant of the Eastern Signal Corps School at Fort Monmouth, estimated that enrollment in the Officers Department of the school should reach 1,930 by the end of the year. Enrollment stood then at only 520, and task forces would take most of these men before they completed the courses. But as officers became more plentiful, the Officers Department of the school could be expected to bulge for the first time since the emergency had made students scarce.[69]

The Services of Supply agreed that Fort Monmouth's facilities must be increased before the Signal Corps could even begin to cope with the need for training officers. On their return to Washington from their inspection trip, Colonel Jenkins had promised additional instructors, and General Huebner that additional construction would be authorized.[70] The Signal Corps began to compute its needs for both. The estimate called for fifty-six additional buildings, neither coldproof nor soundproof, without plumbing and heated by stoves. These specifications were to cause criticism later. The

[66] Memo, Col Meade, Dir of Planning OCSigO, for CSigO, 30 Apr 42, sub: Visit of Col King and representative of G–1 to OCS at Ft. Monmouth. SigC 352 OCS 2, Apr–May 42.

[67] Memo, Col King, Mil Pers Br, for Dir of Pers SOS, 23 May 42, sub: SigC OCS. SigC 352 OCS 1942–44.

[68] Kent Roberts Greenfield, Robert R. Palmer, and Bell I. Wiley, The Organization of Ground Combat Troops, UNITED STATES ARMY IN WORLD WAR II (Washington, 1947), Tab 3, p. 203.

[69] (1) Ltr, Van Deusen to CSigO, 9 Jul 42, sub: Increase in capacity of officers' courses, ESCS. SigC 352 Ft. Monmouth 2, Jun–Dec 42. (2) CSigO, Annual Report, 1943, p. 340.

[70] Another impression they brought back was that the Signal Corps did not know how to teach the candidates to shoot a rifle. Colonel King said, "We are supposed to be communications people—not sharpshooters!" With a student body of 1,800 in April, the OCS had only 222 rifles, issued under a table of allowance for a student capacity of 500. King straightway sought the advice of a rifle expert to locate a good instructor for the Officers' Department and the RTC's as well. (1) Ltr, Col Reeder, Asst Comdt SigC School, to CSigO, 7 Apr 42, sub: Increase in allowance of rifles for Officer Candidate Dept, Signal School. SigC 474 Gen (Small Arms). (2) Recording of telephone conversations between Col King and Col Richard B. Moran, Sig Officer AGF, 30 May 42; between King and Reeder, 26 May 42. SigC 352 OCS 2, Apr–May 42.

War Department authorized the construction, as General Huebner had promised, although not until after a decision had been rendered on a capacity increase for which King argued practically man by man.[71]

Getting more buildings, more instructors, and a larger authorized capacity were necessary steps toward producing more officers. Getting the men, and particularly qualified men, was another matter. By July 1942 the Signal Corps had 8,800 officers. It needed 13,400. Despite the expected output of the Officer Candidate School and procurement objectives already approved, the supply would still fall almost one-third short of the more than 30,000 who would be required for an Army of four and a half million men, which was in prospect. The Under Secretary of War had advocated bringing more officers into all the technical services by direct commissioning, through decentralized committees which were authorized to commission applicants without reference to the War Department. The Signal Corps agreed with the General Staff in rejecting this manner of commissioning, which it was thought would result in unsuitable officer material. Colonel King asked for authority to commission 1,100 men from civil life, under the provisions of AR 605–10. He also wanted a larger pool of officers to draw on rapidly to meet whatever needs might materialize. The War Department General Staff denied the request for direct commissioning, because it held the optimistic view, not shared either by the Signal Corps or by the Services of Supply, that with proper administration of the OCS and the utilization of Army Specialist Corps officers the Signal Corps could meet its requirements.[72] The Services of Supply was able to increase its officer pool to 4,500, second only to that of the Infantry in size.

Except for the Electronics Training Group, the Signal Corps had practically reached its authorized strength in officers by July 1942. Further action would have to wait on new authorizations, and Colonel King relaxed his efforts to obtain more officers from civil life. He did not yet know what a deep disappointment the Army Specialist Corps would prove to be, nor that the Signal Corps therefore would have to depend upon the nontechnical output of second lieutenants from the Officer Candidate School.

Meanwhile the percentage of candidate failures at OCS continued to be high. The fifth class, which graduated in June, was the first to have studied under the revised, simpler curriculum instituted in March. Entrance requirements had been so relaxed that only an estimated 2 percent of the candidates possessed engineering degrees or even a working knowledge of communications subjects. The course covered subjects common to officers' candidate training for all branches of the Army, with only 48 hours' instruction in signal subjects in the basic, 33 hours in the intermediate, and 21 hours in the advanced phase. In these brief periods devoted to strictly Signal Corps subjects, the candidates got a smattering of the elements of electricity, radio code and

[71] (1) Ltr, Van Deusen to CSigO, 30 May 42, sub: Increases in OCS. SigC 352 Ft. Monmouth 1, Jan–May 42. (2) Recording of telephone conversations between King and Jenkins, 1 Jun 42. SigC 352 OCS 1942–44.

[72] (1) Memo cited n. 66. (2) Memo, King for Dir Pers SOS, 8 May 42; (3) Memos, Brig Gen James E. Wharton, Dir of Mil Pers SOS, for CofS, 12 and 20 May 42, sub: Increase in proc objective AUS (SigC); (4) Memo, Brig Gen John H. Hilldring, ACofS G–1, for Mil Pers Div SOS, 23 May 42. SigC 381 Affiliated Units 4. (5) Daily Data, Mil Pers Div OCSigO, 6–11 Jul 42. SigC SPSTP 14. On the disappointing experience with the Army Specialist Corps, see below, p. 316.

procedure, basic signal communication and signal supply matters—not enough to fit a graduate for technical duty. The communications instruction of the fifth class was so elementary that the 27 percent of failures could not be attributed to it.[73]

The sixth class, which graduated in July, did better, with a failure rate of only 16 percent.[74] The next two classes did still better, with failures of only 13 and 15 percent respectively, the lowest percentage the Officer Candidate School ever attained. It was achieved during the school's most crowded period. Expecting 1,100 men for the eighth class, Monmouth received well over 1,500. Somewhere there had been a failure to co-ordinate; the quotas set for the June class were confused with the capacity authorized for the period later in the summer when the additional buildings would be ready. As many as 75 men crowded into barracks designed for 63, every tent Monmouth possessed was set up and occupied, and mess halls operated on two shifts.

The lower rate of failures may have resulted in part because of a change in administration and teaching methods. Many theories had been advanced to explain the previous high rate of failures. Colonel King had been particularly disturbed about a heavily weighted final quiz. To save potential officers who had otherwise completed the courses satisfactorily, he urged Milliken to omit this "embroidery," and he carried his point despite Lattin's advocacy of the practice.[75] Other officers noted that candidates sent by the Air Forces had not understood that the purpose of the school was to provide leadership training, and had expected that they would receive training in communications subjects. Lacking interest, they proved to be poor students.[76]

Many officers and students alike denounced the demerit system as tending to perpetuate a schoolboy atmosphere not conducive to building up self-esteem and responsibility in prospective officers. General Van Deusen said that no candidate was ever relieved until the general had reviewed his record, and that he himself had never attached any special importance to demerits. But because the practice of giving demerits had been so misunderstood, he discontinued it. Colonel Guest deplored the directives "requiring numerous compulsory subjects," which he believed had "hamstrung" the school in its teaching.[77] Despite all the explanations, General Olmstead felt that the high rate of failure of officer candidates lay not in administration or in teaching methods, but stemmed straight from poor selection of candidates. The rate of failure in relation to the AGCT ratings of members of classes two through six bore him out in this:

AGCT Score	*Percentage of Failures*
Below 110	60.
110–119	53.3
120–129	26.6
130–139	14.
140 and above	13.2

[73] 1st Ind, Asst Comdt ESCS to CSigO, 22 Jun 42, on Ltr, CSigO to Comdt ESCS Ft Monmouth, 16 Jun 42, sub: Failures, OCS. SigC 352 Ft. Monmouth 2, Jun–Dec 42.

[74] Memo, CG Ft. Monmouth for Col Lattin, 6 Aug 42. SigC 342 Ft. Monmouth 2, Jun–Dec 42.

[75] OCSigO R&W Action 1, King to Opns Br, 8 May 42; Action 3, Lattin to Opns Br, 22 May 42; Action 5, King to Opns Br, 23 May 42, all on sub: Trip to Ft. Monmouth by Capt Duncan Hodges. SigC 333.1 Ft. Monmouth, 1940–43.

[76] Memo for File, Capt W. M. Atkinson, OCSigO, 14 Aug 42, sub: Interview of unsuccessful officer candidates, ESCS. SigC 352 Ft. Monmouth 2, Jun–Dec 42.

[77] (1) OCSigO R&W Action 3, Guest to Meade, 9 Jul 42, sub: Article; (2) Ltr, Van Deusen to Lattin, 14 Jul 42. SigC 353 Ft. Monmouth 2, (RTC) May–Aug 42.

Seeking to improve the methods of selection, he directed that class standing be determined as upper, middle, and lower third, hoping that thus a good formula might be established to guide the selection of the more apt candidates.[78]

No matter how competent the graduates or how excellent the instruction, the Officer Candidate School could not turn out officers able to perform the highly complex duties of a signal officer without at least a fair measure of technical training—training which they would get if there happened to be enough time to permit them to go on to the specialized work in the Signal Corps School. But the calls for officers were still too urgent to allow for that. As one of the officers who went directly from OCS said: "We could march, drill with precision, fire a rifle, and creep and crawl like veterans, but we were not able to operate a signal center until we got our training overseas the hard way." [79]

One group of officers able to fill highly technical positions were those graduated from the Electronics Training Group. As one of its varied training services, Fort Monmouth accounted for these students, although most of them were enrolled in British schools and attended Monmouth only long enough to receive a short course in basic military subjects while on their way to or from England. These officers had been directly commissioned especially to fill technical positions in the Aircraft Warning Service. Like the authorizations for officer candidates, the authorization for ETG officers had been increased from time to time, and totaled 3,000 by June 1942. But as of 30 June, only 616 such officers were actually on duty, 151 at Fort Monmouth and 465 on detached service.[80]

Because the educational and personal requirements for appointment were exceptionally high, it was difficult to find men to meet them. An educational prerequisite was a background fitting the applicant for radar study. Since very high and ultrahigh frequency subjects had as yet only been touched upon in electrical engineering courses, few college graduates could qualify and these few were in heavy demand in all the military services and in industry. Some appointees were electrical engineering graduates who had majored in power courses and who would have to be trained from scratch in very high frequency subjects. The type of loyalty investigation to which they were subjected also delayed appointments and eliminated some applicants.[81]

Although the bulk of the first ETG officers had been sent immediately to the United Kingdom, by June the Signal Corps received permission to divert 100 per month, up to 600 students at any one time, to take the Cruft Laboratory course at Harvard University. Those who completed that course and who were qualified for advanced work (about one half of them) might then be sent for another twelve weeks of instruc-

[78] (1) Incl, Data on Classes 2 through 6 inclusive, to Memo, Van Deusen for Lattin, 21 Jul 42. SigC 352 OCS 3, Jun–Aug 42. (2) Ltr, Olmstead to Comdt ESCS Ft. Monmouth, 29 Jun 42, sub: Relative class standing of graduates of OCS. SigC 352 Ft. Monmouth 2, Jun–Dec 42.

[79] Interv, SigC Hist Sec with 1st Lt Robert C. Osborne (formerly attached to the 16th Signal Operations Battalion as a signal center operator in Australia and New Guinea), 14 Nov 44.

[80] Signal Corps Information Letter, No. 9 (1 August 1942), p. 33. See above, pp. 44ff.

[81] (1) Memo, Capt J. S. Vaughan, Mil Pers Div OCSigO, for King, 7 May 42, sub: Proc of technically qualified officers for SigC; (2) Recording of telephone conversation between King and Jenkins, 27 Apr 42; (3) TAG Ltr, 17 Feb 42, AG 210.1 SigC (2–12–42) RA. SigC 352.11 Gen 2, May–Dec 42.

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tion at the Massachusetts Institute of Technology, where the training compared favorably with that received in the British military schools.[82] Although it was the practice to cull out the better qualified for the overseas training, the British training officials found that some students were not ready for the advanced courses they offered, and had to be given ten to twelve weeks of fundamental instruction in electronics. Others were assigned to filter information center courses, and a few to very high frequency courses.

Of the students sent to the United Kingdom, about half were trained by the Royal Ordnance Corps and half by the Royal Air Force (RAF), none by the Royal Corps of Signals. Airborne training, as such, was limited to the 10 percent of the group that would be transferred to the Army Air Forces upon completion of the courses. But many more were enrolled in the RAF schools because in the British organization the RAF operated much of the ground equipment which in the United States Army was a responsibility of the Signal Corps.[83]

The British gave instruction in ground radar and related apparatus (MRU, CH, GCI, ACH, TRU, VHF, and filter equipment), in airborne radars AI and ASV, and in army sets GL and SLC.[84] By the summer of 1942 the British schools were also teaching the American officers how to site the Signal Corps' own radars, the SCR–270 and SCR–271 sets, according to texts revised by the Signal Corps as a result of experience with these sets.[85] The British also eagerly opened their research establishments to growing numbers of ETG students who were assigned to work on every new type of pulse radar equipment under development.[86]

Ionospheric radio propagation was also studied. Most of the experimentation in that field had been done by the British, the reason assigned for the relatively laggard program in the United States being that commercial airlines, as well as the Navy and the Air Forces, depended upon short-distance communications, especially the systems of beacons and radio ranges which covered the continent. The British Commonwealth, needing to communicate at considerably longer range, 2,000 miles, for example, instead of 500 miles, had sought to send messages by sky waves, utilizing the reflecting properties of the ionosphere, which lies approximately 60 to 300 miles outward from the earth's surface. Ionospheric data gathering stations were new and few. The principal emphasis, especially military, had been upon the development of radio transmitters and receivers which would operate in the high frequency band employing sky wave propagation. If the operation were not successful, one tended to assume that the fault was in the equipment. But it had become apparent that since so much activity in radio communication extended to, through, and beyond the ionosphere, radio engineers and scientists must well understand the nature of that layer. The British Admiralty and Air Ministry had set up the

[82] (1) Daily Data, Tng Div OCSigO, 20 Feb 42, and Mil Tng Div OCSigO, 28 May 42. SigC Hist Sec Card File. (2) Memo for File (unsigned), 23 Apr 42, sub: Progression of students, Harvard—M. I. T. SigC 000.8 Cruft Lab.

[83] SigC 352.11 ETG, *passim*.

[84] Memo, Col Baker for King, 4 Aug 42, and Incl to Memo, CO ETG for Mil Pers Div OCSigO, 18 Jul 42. SigC 352.11 ETG.

[85] (1) Memo, Col Saville, Div of Air Defense, for CSigO, 24 Mar 42, sub: Siting experts from ETG officers; (2) Ltr, CG AAF to CSigO, 24 Mar 42, same sub. SigC 353 Gen Feb–Aug 42. MT–40.

[86] Cablegrams 330, London to AGWAR, 31 Dec 41, and 462, AGWAR to Milattache (SPOBS) London, 4 Feb 42.

Inter-Service Ionosphere Bureau (ISIB) at Great Baddow, near Chelmsford, Essex, in 1941. At the time of the arrival of the ETG officers the bureau was working day and night taking vertical incidence soundings of the ionosphere, measuring field intensities and monitoring the bearings and other characteristics of special enemy transmissions, some of which were located as far away as Berlin and northern Italy.[87]

In their training assignments the ETG officers became closely identified with their British comrades. Some took part in bombing missions over the Continent; a few would be on the Rock of Gibraltar before the invasion of Africa; others would be with the invasion parties at Casablanca. It became more and more difficult to keep track of them even though overseas they were charged to the headquarters of the Services of Supply in London and officially were restricted to service in the United Kingdom.

The great need everywhere for electronics officers brought many requests for the ETG trainees. There was pressure from the United States Army and the British Army for their assignment in Europe; the Pacific wanted them; schools and other activities in the homeland needed them. So rapidly were the requirements of the Air Forces increasing that it was proposed to have the Royal Air Force train 75 percent of the second contingent of 500 instead of half as heretofore. The RAF was willing, provided it could retain the men on a training status for fourteen months instead of the eight agreed upon, in order that they might serve as officers of coastal and bomber commands, some in the Near East. Since this would not have permitted the Signal Corps to meet its commitments to the United States Army Air Forces,[88] no change was made in the original arrangement. Practically all the officers were returned to the United States for assignment. An exception was a contingent of 50 held in England to join the 562d Aircraft Warning Battalion with ROUNDUP under the plan for launching a cross-Channel offensive early in 1943.[89] The British-trained ETG officers were ready almost immediately for operational employment. A week usually sufficed for study of the American equipment with which they were not familiar. On their return to the United States they paused at Fort Monmouth only long enough to receive their assignments, or to get a short period of basic military training in case they had missed it on the way overseas because of transportation schedules that hurried them across the Atlantic.

With the facilities existing earlier it had not been possible, in an equivalent length of time, to obtain results in the United States which equaled those of the established British aircraft warning schools.[90] By the summer of 1942 the picture was changing. Aircraft warning training had been centered at Camp Murphy and civilian universities were participating in the electronics training program on a wider scale. Troopships crossing the Atlantic were now heavily laden and ETG officers had to be squeezed in wherever space could be found for a few at a time. Sometimes they arrived

[87] Interv, SigC Hist Sec with Capt Dana K. Bailey, RAF representative, ISIB, England, Jun 44, pp. 1–14.

[88] SigC 352.11 ETG, *passim*.

[89] Ruth F. Sadler, History of the Electronics Training Group in the United Kingdom, SigC historical monograph C–5, p. 31. SigC Hist Sec File.

[90] Ltr, Lt Col W. R. Lansford to CSigO, 15 Jun 42, sub: Proposed course of instruction of ETG officers for tng in the United Kingdom for secs to follow original ten secs. SigC 352.11 ETG.

late for the classes they had been scheduled to attend. Delays became more serious as the RAF schools, which now began to train the uniformed womanpower of Great Britain in aircraft warning duties, could no longer afford to set aside their training facilities for American officers who could not be depended upon to fill the spaces.[91] Gradually the institutions in the United States absorbed the training of these officers. In late summer Fort Monmouth relinquished to Camp Murphy the responsibility for accounting for ETG students, along with its radar courses.

Camp Murphy

The bulldozers and construction crews had barely begun work on the site of the new Signal Corps Radar School at Camp Murphy, on Hobe Sound, Florida, when the whole matter of providing Signal Corps aircraft warning specialists for the Army Air Forces was thrown into question by a dispute growing out of the big 9 March reorganization of the Army. Two days earlier, Signal Corps and Air Forces representatives had met with General Somervell, then G–4 and soon to become the head of the new Services of Supply, and had discussed among other things their differing views of the responsibilities given the AAF for aircraft warning activities. The conference ended in numerous compromises. The Signal Corps yielded the preparation of tables of organization and tables of basic allowances for aircraft warning units to the AAF, along with personnel to perform the work.

On the other hand, the AAF contended that it should have complete control of training for aircraft warning personnel from the time the men left the reception centers. The decision went to the Signal Corps. The Chief Signal Officer would retain control of replacement training centers and technical schools which turned out aircraft warning specialists for both the AAF and the Army Ground Forces. It was recognized that the AAF must be able to modify from time to time the number and type of specialists being trained, and to change the amount of time devoted to training specific specialists, in order to meet changing requirements for aircraft warning activities for task forces, defense commands. and theaters. To serve this need, the Signal Corps, the Army Air Forces, and the Army Ground Forces agreed to review jointly the Signal Corps training programs at Signal Corps reception centers and technical schools in order to screen out all types of specialists who could be trained in units or in training establishments of lower classification, and in order to reduce to a minimum the time required to train each individual. The initial review would be followed by others, the Signal Corps schools to be thrown open to AAF and AGF inspection at any time.[92]

The decision to give only the *minimum* training to the largest number of men—as Somervell put it, the problem of numbers versus quality production—was one that gave many Signal Corps officers concern. Radar was new, and intricate. There were no precedents on which to base even a good guess as to the length of time it would take to train men how to use, maintain, and repair the equipment properly. Some officers not very familiar with the equipment thought three months would be enough. The

[91] Ltr, Lt Col K. S. Stice, CO ETG London, to CSigO, 24 Dec 42, sub: Delayed handling of ETG officers. SigC 352.11 ETG.

[92] Memo. CG SOS for CSigO, 9 Mar 42, sub: AW activities. SigC 020 WD (Reorgn of the WD) 1942. Deputy CSigO File.

men who had worked most closely with it in the laboratories made the longest estimates; Colonel Conrad, for example, estimated that it would require from ten to twenty-two months to give a qualified student a thorough understanding of the technical performance of radar sets.[93] Dr. William L. Everitt, who headed the Operational Research Group in the Office of the Chief Signal Officer, thought radar equipment was still a laboratory instrument, and would remain so for some time to come. As such, he thought it should be in the hands of thoroughly qualified men, and deplored a tendency to consider the average American "so smart" that he could be trained for radar work in a few weeks.[94] Colonel Gardner, the director of the Aircraft Radio Laboratory at Wright Field, thought it would take a long time to train men to maintain and repair the new devices. He thought that even a thorough understanding of them would be but "a prelude . . . to further education in the field by the actual maintenance and use [of the equipment]." [95] The Chief Signal Officer himself wrote that "no matter how efficiently constructed these technical sets may be, unless they are properly operated and maintained in the field the objective for which they were produced is lost." [96]

However sound the arguments for thorough training of radar specialists might be, time pressed too heavily to permit such a luxury. Training administrators set the cycle for training enlisted men at seven months: four months for the radio course and three months for the radar maintenance course. The officers' course they set at approximately five months.[97]

Though reverberations from the Army Air Forces-Signal Corps differences of opinion over aircraft warning training continued to resound for some time to come, they had little effect on local operations at Camp Murphy. Colonel Mitchell, the commandant, was assigned to the new school in March 1942. After a brief trip to look things over, he returned to Washington with plans to rush construction, and to start classes meanwhile in a leased warehouse in nearby Riviera, Florida, until Camp Murphy should be ready for occupancy.[98]

The new establishment was well situated for radar instruction. The climate made year-round training feasible, and much of the 11,500-acre tract stretching along Hobe Sound for about five miles was wild, inaccessible swampland covered thickly with palmetto, fern, and bamboo which would discourage prying observation of the secret radar operations practiced there.[99] By summer more than 400 one-story paintless buildings had sprung up on the site. The foliage of the Everglades provided camou-

[93] OCSigO R&W Action 2, Col Conrad, Asst Dir of Planning, to Exec Officer Sig Tng Div, 11 May 42, sub: Educational program for officers and enlisted pers. SigC SPSTP 5 Misc.

[94] OCSigO R&W Action 5, Everitt to Mil Pers Div, 28 Sep 42. SigC 353 Gen Sep 42–Dec 42. MT–41.

[95] Ltr, Gardner to All SigC Pers on Duty at Philco Tng School, 19 Feb 43. Pamphlet Philco Tng School, n. d. SigC Hist Sec File.

[96] Ltr, Olmstead to R. C. Muir, GE Co., Schenectady, N. Y., 6 Apr 42. SigC 095 GE Co.

[97] Ltr, CSigO to CG SOS, 16 May 42, sub: Expansion of SigC school facilities for tng radar repairmen. SigC 352 Southern SigC School, Jan–Dec 42. MT–32.

[98] (1) Report of Inspection Trip to Hobe Sound, Florida, by Col Mitchell, 17 Mar 42; (2) OCSigO R&W Action 1, Mitchell to Chief of Fld Svs, 23 Mar 42; Action 2, King to Milliken, Chief of Fld Svs, 25 Mar 42; Action 3, Milliken to King, 26 Mar 42, all on sub: Necessary schedule to initiate tng at Camp Murphy prior to 25 Apr 42. SigC 352 Hobe Sound 1942.

[99] Memo for File, Capt Charles F. Fell, OCSigO, 11 Feb 42, sub: Acquisition of land for SigC AW school, Hobe Sound. SigC 353 Gen 12, Jan–Mar 42.

flage for the green lumber structures and the crushed-shell roads which ribboned the post.

Even before the school was ready to accept its first students, the scheduled capacity of 1,605 students had been increased to 3,605, to be divided between the prerequisite radio repair course and the radar course. This output would fall short of the year's requirements; by activation schedules, 1,754 short, or on the basis of equipment delivery schedules, 4,210 short. Acting on the March agreement with the AAF to put as much of the training as possible in schools of lower classification, the Signal Corps proposed to give the radio repair training in civilian schools, devoting Camp Murphy's entire capacity to the radar courses, and the Services of Supply agreed.[100]

It was a decision that could not be adhered to. At first the school comprised three main departments: Pulse Goniometry, which had divisions devoted to airborne, gun-laying and searchlight, and reporting equipment: Engineering, which taught repair shop techniques; and Training Literature, which provided the lesson texts. As summer moved on, some students coming from the radio courses in civilian schools proved to be still not qualified to enter the radar courses, and about one third of the officer students needed preliminary instruction. New courses in the principles of electricity and the elements of radio, a radar survey course, and eventually a new department, General Radar, had to be added to the school to mend the deficiencies. The whole organization of the school was necessarily experimental.[101]

Obviously, a radar school had to have radar sets for its students to work on, not merely blueprints or textbooks to study. But from its beginning, the school was handicapped by a lack of training sets. Each one it got had to be diverted from operational use by the Army Air Forces or the Coast Artillery Corps, and the scheduled production of sets was not enough for operational requirements alone. Moreover, plans for the operational use of the Aircraft Warning Service were by no means fixed; the equipment changed repeatedly as experience in its use revealed new secrets, and this in turn changed personnel and training requirements. Thus, even had there been plenty of sets, the services would have had difficulty in fixing priority of importance to particular sets, and hence to the numbers of men to be trained in their use. Yet the amount of training equipment available to the Radar School would largely determine the size of the classes it could train.[102] The whole situation resembled a jigsaw puzzle, identification of each piece depending on fitting another piece smoothly into place.

The Coast Artillery Corps had given first

[100] (1) Ltr, CSigO to CG SOS, 16 May 42, sub: Expansion of SigC school facilities for tng radar repairmen, and 1st Ind, Tng Div SOS to CSigO, 29 May 42. SigC 352 Southern SigC School, Jan–Dec 42. MT–32. (2) 1st Ind, Hq SOS to CSigO, 15 Jun 42, on Ltr, CSigO to CG SOS, 6 Jun 42, sub: Tng of SigC radio mechanics in civ institutions for entrance to SigC Radar School, Camp Murphy. SigC 352 Hobe Sound SigC School 3, Jun–Jul 42. (3) 2d Ind, Comdt SigC Radar School to CSigO, 19 Sep 42, on Ltr, Comdt Radar School to CSigO, 25 Aug 42, sub: Courses of instruction, SigC Radar School. SigC 352 Hobe Sound, 1942.

[101] Ltrs, Comdt SigC Radar School, Camp Murphy, to CSigO, 25 Aug 42, sub: Courses of instruction, the SigC Radar School, and 8 Aug 42, sub: Radar survey course. SigC 353 Hobe Sound, 1942.

[102] (1) OCSigO R&W Action 1, Lt Vance, Radar Div, to Col De Armond, Liaison officer AAF, 24 Jun 42, sub: Diversion of radar equip for SigC School. SigC 352 Hobe Sound SigC School 3, Jun–Jul 42. (2) Memo, Rives for Milliken, 26 Apr 42, sub: Spare parts and components of SCR–268, 270 and 271 radio sets for school tng. SigC 413.44 MT–198 and MT–194.

priority to the provision of six SCR–268's for use of the school's Gunlaying Division. The first two sets arrived, minus oscilloscopes and receivers, without which they were practically useless even for training purposes. The Reporting Division's first class had only two SCR–270's and a single SCR–588 CHL set to study. The first students in the Airborne Equipment Division were taught on the SCR–521 airborne search set and on the Mark IV IFF radars, SCR–515, employed in aircraft, and the companion sets, SR–532 and 533, employed on the ground. Later the Mark IV IFF equipment, of American design, was withdrawn from use because of a Joint Radar Board decision to use the British Mark III instead. Thus 64 men trained on the American sets again became unskilled when they were confronted by the British equipment.[103]

To supplement the limited number of actual radar sets available for training, the Signal Corps Radar Laboratory, the Coast Artillery Corps, and the National Defense Research Committee engaged in a search for adequate training substitutes. The Coast Artillery Corps developed and built a breadboard model to teach azimuth and elevation tracking for the SCR–268, and was considering the purchase of another pilot model embodying the BC–412 oscilloscope. Various British trainers were being sought. The First Interceptor Command's Aircraft Warning School at Fort Dix had prepared blueprints for an SCR–270 mock-up which although it would not give the student any operational experience, would give him preliminary training at the controls—that is, in starting the set or shutting it down, in learning the possible source of trouble by variations in the visible lights, switches, and meters. Philco was building SCR–270 trainers which would go a step farther, and provide operational experience without the necessity of using live aircraft for targets.[104] But scarcely any of this equipment was on hand in the summer of 1942.

Not the least of the school's problems was the familiar one, the quality of the students. Every applicant had first of all to survive a thoroughgoing loyalty investigation into his personal and family background. In addition, he was supposed to have a background knowledge of radio and an AGCT score of at least 110, equal to that for Officer Candidate School. The intake of students often brought candidates who failed to meet the educational and mental standards, and the percentage of failures was accordingly high.[105] For example a survey of students enrolled in the principles of electricity subcourse in July revealed that only 10 percent could be expected to go through the Radar School without difficulty. About 40 percent might become apprentice repairmen within

[103] (1) Memo, Lattin for Milliken, 5 Jun 42, sub: Equip. SigC 352 Hobe Sound SigC School 3, Jun–Jul 42. (2) Ltr, Lattin to Comdt SigC Radar School, Camp Murphy, 11 Jun 42, sub: Status radar equip items; (3) OCSigO R&W Action 1, Maj Fell, Sv School Sec, to Capt R. M. Atkinson, Mil Tng Div, 9 Jul 42. SigC 352 Southern SigC School, Jan–Dec 42. MT–32.

[104] (1) Ltr, Rives to CofCA, 9 Mar 42, sub: Trainer equip; 2d Ind, president of CA Bd to Chief of Rqmts Div Hq AGF, 24 May 42; 7th Ind, Col Corput, Dir of SigC Lab, to CSigO, 10 Jun 42; (2) Ltr, Spec Observer, American Embassy, London, to CSigO, 4 May 42, sub: RDF tng equip. SigC 412.684 Tng equip. MT–49. (3) Ltr, Col Hayden to Dir of SigC Radar Lab, 2 Feb 42, sub: Tng Material; 1st Ind, SigC Radar Lab to CSigO, 9 Mar 42; 1st Memo Ind, Capt Earl J. Atkinson to Maj E. A. Redding, Mil Tng Div OCSigO, 14 Mar 42, on Memo, Redding to O/C Radar Div, 22 Jan 42. SigC 413.684 Tng Equip, Oct 41–Aug 42. SigC MT–49.

[105] 1st Ind, CG AA Comd to CSigO, 26 Jun 42, and 2d Ind, CSigO to CG AA Comd (without basic ltr), 1 Jul 42. SigC 352 Southern SigC School, Jan–Dec 42. MT–32.

the allotted time, and another 40 percent were obvious misfits unacquainted with electrical terms and unable to master the simplest forms of arithmetic without difficulty but possibly capable of becoming elementary radiomen. The last 10 percent seemed hopeless.[106]

Radar repairmen were the elite, the Phi Beta Kappas of the school. To earn a "superior" rating as a graduate radar repairman, a student had to be able to take over a type of radar he had not previously studied; to supervise the installation of radar equipment and diagnose trouble quickly; to analyze radar circuits, and make substitutions in an emergency. Less expert repairmen received ratings of "excellent," "very satisfactory," or "satisfactory" according to the degree of ability they displayed. Men who could not quite make the grade as repairmen could usually become operators.[107] But not all of them wished to do so. Radar students worked to a great extent on their own initiative, and men capable of studying in that manner were scarce. Others qualified for radar study objected to assignment at the school because of grapevine rumors that work at the oscilloscope was injurious to an operator's eyesight, and that radiations from a radar set were harmful and could possibly cause sterility. Radar was so new that not even the engineers who developed it could be absolutely certain of the effects. To find out, students at some military institutions and at Purdue University served as guinea pigs in a series of tests which exploded the rumors. They showed that long periods of continuous work at the oscilloscope caused ocular fatigue no greater than that which follows a long period of reading, or watching a double-feature movie. Tests of radiation intensities were no more alarming. Radar men faced no greater hazard than would be encountered in working with high-voltage equipment of any sort.[108]

Wearing two hats, as commandant of the Signal Corps Radar School and as post commander of Camp Murphy, Colonel Mitchell found his duties wide and often burdensome, with scarcely discernible lines of demarcation between his accountability to the service command and to the Chief Signal Officer. The new camp needed almost everything. Mitchell felt it needed protection for the costly and scarce radars on hand—for example, canvas covers for protection against hurricanes and a military police force or some combat troops to guard against hostile human intruders. For his men on the post, Mitchell wanted bus transportation, recreational facilities, a drill ground, a baseball field, a band.[109] Although the camp stretched for miles along Hobe Sound, there was not even a bathing beach available until neighboring estate owners offered private beach, dock, and boat facilities to the men of Camp Murphy.[110]

On 15 June 1942 the first classes began studying at Camp Murphy proper, and all

[106] Ltr, Actg Dir of SigC Radar School to Asst Comdt Camp Murphy, 3 Jul 42, sub: Rpt on Engr Dept students as a body. SigC 352 Hobe Sound SigC School 3, Jun–Jul 42.

[107] Review of Training Activity, The Southern Signal Corps School, Riviera-Camp Murphy, 15 Apr 42–15 Jun 43, Vol. II, *passim*. SigC Hist Sec File.

[108] Norman A. Abbott, "Radar and the Man," *Signals*, I:2 (November–December 1946), 31.

[109] (1) Memo for File, Col Willis, OCSigO, 14 Sep 42, sub: Problems of SigC Radar School, Camp Murphy. SigC 353 Hobe Sound. (2) Ltr, CO Camp Murphy to CG SOS, 28 Aug 42, sub: Request for band and musical instruments for Camp Murphy. SigC 352 Hobe Sound, 1942.

[110] Ltr, Actg CSigO to Chief of Spec Svs, 16 Jul 42, sub: Camp Murphy, recreational facilities, and 2 Incls. SigC 352 Southern SigC School. MT–32.

training at Riviera came to an end. Of the students who had enrolled there in April, 208 officers and enlisted men were graduated on 9 June ahead of schedule, and 50 others received diplomas on 5 July. By the end of July, 305 officers and 2,142 enlisted men were enrolled at the school.[111] Colonel Mitchell felt that Camp Murphy was by then well established and that radar training was on a firm footing, an opinion shared by a representative of the Army Air Forces who visited there in July: "Camp Murphy reflects very creditably upon the Signal Corps . . . the high quality and competency of the instructor personnel impressed me favorably together with the associated good direction and supervision." [112] Mitchell agreed to accept all radar students completing courses in other schools for crew training and postgraduate work before their assignment to field units, and to take full responsibility for any failures attributable to lack of training of the men passing through the school. Camp Murphy, he thought, could grow to a population of 25,000 or 30,000 men under the existing organization.[113]

It began to look as though it would have to. The Services of Supply had just stated the minimum requirements for Signal Corps personnel for the Aircraft Warning Service: 70,000 men by the end of 1942, with an additional 37,000 on other duty with the Air Forces.[114]

The real participation of the United States Army in the war was just beginning. Across the Atlantic America's allies still bore the brunt of the fighting. In the Pacific the United States forces still lacked the men and material to conduct a major offensive. Plans for the invasion of North Africa were just taking shape. But already nearly every training problem that would plague the Signal Corps during the entire period of the war had been encountered in some measure, and in achieving at least partial solutions the training structure was showing stability and strength.[115]

[111] Ltrs, CO Camp Murphy to CSigO, 20 Jun 42, 26 Jun 42, 10 Jul 42, 30 Jul 42, all on sub: Prog rpt, Camp Murphy. SigC 319.1 Rpts, Prog (SSCS), May–Aug 42. MT–19.

[112] Ltr, Maj Harry B. Porter, Hq AAF, to CSigO, 27 Jul 42, sub: Personal observations at Camp Murphy. SigC 352 Hobe Sound SigC School 3, Jun–Jul 42.

[113] (1) Memo for File, Maj Fell, Mil Tng Div OCSigO, 1 Jul 42, sub: Radar repairmen SCR–588 (775); (2) Ltr, CO Camp Murphy to Milliken, 7 Jul 42. SigC 352 Hobe Sound SigC School 3, Jun–Jul 42.

[114] Memo, Maj H. H. Butler, Mil Pers Div OCSigO, for Enlisted Br and Officers Br, 8 Jul 42, sub: Allotments SigC pers with AAF. SigC Career Mgmt Br File, SigC Units with AAF.

[115] For the growth of training facilities in the latter part of 1942, see below, pages 318–22.

CHAPTER VIII

Signal Equipment: Wire and Radio (June–October 1942)

The Signal Corps' responsibility to develop electronic equipment for the Army, to keep American fighting men supplied with the best that science and mass production could devise, was now being met with notable success. Before the end of 1942 Signal Corps research and development efforts had sketched out or completed the chief types of communication equipment with which the Army would fight to the war's conclusion: automatic communication office equipment and radioteletype, spiral-four field cable and carrier, FM radio, radio relay, and microwave radar. The threads of all these developments extended back into the past, in laboratory cogitations and experiment; but the year 1942 saw them beginning to form a definite pattern, one that became a part of the fabric of World War II victories.

Automatic wire and radioteletypewriters, combined with carrier operation, would convey communication loads with unheard-of ease and rapidity, transforming civilian no less than military communications and bringing all the world closer to that ideal state of society wherein all men everywhere may be able to communicate readily and rapidly with one another.

FM had by this time become accepted for tank and car radios and was pointing the way to radio relay. The fortunate coincidence that the Armored Force and mobile FM had both made their initial appearance in 1940 (Armor, equipping itself from the ground up, was not committed to the older AM sets) had made possible the wholesale acceptance of the totally new and better type of radio. No other army in the world had been able to make so fresh a start,[1] and the American Armored Force began in 1942 to profit from communications of unprecedented reliability and simplicity.

Microwave radar became as indispensable as the explosives it aimed against the enemy—not only airborne radar directing the deadly design of hurtling fighters and bombers, but also ground gun directors, accompanying every large antiaircraft and coastal battery.

Toward Automatic Teletype and Tape Relay

Each signal center of the Army Command and Administrative Network (ACAN) was transmitting and receiving ever greater traffic loads over its wire and radio facilities. The press of work weighed increasingly

[1] Col T. B. Gravely *et al., The Second World War 1939–1945: Signal Communications* (London, The War Office, 1950), p. 191.

upon the operators who sat at teletypewriters or at Boehme high-speed equipment or who simply, in the older manner of continuous wave operation, transmitted in Morse code by a hand key; or who received, with headphones clapped to ears and with fingers converting the dah dits upon a typewriter. The pressure became intolerable—not enough trained operators; not enough space to accommodate them, had their numbers sufficed; not enough time to waste in such hand methods. Obviously automatic devices had to be provided.

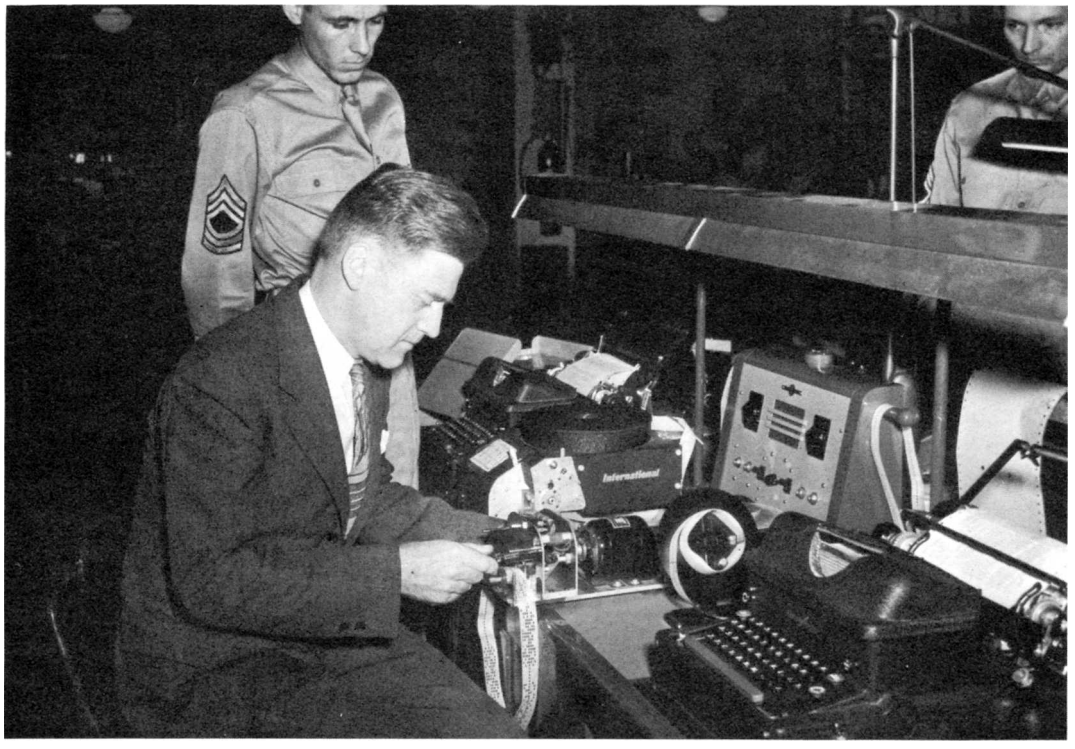
Even a commercial-type teletypewriter demanded too much. The teletypewriter was keyboard operated, hand punched, that is, an operator typed the message on the sending teletypewriter. True, at the receiving end, a similar machine automatically typed out the transmission. But if the message was to be sent on to a third station, an operator in the intermediate, or relaying, signal center had to take the automatically received message and type out a copy on another teletypewriter, which would then send the words on to their ultimate destination. In such a case, it would be better if the first receiving machine punched a tape that could then be fed into the relaying machine for automatic retransmission. The American Telephone and Telegraph Company had such machines in its 102–A system, which relayed messages by means of a perforated tape, carrying along its edge the printed text. It was a simple matter for the operator at the relay station to identify each message by means of a code symbol inserted at the beginning of the message, tear the tape at the proper point, and relay it by inserting the tape into an automatic transmitter connected to the appropriate trunk channel. In mid-July 1942 the Signal Corps installed this system, giving it the designation Q–102, on the circuit between the War Department Signal Center in Washington and Governors Island, New York. This circuit became the first link in what grew into the world-wide ACAN automatic network (*automatic* being stressed here, not the Q–102 equipment, which would yield to better devices).[2]

Q–102 was automatic *wire* teletype. There had been, and there continued to be increasingly, an urgent need for teletype that could operate, not merely on signals flashed through wires, but on radio waves radiated through space. In April 1942 the Air Forces had asked the Signal Corps to provide a radioteletype circuit for weather services, linking three fields in the Caribbean area: Borinquen, Waller, and Albrook. Mounting air travel along the South Atlantic air route, Arnold wrote to Olmstead, required faster and more numerous weather reports than existing Army Airways Communications System equipment could provide.[3]

At this date AACS weather reports had to be manually enciphered, transmitted, and deciphered, all of which took so much time, often in the hands of rather unskilled operators, that the reports might be received hours later, too late to be valuable. The Signal Corps therefore set about developing radioteletype, RTTY, specifically to as-

[2] Pauline M. Oakes, The Army Command and Administrative Communications System, Pt. II, Signal Corps Domestic Communications Network as Extended to Overseas Terminals FY 1941–15 August 1945, SigC historical monograph E–5b, pp. 29–30, 102. SigC Hist Sec File. This Q–102 teletypewriter circuit was "cut over and commenced handling traffic satisfactorily" in the third week of July, so Brig. Gen. Frank E. Stoner, head of the Army Communications Service, reported on 22 July. Memo, Stoner for Exec Control Div, 22 Jul 42, Rpt 46, sub: Prog rpt 16–22 Jul 42, Item 5b. SigC (AC) 319.1 Weekly Prog Rpts, Army Com Br, Dec 41–Jul 42.

[3] Ltr, CG AAF to CSigO, 1 Apr 42, sub: Weather radio circuits. SigC 413.52 Teletype 1, Jan–Jun 42.



RADIOTYPE EQUIPMENT. *A representative of IBM demonstrates the equipment in the Office of the Chief Signal Officer in the Munitions Building in Washington, D.C., May 1942.*

sist the AACS.[4] RTTY operation was speeded by the assistance of automatic cipher machines to encode and decode simultaneously, on the line, at both the sending and receiving teletypewriters. This combination made possible the secure transmission of a weather message at the speed of the sending teletypewriter. The sender typed the English text of the message on a teletypewriter, which, while producing a page copy also perforated a tape. The tape was fed into an automatic enciphering machine that conveyed the cryptic product to the transmitter to be broadcast. Inversely, at the receiving end, the faint skyborne signals would be picked up, amplified, and passed on to a perforator which would punch a tape in cipher. The enciphered tape, now passing through a second cipher machine, set to the same key as the enciphering machine, would yield a plain text tape, perforated in the five-unit teletypewriter code. The plain text tape would, in the last step of the process, actuate the receiving teletypewriter so that it would type up the message on a sheet, in all respects the exact counterpart of the original text. All this was done with the speed of light, with only one person working, the one sitting at the originating key-

[4] For Signal Corps responsibilities and assistance to the AACS, see pp. 277ff, below.

board.[5] This is the way RTTY would eventually work, but in mid-1942 it did not yet exist.

There was, however, another device at hand—radiotype. The Air Forces' need for speeding weather messages was obvious, made vividly so by the BOLERO mishaps in June along the North Atlantic air route to England.[6] But there were obvious problems, too, presented by the wayward behavior of radio signals, which, undisciplined by the straight narrow path of wire, stray into the wide open spaces of sky and mingle promiscuously with static, interference, and fading. The International Business Machines Corporation had worked out an imperfect solution involving equipment that the firm called radiotype, using, unfortunately, not the standard five-unit teletypewriter code but a special six-unit code. Like a narrow-gauge railroad adjoining a standard line, this special code necessitated much hand labor at conversion points where standard teletypewriter texts had to be shifted onto radiotype circuits, and vice versa. Moreover, the standard automatic cipher machines could not function with the six-unit system.

Notwithstanding these inconveniences, the Signal Corps early in the war began making use of radiotype, leased from IBM. It was another step in the right direction, toward automatic, high-speed, heavy-duty communications for the Army. Like Q–102, radiotype equipment produced a punched tape which could be relayed automatically. The only hand work needed was the typing at the originating machine. Radiotype, speed 100 words a minute, would replace Boehme equipment, which was very fast, up to 400 words a minute, but which was not entirely automatic.[7] So General Olmstead informed ACAN stations WTJ (Hawaii), WVN (Puerto Rico), and WVL (Panama) on 20 June, adding: "For your information this equipment performs the same function on radio transmission as a teletype machine performs on wire transmission." [8]

In military radio, hand-keyed Morse dah dits had been the first step; Boehme the second. The second step was now yielding to the third advance in the art, radiotype. By September Signal Corps' Washington station was using automatic equipment, both wire teletype Q–102 and radiotype, all leased, in communicating with eight ACAN stations at home: [9]

IBM Radiotype

WVR	Fort McPherson, Atlanta
WVQ	Wright Field
WVT	Chicago
WVU	Fort Omaha
WVB	Fort Sam Houston
WVY	Presidio of San Francisco

Q–102 Teletype

WVO	Boston
WVP	Governors Island

[5] Incl, Radio Teletype System (unsigned), 3 Oct 42, to OCSigO R&W Action 1, Gen Stoner to Col Will V. Parker, 9 Nov 42, sub: Revision of AR 95–200 AACS. SigC 676.3 AACS, 1942–44.

[6] See below, pp. 283–85.

[7] IBM had first offered its radiotype to the Signal Corps in March 1941. After some experimentation, the Signal Corps agreed to give it a trial, and put into operation Army's first radiotype circuit between WAR and WVQ, Wright Field, Ohio, on 20 August 1941. (1) Mary-louise Melia, Signal Corps Fixed Communications in World War II: Special Assignments and Techniques (1945), SigC historial monograph E–10, pp. 6, 10–11. SigC Hist Sec File. (2) Oakes, Army Command and Administrative Communications System, Pt. II, pp. 26–27.

[8] Msg, Olmstead (Col French) to Signals WTJ, WVN, and WVL, 20 Jun 42. SigC 413.44 Radiotype 2, May–Dec 42.

[9] Oakes, Army Command and Administrative Communications System, Pt. II, pp. 30–31. In communicators' parlance, the equipment was not exactly automatic, but "semi-automatic," since some

Radiotype continued to expand in military use during the last half of 1942 and early 1943 before radioteletype, using the five-unit teletypewriter code, began to replace it. Late in 1942 a radiotype circuit went into service between WAR and Honolulu, the installation at WTJ, Fort Shafter, accomplished by six enlisted men from WAR and an IBM engineer, who arrived in Hawaii early in October. On 18 December another radiotype circuit would go into regular operation between WAR and WVL, Quarry Heights, Panama.[10]

Radiotype was good. It was faster than hand-keyed radiotelegraph, faster even than Boehme when one considers the time taken to hand punch Boehme tape for transmission, plus the time taken to translate the received tape back into English. Even so, radiotype was not good enough, especially since it suffered, as already noted, from the disadvantage of employing a six-unit code, which did not conform with the universal five-unit teletypewriter system.

With the intensifying of the Army's communication needs during 1942, fresh determination arose to find ways to put the conventional wire line teletypewriter, five-unit code and all, on the air, as radioteletype, RTTY. And it was done, too, with the efforts of American Telephone and Telegraph and Press Wireless. It was done in large part by capturing the elusive far-darting radio waves by means of two diversity devices: frequency diversity and antenna or space diversity. The former means simply that two frequencies were employed to transmit and receive mark- and space-signals; the latter means that the receiving station used two receiving antennas and two receivers in somewhat separate locations, several wavelengths apart. The purpose of diversity, whether of frequencies or of antenna positions, is to overcome the maddening tendency of high-frequency sky wave radio signals to fade. For fading is fatal to radioteletype, fatal to the synchronized operation of the machines. The receiving teletypewriter must have a strong, steady signal impulse at all times to keep its motions in step with those of the sending machine; otherwise, the printing of the former will go awry. Radio engineers had learned that when fading occurs on one frequency, another adjacent frequency will come in strong. Similarly, when the signal fades at the location of one receiving antenna, it will remain strong at another located some distance away. Hence the solution to fad-

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hand labor was required at relay points. Semiautomatic was the term subsequently applied to the type 19 teletypewriter and its associated tape perforator equipment, used both in wire and in radio transmission. At first, however, men called it automatic, as indeed it was, compared with hand-keyed and Boehme operation. See, for example, Memo, Col Sadtler for Exec Control Div, 20 Feb 42, Rpt 24, sub: Prog rpt, 13–19 Feb 42. SigC (AC) 319.1 Weekly Prog Rpts, Army Com Br, Dec 41–Jul 42.

[10] (1) Oakes, Army Command and Administrative Communications System, Pt. II, pp. 31, 117. (2) Weekly Digests, Col French, Traffic Div, 14 Oct 42, Item II A5, and 30 Dec 42, Item I A1. SigC 319.1, Drawer 483 AC 133, Weekly Digest of Prog and Problems, Rpts from Divs, 7/30/42–12/30/42.

Radiotype would continue to be used considerably. Not till September 1943 would the Signal Corps stop its procurement in favor of radioteletype and not until May 1945 would the Army take its last radiotype out of service (on the WAR-Accra circuit). Then the triumph of radioteletype would be complete. (3) Melia, Signal Corps Fixed Communications, pp. 19–20. (4) Oakes, Army Command and Administrative Communications System, Pt. II, pp. 34, 84, 122.

Manual operation continued to the war's end on lightly used circuits, such WAR-Iceland. Hand keys were retained for occasional use to break through the static encountered in auroral zones during magnetic storms. Under these conditions an operator, by repeated manual transmissions, could pound through a short emergency message when radioteletype was blacked out.

ing at high frequencies was to use either principle, or better, both of them.

Frequency diversity immediately presented a further great advantage. More than two frequencies, or two tones, can be imposed upon the air, using a single set of equipment. Four or six frequencies can be imposed and a separate communication channel assigned to each pair of them. An operator can then make radioteletype convey several signals simultaneously. Thus, multi-channel radiotelegraph emerged, exactly the counterpart in radio of carrier telegraphy in wire. Something along these lines was already being done in mid-1942 when the Signal Corps established a multichannel link with London, using American Telephone and Telegraph equipment which enabled three two-tone telegraph signals to flash over the Atlantic on one sideband of a powerful 40-kilowatt radio transmission. Brig. Gen. Frank E. Stoner had opened negotiations early in the year with American Telephone and Telegraph for multichannel telegraph circuits overseas "in anticipation of heavy radiotelegraph circuit requirements between Washington and the British Isles, the European Continent and North Africa and between San Francisco and Australia. . . ." [11] By June he reported that the Radio Section of Signal Corps' Plant Division was purchasing four such sets of heavy duty radios. According to his report for the week ending 22 July, "a multi-channel radiotelegraph system was placed in operation between WAR (Washington) and London using leased radio facilities of the American Telephone and Telegraph Company and the British Post Office authorities." [12]

Thus the diversity principles would not only make possible single channel radioteletype, RTTY, but they would also enable radio operators to provide many channels over one set of equipment, accomplishing for military radio what spiral-four and carrier systems were doing for military wire.

Multichannel radiotelegraph for huge, fixed ACAN stations was one thing. To develop small single-channel radioteletype equipment for the Air Forces and for field troops was something else. The demand for it was now increasing. A relatively simple, efficient, and rugged RTTY was a device that Ground Forces officers, no less than airway weather stations, were increasingly seeking. On 6 June 1942 Col. Donald B. Sanger, Coast Artillery Corps, president of the Desert Warfare Board, asked for two radio teletypewriters for the First Armored Signal Battalion to test. Col. Edward F. French, chief of the Traffic Division in the Washington headquarters, replied, discouragingly, that the only such machine available was the IBM radiotype, production of which was not even meeting his Signal Center needs. Furthermore, Colonel French thought it "extremely doubtful if any such machine would prove satisfactory"

[11] Memo, Stoner for CSigO, 27 May 42, sub: Provision of multichannel telegraph circuits. SigC 320.3 BOLERO, May–Jun 42 (MT–24).

[12] (1) Memo, Stoner for Exec Control Div, Rpt 40, sub: Prog Rpt, 4–10 Jun 42, Item 1 b 2. SigC EC 319.1 Prog Annex, Evaluation Br, 17 May 42–19 Jun 42. (2) Stoner, Memo, cited n. 2, Item la. This first Signal Corps ACAN multichannel radiotelegraph channel between Washington and London was a high-quality radiotelephone for fixed operation, engineered by American Telephone and Telegraph, using Western Electric carrier equipment 40C1, modified to provide three two-tone channels on one sideband of the radiotelephone system. (3) Melia, Signal Corps Fixed Communications in World War II, p. 14. (4) Oakes, Army Command and Administrative Communications System, Pt. II, pp. 39, 118.

for use in the field since it demanded "extremely good signals and operating conditions." Field officers would not be discouraged, however. On the contrary, they went so far as to aspire to mobile RTTY, planning to combine it with such powerful field radio sets as the SCR–299. Thus Col. Elton F. Hammond, at the headquarters of the Desert Training Center, Indio, California, telephoned to Colonel O'Connell, head of the General Development Branch in Washington, on 14 July: "I also would like to ask for radio teletypewriters. Would like at least six with the idea of installing them in the radio trucks, [SCR–] 299's. I believe it would be of very practical use." [13]

Whereas Colonel French did not favor the field demands, Maj. Vernon B. Bagnall, head of the Fixed Radio Branch in Army Communication Service, did. He asked the American Telephone and Telegraph Company and the Bell Laboratories to figure out a way to make radioteletype work, using the five-unit code. The problem was to devise suitable military equipment, single channel. On 28 August, Austin Bailey, an American Telephone and Telegraph official, sent to Bagnall his corporation's proposal to meet the Signal Corps requirements for a radioteletype system. It would operate on diversity principles, using two tones, and would permit the use of cipher machines working with standard teletypewriters.[14]

Radioteletype for the military took shape during a series of conferences among representatives from the Signal Corps, American Telephone and Telegraph, and Press Wireless during the late summer and autumn of 1942. They decided to use single sideband communication on a frequency shift (two-tone) basis, making it possible to transmit teletype signals by means of ordinary continuous wave radio equipment, rather than by means of the more elaborate transmitters of radiotelephone quality. They conducted tests on an experimental single-channel radioteletype circuit between WAR and the Press Wireless receiving station at Baldwin, Long Island. The Signal Corps men in WAR transmitted through a 500-watt set in the transmitting station of the Army Communication Service at Fort Myer, Virginia. They assembled the receiving equipment from commercial and special components supplied by Press Wireless and the Bell Laboratories. Two Hammarlund Super Pro receivers were used, together with the modified CF–2A telegraph terminal equipment of the type originally designed for operating tactical typewriters on spiral-four cable. This conglomeration worked so well that the Signal Corps decided to initiate procurement. The Air Forces wanted 12 sets at once, especially for their Caribbean stations of the Army Airways Communications System. This would be only a starter, since hundreds of single-channel military RTTY would follow, for use by the AACS and by other military arms also.[15]

[13] (1) Ltr, Sanger to CG AGF, 6 Jun 42, sub: Sig equip, with 3d Ind, CSigO (Col French writing) to Hq AGF, 22 Jun 42. SigC 413.52 Teletype 1, Jan–Jun 42. (2) Incl, Telephone conversation between Hammond and O'Connell, Washington, 14 Jun 42, with Ltr, Capt William M. Crook, Asst Sig Officer Hq Desert Tng Center, Camp Young, Calif., to O'Connell, 15 Jul 42, sub: Telephone conversation. SigC 413.52 Teletype 2, Jul–Aug 42.

[14] (1) Ltr, Bailey to Bagnall, 28 Aug 42, with attached Memo, 28 Aug 42. SigC 413.44 Radio Teletype, 1942–43. (2) Two weeks later Bailey informed Bagnall of conferences between his company and Press Wireless, respecting modifications of the equipment. Ltr, Bailey to Bagnall, 10 Sep 42, with Memo, R. B. Shanck, 8 Sep 42. In same file.

[15] (1) Melia, Signal Corps Fixed Communications, pp. 16–18. (2) Oakes, Army Command and Administrative Communications System, Pt. II, p. 38. (3) Ltr, Bailey to Bagnall, 15 Oct 42, with Memo, recording conf among SigC, Press Wireless,

Carrier Equipment and Spiral-Four Readied for Use in War

While the Signal Corps developed efficient, increasingly automatic terminal equipment to handle Army's wartime traffic, its laboratories improved the efficiency of the wire links also. In the forefront of Signal Corps' biggest wire developments during 1942 was carrier equipment, whose application to military use was made possible by the perfection shortly before of heavy-duty spiral-four field cable.[16]

Carrier, a method which enables many messages to speed over a single wire circuit simultaneously yet without mutual interference, had been suggested to the Army years earlier—in 1931 by a Signal Corps reservist, 1st Lt. Clarence R. Kingston. His suggestion, however desirable more and better communications for the military might be, ran into the disapproval of Maj. William P. Blair, then charged with the Signal Corps Laboratories. The weight that the system components entailed would be very great, in terms of field wire equipment during the 1930's—no doubt about that. For the system would require what then seemed excessive amounts of terminal gadgetry: oscillator, modulator, demodulator, filters, ringing equipment, and auxiliary power supply. It would also require excellent wire circuits with minimum current loss, far less than the best that the standard field wire W–110–B could provide under field conditions. (The light insulation of the wire allowed too much current to leak out, especially in wet locations; heavy insulation would make the wire more efficient as an electrical conductor but too heavy for field use.) Blair, although he believed these factors made the carrier system unwarranted "at this time," nonetheless evinced prophetic foresight when he reported the matter to the Chief Signal Officer in May 1931. "It is possible," he wrote, "that there may be a requirement for the development of such equipment for operation on special circuits in the future." [17]

The possibility which Blair had foreseen was more than that—it became an inevitability. By 1940 the laboratories at Fort Monmouth had projects afoot for "Carrier Telephone Systems," several versions of which were already in wide commercial use.[18] Application to military uses would be assured by the coincidence which, toward the end of 1941, brought together the efficient spiral-four field cable with urgent demands from field officers who insisted upon wire communications far exceeding the limited capacity of their outdated field wire equipment.

For years commercial communication companies had been relying upon carrier systems to handle the huge and facile telephone and telegraph traffic of America. Now the fast-growing Army wanted carrier facilities

Western Electric, Bell Telephone Labs, and AT&T, New York, 5 Oct 42. SigC 413.44 Radio Teletype, 1942–43. The final RTTY product was of joint Bell System-Press Wireless design, and was built by the latter. Memo, Col Parker for Dir of Army Com Sv, 30 Dec 42, sub: Weekly digest of prog and problems, 24–30 Dec 42. SigC 319.1, Drawer 483 AC No. 133, Weekly Digest of Prog and Problems. A good summary of RTTY development is contained in Memo, Bagnall for Lt Col Carl H. Hatch, 12 Nov 42, sub: Teletype equip for AACS and adm radio stations. SigC 676.3 AACS, 1942–44.

[16] For the origin of spiral-four field cable, see above, pp. 66–67.

[17] (1) Ltr, Kingston to CG Third Corps Area, 15 Apr 31, sub: Carrier set with rpt signed by Kingston, Carrier Set for SigC U.S. Army, 13 Mar 31; (2) 4th Ind on Kingston Ltr, Blair to CSigO, 25 May 31. SigC 413.42 Carrier Sets 1, May 31–Dec 41.

[18] SCL, Annual Report, 1941, proj. 4–18, pp. 38–39.

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too. For example, on 12 December 1941, Lt. Col. Fred G. Miller, signal officer at the Third Army Headquarters, San Antonio, Texas, had urged that tables of basic allowances include "carrier telephone and telegraph equipment for the higher echelons." Major O'Connell, then charged with the communication projects at the Signal Corps Laboratories, replied to Miller that the Bell Telephone Laboratories were co-operating with him toward a military system that would provide three voice channels and four telegraph channels over one circuit (C carrier). The system had not yet been completely developed.[19]

However, O'Connell received assurances in February 1942 from A. B. Clark, Director of Systems Development at the Bell Laboratories, not only that there would be no hazard in placing large orders for the C carrier at once, without field tests, but also that the first models could be delivered to the Signal Corps by April or May, and the Signal Corps went ahead with the standardization of the equipment. Like a number of other Signal Corps items of equipment, such as the coast defense radar SCR–582, for which so dire and sudden a need had sprung up after Pearl Harbor, C carrier had become so desperately desired in 1942 that the Army decided to accept and standardize it without the customary service tests. It was accepted on its promises.

C carrier for the Army was to be perfected soon thereafter, phenomenally soon—in fact, by August 1942, and largely because of the million-dollar orders for the heavy-duty carrier which the Army Air Forces had laid upon the Signal Corps for Air Defense needs. In the meantime, enthusiasm mounted as a military delegation on 12 April inspected the progress which the laboratories were making, both at Fort Monmouth and in the research labyrinths of the companies. On 11 May the Signal Corps Technical Committee recommended C carrier for standardization and did standardize it four months after, on 7 September. The equipment, in Signal Corps nomenclature, comprised: TC–21, or CF–1, C carrier terminal equipment (telephone); TC–22, or CF–2, C carrier terminal equipment (telegraph, teletypewriter); TC–23, or CF–3, C carrier repeater; and TC–24, or EE–100 (later EE–101) ringing equipment.[20]

Standardized but not yet procured or tested, C carrier by mid-1942 held the precious promise of heavy-duty commercial-type communications for the Army, without which the 50-million-words-a-day work load, commonplace by the war's end, could never have been attained. Such was the promise held forth in 1942, not by C carrier alone, but rather by carrier techniques generally, working in conjunction with spiral-four cable, teletypewriter, and

[19] Ltr, O'Connell to Sig Officer Third Army Hq, 31 Dec 41, sub: Telephone and telegraph carrier. SigC 413.42 Carrier Sets 1, May 31–Dec 41.

[20] (1) Ltr, Clark to O'Connell, 23 Feb 42; (2) Memo, Capt M. M. Bower and Others for O'Connell, 23 Apr 42, sub: Brief account of inspec trip, 12 Apr 42, to Ft. Monmouth, Bell Telephone Labs Inc., and International Telephone and Radio Company, by Bower, Coller, and Bedford, Wire Sec Gen Dev Div. SigC 413.42 Carrier Sets 1, Jan–Jun 42. (3) Ltr, O'Connell to Dir of SCGDL, 15 Jul 42, sub: Nomenclature for carrier sets. SigC 413.42 Carrier Sets 2, Jul–Dec 42. (4) Signal Corps Information Letters, No. 7 (January, 1942), pp. 45–46, 74–75; No. 11 (October, 1942), pp. 17–18, 22–23. (5) SigC Tech Committee Mtg 214, 11 May 42. See OCSigO R&W Action 7, SCTC to Equip Coord Div, 11 May 42, sub: 1000–20 cycle ringing equip for SigC use. SigC 413.42 Carrier Sets 1, Jan–Jun 42. (6) SigC Tech Committee Mtg 229, 7 Sep 42. See OCSigO R&W Action 3, Maj R. O. Franzen, SigC Gen Dev Br, to S&I Br, 14 Sep 42, sub: Carrier telephone equip and spiral-four cable. SigC 413.42, Carrier Sets 2, Jul–Dec 42.

radioteletype. The conditions which Blair had prophesied in 1931 had, indeed, arrived in 1942, creating demands which, like so many other demands on the Signal Corps, such as that for radar and FM tank radio, came with extreme urgency and explosive pressure.

Meanwhile, the first models, which Clark had overoptimistically assured the Signal Corps for April or May, did not arrive. In June Western Electric, manufacturer for the Bell Laboratories, concluded it could promise no production before November, even with the highest priorities, which the development did not then have. (Other equipment devouring copper, aluminum, and electrical components such as meters, enjoyed higher priority.)[21]

Pressed to the utmost and blessed with higher priorities (AA–1, granted by the Joint Army and Navy Munitions Board), together with help in the person of a special expediter from Signal Corps' Production Expediting Section, Western Electric was soon able to speed its carrier development.[22] On 1 August, Fred R. Lack, vice president of Western Electric, promised the first three carrier sets by the twenty-second of the month, whereupon General Olmstead in turn committed them to the 62d and to the 928th Signal Battalions for field tests in late 1942 maneuvers.[23]

Considerable time would yet pass before the production of carrier equipment got rolling. Neither the cable nor the terminal sets would become available in any quantity before 1943. Meanwhile, the initial driblets were invaluable for Signal Corps experimentation. Though the Signal Corps had standardized carrier equipment, anticipating that it would perform well, Signal Corps troops had yet to find out how to handle it in the field, to discover what sort of crews could best manipulate it and how. They also had to discover what the operation and maintenance requirements might be.[24]

Before the summer's end, General Colton, head of the Signal Supply Service in Washington, thanked both Dr. O. E. Buckley, president of the Bell Telephone Laboratories, and Fred Lack for their efforts in speeding C carrier. The first deliveries of some of the system components had already, early in August, begun arriving at Fort Monmouth. Fortuitously and fortunately, only a few days earlier, late in July, the General Development Laboratory at the fort had received its first consignment of production spiral-four (150 miles of the first order, stipulating 1,500 miles) "for im-

[21] Memo for File, Capt Franzen, 24 Jun 42, sub: Inability of Western Electric Company to deliver carrier systems with present priorities. SigC 413.42 Carrier Sets 1, Jan–Jun 42.

[22] OCSigO R&W Action 3, Maj G. J. Filiberti, SigC Prod Sec, to Gen Dev Br [O'Connell], 23 Jul 42, sub: Expediting of carrier equip ordered on DP 42–T–600. SigC 413.42 Carrier Sets 1, Jan–Jun 42.

[23] (1) Ltr, Lack to Capt A. L. Chilman, Contracting Officer OCSigO, 1 Aug 42; (2) Ltr, CSigO to CG SOS, 21 Aug 42, sub: Shipment of first three carrier systems—spiral-four cable. SigC 413.42 Carrier Sets 2, Jul–Dec 42.

On 22 August the CSigO informed the commanders of these two battalions that they would receive for autumn field tests the following: 2 Telephone Terminals CF–1 (Carrier); 2 Telegraph Terminals CF–2 (Carrier); 5 Telephone Repeaters CF–3 (Carrier); 8 Ringing Sets EE–100–T1; 30 six volt storage batteries; and 9 power units.

All of this with necessary auxiliary apparatus, the whole weighing tons, was intended for field use, despite its ponderous bulk. Ltrs, CSigO to CO 928th Sig Bn, Camp Upton, N. Y., and to CO 62d Sig Bn APO 308, Leesville, La., 22 Aug 42, sub: Shipment of carrier systems for spiral-four cable. In same file.

[24] By December, the Signal Corps Technical Information Letter, No. 13 (December, 1942), pages 6–14, would disseminate to the field first instructions in the use of the spiral-four cable.

mediate tests on the carrier equipment." [25] Wire engineers from the laboratories of the Signal Corps and the Bell System laid four 20-mile loops of the cable over the countryside around Monmouth and tested them for conductivity. Then on 4 August they linked three of the loops together in one continuous 60-mile circuit incorporating the newly delivered carrier equipment. They placed a telephone terminal, CF–1 or TC–21, at each end and two repeaters, CF–3 or TC–23, along the cable, presumably at each 20-mile joint. All this the experts supervised and operated successfully.[26]

Not until the very end of August did the first field test by the troops on maneuvers take place. During 28–30 August members of the 62d Signal Battalion laid spiral-four, using the one-quarter-mile cable assemblies called CC–358. They found, despite their inexperience, that they were able to lay it, using conventional field wire equipment, as fast as five miles an hour during daylight. By night, under blackout conditions, they could lay up to three or four miles an hour, this despite rain and accidents, such as on the occasion their heavy 2½-ton truck carrying the cable reels and pay-out motor reel (RL–26–A) ran off the road and cut the cable. Transmission both over a ten-mile and over a twenty-mile stretch was reported to be "very satisfactory." [27] In October, during the Second Army maneuvers, the 262d Signal Construction Company got its first field cable experience, laying in one night ten miles of the cable during five hours of heavy convoy traffic, dust, and blackout. Though some mechanical defects turned up, which experience both in manufacture and in field use would eliminate, 1st Lt. George W. Good reported that the cable was "enthusiastically received by the men and officers who have handled it." [28]

Obviously this new cable was already a success in the field. And there was no doubt of the coming success of carrier equipment either, although for the time being full production tarried as a result of priority troubles and shortages of raw materials and components. Carrier terminal sets would be heavy—for example, the first telegraph-teletypewriter terminal, TC–22, involved two cabinets which totaled over a thousand

[25] (1) Ltrs, Colton to Buckley and Lack, 1 Sep 42. SigC 413.42 Carrier Sets 2, Jul–Dec 42. (2) Ltr, CSigO to Dir of SCGDL, 17 Jul 42, sub: Shipping instructions for cable assembly CC–358. SigC 413.43 CC–358, No. 1, Jan–Jul 42. (3) Signal Corps Information Letter, No. 8 (July, 1942), p. 12.

[26] (1) Memo for File, P. L. Bedford, Asst Elec Engr Gen Dev Br, 6 Aug 42, sub: Rpt of Bedford re temporary duty at SCGDL, 30 Jul–4 Aug 42. SigC 413.42 Carrier Sets 2, Jul–Dec 42.

The Signal Corps desired that technical advisers both from its own laboratories and from industry attend the contemplated maneuvers using carrier—so General Olmstead informed the Commanding General, AGF, on 24 August, at the same time acquainting him with the new development as follows:

"The Signal Corps has recently standardized new carrier equipment and a new spiral-four cable for transmitting 4 voice channels over long distances. Because of the lack of standard long distance tactical communication facilities other than open wire line which cannot always be used, carrier equipment and associated cable were standardized and procured without service test." (2) Ltr, CSigO to Dir of SCGDL, 24 Aug 42, sub: SCGDL tech advisers at maneuvers; (3) Ltr, CSigO to CG AGF, 24 Aug 42, sub: Civilian tech observers at maneuvers. SigC 413.42 Carrier Sets 2, Jul–Dec 42.

[27] Ltr, Lt Col E. B. Williams, Hq 62d Sig Bn, Leesville, La., to CSigO, 31 Aug 42, sub: Cable assemblies CC–358. SigC 413.43 CC–358 No. 2, Aug–Dec 42.

[28] Memo, Good for Maj Arthur A. McCrary, 21 Oct 42, sub: Rpt of Sig activities during Second Army maneuvers, 12–18 Oct 42. File cited n. 27.

pounds, not counting the power equipment and sundry accessories.[29]

Nonetheless, a carrier cable line 100 miles long would weigh far less, and could be installed in far less time, than a 100-mile pole line of equal traffic capacity. Before the end of 1942 Colonel Magee, chief of the Equipment Coordination Branch in Washington, would write that "the need for this equipment in almost every theater of operation has been apparent to all concerned for over a year. When equipped with carrier telephone equipment," Magee summarized these new blessings, "Spiral-Four Cable will provide long distance facilities which can be placed in service by troops in less than one-tenth the time and with one-fifth the material required for the most rapid type of pole line construction which will provide equal facilities. Equipment for a 100-mile Spiral-Four Cable carrier system, including cable reels, weighs 39 tons. Equipment for 100 miles of rapid pole line would weigh approximately 240 tons. Equipment for a standard pole line 100 miles long would weigh 870 tons." Magee noted also that no deliveries (after the rushed delivery of three sets in August) had been made on the carrier during September, October, or November, because of "inadequate priorities to obtain a small number of components." There had been an "urgent request for this equipment from task forces in October," he remarked, yet it could not be fulfilled. Not until early December would five systems be delivered, and then only because extraordinary efforts were made to provide nonstandard engine generators and batteries.[30]

Ground Radio and Radio Link or Relay, Transformed by FM

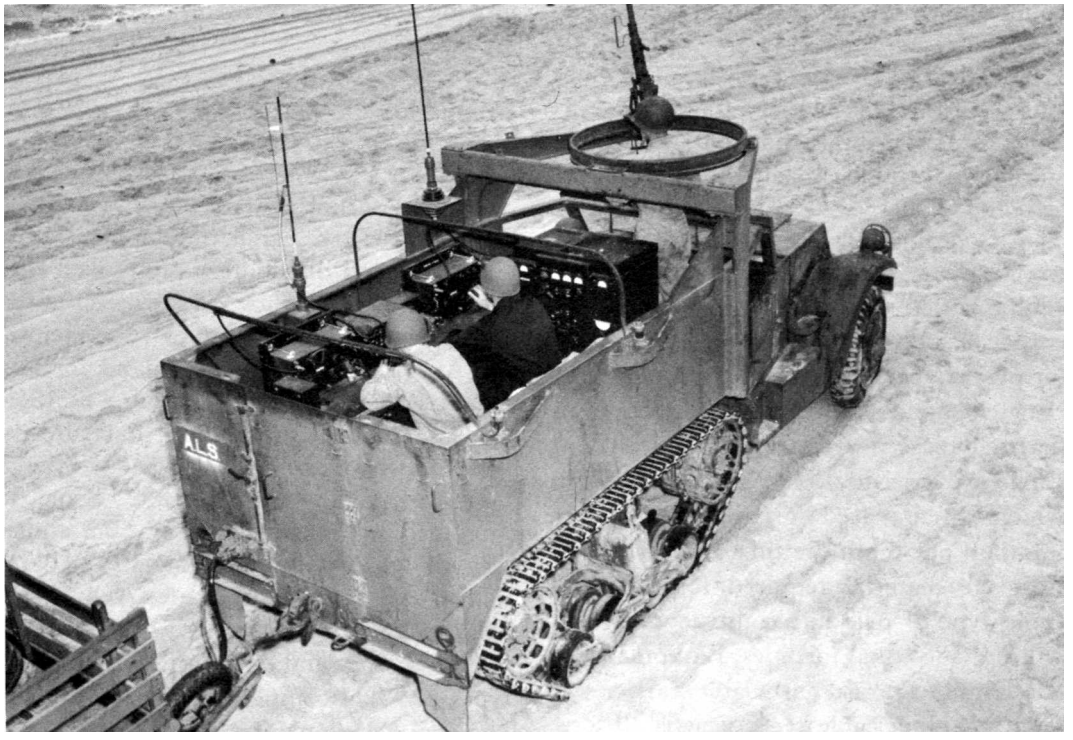
By the last half of 1942 the efforts of the Signal Corps in research, development, procurement, and distribution pretty well met the radio needs of those who pressed hardest among the ground troops—the men of the Armored Force. The demand for Armored Force radio types, initiated in 1940 by Capt. Grant A. Williams, had already been or was being well satisfied—Type I (for long range) by SCR–299; Type II (for medium range) by SCR–506, which was still under development while the older SCR's–193 and 245 substituted well; Types III and IV (for short range) by SCR–508, 528, 538, 509, and 510. In the III and IV types FM had completely captured the affections of the tankmen.

Late in August 1942 Lt. Col. William P. Withers, an Armored Force officer who, like

[29] TM 11–487, Electrical Communication Systems Equipment, 2 Oct 44, p. 220. The CF–2–A telegraph terminal weighed 530 pounds per bay, this being a metal box 5½ feet high by about 2 feet wide and 2 feet deep.

[30] OCSigO R&W Action 1, Magee to Dir of Planning, 21 Dec 42, sub: Need for carrier equip with spiral-four cable. SigC 413.42 Carrier Sets 2, Jul–Dec 42. Major Bower noted on 30 November 1942 that "whereas a single construction platoon can construct only from 2 to 5 miles of open-wire line a day, depending upon the type of construction, availability of supplies and nature of the terrain, it will be perfectly feasible for the same unit to construct and place in operation from 50 to 100 miles a day of Spiral-Four Cable equipped with carrier." Memo for File, Bower, 30 Nov 42, sub: Discussion of organizational rqmts for opn of spiral-four cable carrier system. In same file.

The virtues of spiral-four carrier in terms of ship tons (together with the still greater virtues of radio link equipment) were proclaimed by Maj. E. E. Boyer, Signal Corps, in an undated account entitled Radio Link Equipment, filed with other papers in SigC OP 334 [C&E] Case 31, entitled A Study of Frequencies Available for Signal Corps Radio Sets and Recommendations for Their Use, Feb 42–Aug 43.



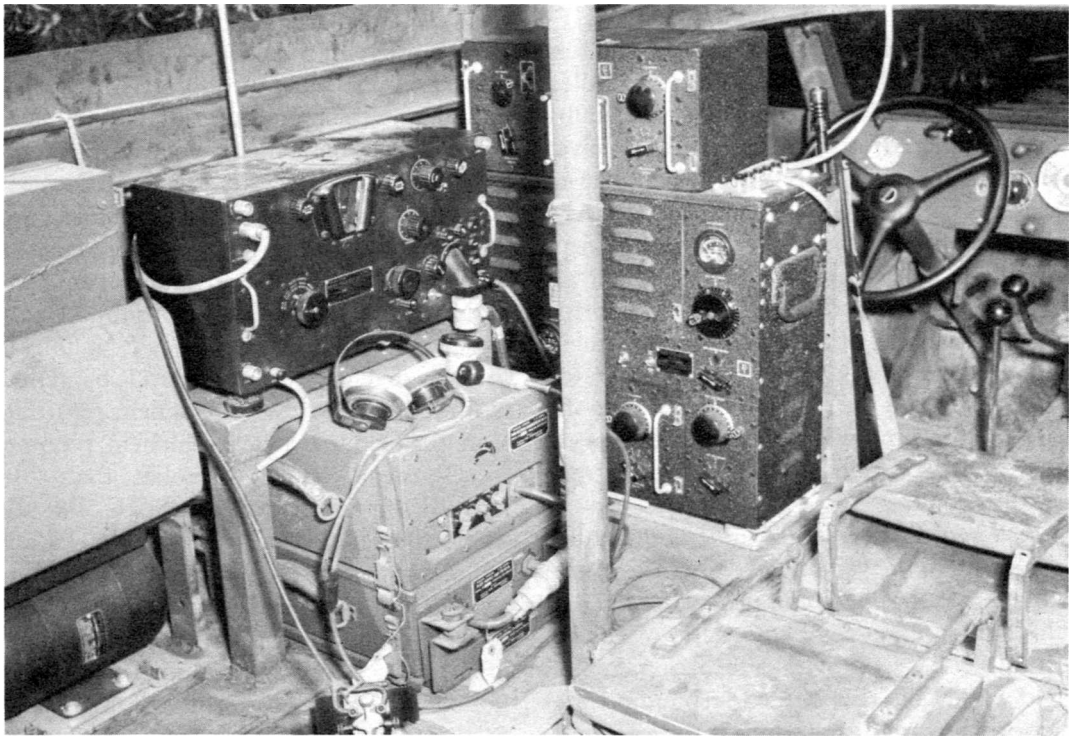
VEHICULAR MOUNTING OF RADIO SETS. *The SCR-299.*

Williams, had long labored with the Signal Corps toward modernizing the tankmen's communications, expressed his appreciation of Signal Corps efforts just after he had taken command of the 37th Armored Regiment at Pine Camp, New York. Withers warmly thanked Colton, head of the Signal Supply Service, and his helpers, naming in particular O'Connell, Rives, Elder, and Hildreth, all associated with the heavy duties of both developing and procuring Army's communication facilities. Here in the thick of the Signal Corps battle of production, wherein Olmstead and Colton received many more brickbats than bouquets, Withers' appreciation must have been encouraging indeed.[31]

Withers' thanks re-echoed throughout the Armored Force in proportion to the ever wider distribution of the "500" radio series. Everyone loved to push the buttons and talk over the air, especially the officers, despite regulations against excessive use of radio transmissions. After a month at Pine Camp, Withers again wrote to O'Connell saying that these sets enjoyed huge favor, with the result that the Signal Corps had risen high in the opinion of the field troops—quite a contrast with the Corps' reputation during the 1940 and 1941 maneuvers.[32] "Generally speaking," he told

[31] (1) Ltr, Withers to O'Connell, 28 Aug 42; (2) Ltr, O'Connell to Withers, 22 Sep 42. SigC 413.44 Armored Force (Sets) 1942–43.

[32] In the words of a memorandum for the Chief Signal Officer in September 1940, "Some of the observers at the recent maneuvers stated their belief



VEHICULAR MOUNTING OF RADIO SETS. *The SCR-510 and SCR-193.*

O'Connell, "the radio is splendid and is actually furnishing more communications than we have ever had. If we can ever persuade the high command that it is strictly a battalion set, and not a headquarters telephone, I won't worry nearly so much about communication . . . the Commanding General . . . has to resist attempts of officers senior to him, mainly in the Division Headquarters, to grab sets from line units. . . . Most officers are entranced with this FM and just can't bear to see a microphone idle. . . . From the field point of view, especially considering present and past difficult conditions, the Signal Corps is doing a fine job." [33]

Rather often the pushbutton tuning mechanisms got out of order, generally because of inexperienced operators, who, with unwarranted confidence, tinkered with the adjustments, especially when they could not get good reception, a condition not uncommonly encountered by ground troops in deep valleys or depressions where very high frequency waves are naturally blacked out by absorbing objects or blocking terrain.

that our Army signal equipment is behind commercial development." Memo, CofS for CSigO, 7 Sep 40, OCS 16281–6. Mark Skinner Watson, *Chief of Staff: Prewar Plans and Preparations*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1950), p. 49. See also Terrett, *The Emergency*, pp. 160, 176–77.

[33] Incl, Personal Ltr, Bill Withers to Jim, 26 Sep 42, with Ltr, Maj S. E. Petrillo, SigC, to Maj William S. Marks, Jr., SCGDL Fld Lab No. 1, Camp Coles, 13 Oct 42. SigC 413.44 (SCR–508) 3, Aug–Dec 42.

Expecting too much, in ignorance of VHF-FM characteristics, the receiver operators generally cursed the transmitters or fiddled with their receiver adjustments. Actually, the aligning adjustments in an FM receiver or transmitter are very exacting and even require special FM test equipment (AM test sets will not do). While the Signal Corps men tried to instruct and restrain the overzealous operators, Colonel Withers resorted to the expedient of assigning men to ride in the vehicles of the 37th "merely to watch the officers and the men use the radio, in the hope of learning what queer things they do to cause the trouble [with the tuning adjustments]." [34]

Even so, FM vehicular short range radios operating in the very high frequencies above 20 megacycles had completely captivated the Armored Force. These were, of course, the 500 series sets: SCR–508, 528, 538, 509, and 510. Likewise, the corresponding 600 series of sets were now winning the affections of the Field Artillery men. Now, too, the British became interested; FM military radio was something new under the sun. To make comparisons, they brought over their conventional AM wireless radio No. 19, which operated in the high frequencies only, far below the very high frequencies of the American FM sets. From 28 August to 2 October 1942, the Signal Corps arranged a series of tests between the 508 and the No. 19 (also between the Infantry's new walkie-talkie, the FM SCR–300, and the British No. 48; and also between the SCR–284 and the British No. 22, the last three all being AM radios). In the course of the tests, conducted in the vicinity of Fort Monmouth and among the mountain ridges of the Alleghenies near Bethlehem, Pennsylvania, the SCR–508 proved better than the No. 19. Although the British set was smaller and consumed less power, the disadvantages of its amplitude modulation (subject to static and interference), its numerous tuning controls, and its lower frequencies (falling in the crowded, noisy 2–8 megacycle band), all militated against it.[35] O'Connell, returning from the field tests near Bethlehem, reported to Olmstead on 10 October that "the marked superiority of the SCR–508 and SCR–300 [compared with the No. 19 and No. 48 respectively] for reliability of communication was clearly determined." [36]

As if the multiplicity of the 500 and the 600 radio series was not enough, both series doubled in number during 1942 with an SCR–700 and an SCR–800 series—all because of anticipated crystal shortages.[37] Each 500 set required up to 80 crystals, one for each radio channel which the Armored Force might wish to use; each 600 set required up to 120 crystals to cover the Field Artillery's span of allotted channels. The total crystal requirement naturally became astronomical, especially since other sets were calling for crystals too, for example, SCR–

[34] (1) *Ibid.*, together with second Incl on Petrillo—Marks Ltr, unsigned and undated Memo, Radio Repair Officer, Div Radio Maint, 144th Armored Sig Co, Pine Camp, N. Y., for Div Sig Officer. (2) Memo, Capt Lawrence C. Sheetz, SigC for Col Magee, 12 May 42, sub: Rpt on trip to Ft. Benning by B. V. Blom. SigC 413.44 (SCR–508) No. 2, Jan–Jul 42.

[35] Ltr, Col Maier, Dir of SCGDL, to CSigO, 7 Nov 42, sub: Comparative tests of British and American radio sets with Incl 1, Summary of Comparative Test SCR–508 and B–19, and Incl 2, Memoranda Comparative Tests SCR–300 vs B–48 and SCR–284 vs B–22. SigC 413.44 (SCR–508) No. 3, Aug–Dec 42.

[36] Memo, O'Connell for CSigO, 10 Oct 42, sub: Rpt of trip to Bethlehem, Pa., 29 Sep–1 Oct 42. SigC 413.44 Gen (Sets) 4, Sep–Oct 42.

[37] Contrast all this proliferation of radio with General Marshall's unrealistic order to Olmstead, in October 1941, to reduce radio types. Terrett, *The Emergency*, pp. 294ff.

245, 299, 511, and 536. This demand, it seemed for a while, could not be met from the critical supply of high grade quartz from which the crystals were cut. The supply was short, to say the least, and very remote (the only good sources being in Brazil and in India). Moreover, there was a still more critical shortage of craftsmen and equipment to prepare the delicate quartz crystal wafers. All these considerations led the Signal Corps into a frantic effort to devise means of reducing its crystal needs while retaining the indispensable advantages which crystal-controlled pushbutton radio sets could offer.

The new crystal-saving series (the 700's paralleling the 500's; the 800's duplicating the 600's) had begun to take form even before any of the original series reached mass production. On 22 November 1941 the Signal Corps Laboratories had contracted with the Zenith Radio Corporation for three multichannel master-oscillator FM transmitters and six receivers, embodying a crystal-conserving system. E. F. McDonald, president of Zenith, had hoped to complete the contract sooner than the ninety days which the Signal Corps had specified. Usually in electronic production, harassed by supply shortages, priorities, and design changes, such hopes prove impossible to realize; but not so in this case. McDonald wrote to General Olmstead on 21 February 1942 that he was "happy to say that the three transmitters are finished and the receivers will be Monday." He could not refrain from concluding triumphantly, "I like to make good on a promise of delivery." Needless to say, the Signal Corps was pleased too, as Olmstead hastened to reply.[38]

[38] Ltr, McDonald to Olmstead, 21 Feb 42, and reply, CSigO to McDonald, 28 Feb 42. SigC 413.44 Armored Force (Sets), 1942–43.

Master-oscillator systems, which had been devised to hold radio circuits to their exact operating frequencies, had long been a subject of research in the Signal Corps Laboratories and in industrial laboratories also. Now these efforts led to successful crystal-saving radio designs, reducing the 80 crystals of the 508 sets and the 120 crystals of the 608 series to but one crystal a set, which was used to calibrate four master-oscillator circuits, providing four pretuned channels (six less, unfortunately, than the ten channels of the original multicrystal sets). In the 509/10 and 609/10, the reduction was less drastic, each set still requiring 19 crystals per set. Known at first as 508–XS, 608–XS and so on (the XS meaning "crystal saving"), the new versions acquired formal status in September 1942 as SCR–708 and so on (the 700 series) for the Armored Force III and IV sets, SCR–808 and so on (the 800 series) for the Field Artillery counterparts.[39] By then the crisis in the crystal supply was subsiding. Drastic measures to provide radio crystals in quantity proved successful. Consequently, the 700 and 800 series were not needed in World War II. Yet the effort spent on their development was by no means lost since crystal-saving techniques would be incorporated in postwar vehicular radios.[40]

Meanwhile, by the late summer of 1942 the Infantry's first and only FM radio to

[39] OCSigO Engr and Tech Div, History of Signal Corps Research and Development in World War II, VIII, Pt. 2, projs. 813–A and B, and Pt. 3, projs 822–A and B.

[40] By 1950 the crystal-saving circuits would become universal, resulting in "a requirement of 11 to 21 crystals per set versus a comparable requirement of 80 to 120 in World War II series." Col E. R. Petzing, "Engineering the Integrated Communications System," *Radio and Television News* (December, 1950), p. 39.

be used in World War II had reached the stage of field tests. This was the new walkie-talkie SCR–300 destined to fulfill "the Infantryman's dream for better communication and control of troops by radio." [41] Running the usual gantlet of tests prior to production, the SCR–300 had to take few blows. At the Signal Corps General Development Laboratory, the Field Radio Communication Section (located in Camp Coles, New Jersey) reported that only minor mechanical and electrical defects had turned up in the service test models which the Galvin Manufacturing Corporation and the Philco Corporation had offered. This new FM radio not only survived the tests well but at the same time dealt heavy blows against its competitors in the Infantry, even against the newest AM sets which had only recently come into the hands of the troops, SCR–284, 511, and 536. Compared with them, with the British No. 19, let alone with the older and original American walkie-talkie, SCR–195, the new SCR–300 conspicuously outdid them all. "These tests," according to the laboratory report for September, "indicated the great superiority of frequency modulation for short range front line communication . . . ." [42]

Not until the postwar period would all Infantry short-range radios, including the handie-talkie, become FM, integrating the foot soldiers' sets with those of the Armored and the Artillery arms, so that all could intercommunicate. During the war, into which the Army was now daily plunging deeper, front-line infantrymen suffered from a diversity of radio types, both AM and FM, which could not talk with each other. Military FM, in the form of the SCR–300, entered the forward fighting units in time to confer great benefits and to prepare the way for the integrated communications of the future Army.

By 1942 FM had thus wrought a revolution in the Army's vehicular short-range radio communications. Before the year was out, FM was helping to bring on another revolution. Used in radio link or radio relay equipment, it would link together breaks or gaps in wire lines. Indeed, it would soon replace wire altogether. The initial notion restricted the use of link equipment to the jumping of spiral-four or wire line traffic across rivers and over land obstacles. This idea quickly broadened into the concept of a chain of radio links, a succession of stations which could repeat signals from hilltop to hilltop over scores and hundreds of miles, entirely without wire. But the limited idea of using radio to link together the interrupted ends of a wire line came first, and the Signal Corps laboratory workers were giving it thought when, in mid–1942, the airmen started thinking too, in a bigger way, of depending upon radio instead of upon wire to link their ground units, even when they were in a fixed location.[43]

In particular, the Air Forces Aircraft Warning Service nets required huge amounts of communication lines, a requirement that had already given great impetus to spiral-four and carrier developments. Every radar site, every observation post in the Aircraft Warning Service, had to be linked to an information center, for example; and wire or cable, however improved, entailed too much bulk and bother. The

[41] John J. Kelleher, "VHF and Microwave Military Communication Systems," *Signals,* I: 4 (March–April, 1947), p. 47.

[42] SCGDL Prog Rpt, Sep 42, Pt. 1, proj. 10–3, p. 2.

[43] Interv, SigC Hist Sec with Capt Oliver D. Perkins and J. H. Durrer (formerly assisted Co D, 829th Sig Sv Bn, in North Africa and Sicily), Jan 45.

airmen had already been using AM radios when they could get them, such as SCR's–177, 188, 197, and the commercial Hallicrafters HT–4, parent of the SCR–299.[44] They could not get enough of them, and anyway these AM transmitters radiated widely in the high frequencies (which rebound from the sky's ionosphere), so that the reflected radiations interfered with the operation of other radio nets far away over the horizon. Would not VHF FM, with its line-of-sight limitations, be better? In July 1942 General Arnold made just this suggestion. He suggested to General Olmstead that for fixed SCR–271 air search radar stations, "FM radio equipment can be used to provide radio communication channels where line-of-sight or ground wave transmission is feasible." [45] A month later Arnold asked for no less than 700 FM receivers and transmitters, saying that "392 each of these receivers and transmitters are required to provide communications between fixed radar sites." The rest, he added, would "provide radio links between units of SCS–2 and SCS–3 systems." [46] This was not radio merely to link up gaps in wire systems; it was radio replacing wire altogether.

Another Air Forces call for FM radio assistance to the Aircraft Warning Service came in August 1942 from the III Fighter Command in Florida. The airmen complained that in some forty observation posts along the Atlantic coast "it is highly impracticable to provide telephone communications." They wanted specifically a number of SCR–298's, FM sets built by Fred M. Link for umpire use in Army maneuvers. The Signal Corps received the idea coolly, especially since SCR–298's were not standard Army sets. Would not some standard equipment do? "Radio Sets SCR–298 and SCR–298–A," the Chief Signal Officer explained, "are non-standard equipments originally procured as 'Umpire' sets." Remembering General Marshall's insistence that radio types be reduced, Olmstead added, "In an effort to comply with the Chief of Staff's directive to reduce the number and types of equipment, every effort should be taken to utilize the present standard equipment that is capable of performing the required functions." [47]

Standard or no, the AAF would get what it wanted, FM radio for "point-to-point operation" in this case. In September it demanded and got, not 40 but 100 SCR–298's. Again, later that month, the AAF asked for a small delivery of 38 FM sets as a special issue to be provided "for a special operation by an organization activated under a special table of basic allowances. The organization," the Air Forces added, "is scheduled to move overseas before October 15." [48] Col. Will V. Parker, in

[44] 7th Ind, CG Hq Eastern Defense Comd to CofS, on Ltr, CG I Fighter Comd to CG AAF, 9 Aug 42, sub: Radio equip for AWS. AAG 413.4–S Com Equip.

[45] (1) 4th Ind, CG AAF to CSigO, 25 Jul 42, on Ltr, CG AAF to CSigO, 29 May 42, sub: Radio sets SCR–270 ( ). AAG 413.4–N Com Equip. (2) Memo, Lt Col Robert E. Burns, Exec Officer, Radar Div, for Exec Control Div, 31 Jul 42, sub: Weekly digest of prog and problems, Radar Div, week ending 30 Jul 42, p. 1. Weekly Achievements Rpts, 17 July–19 Aug 42. SigC Central Files.

[46] Ltr, CG AAF to CSigO through CG SOS, 28 Aug 42, sub: Proc of FM receivers and transmitters for radio links. SigC 413.44 Radio Link 1942.

[47] Ltr, CG III Fighter Comd to CSigO, 4 Aug 42, sub: Request for radio sets, with 3d Ind, CSigO to CG III Fighter Comd, 12 Sep 42. AAG 413.4–S Com Equip.

[48] (1) Ltr, Col Saville, Dir of Air Defense, to CG III Fighter Comd, 11 Sep 42, sub: Proc of one hundred SCR–298 radio sets for forestry tower observation posts, with 5th Ind, CSigO to CG SOS, 21 Oct 42. AAG 413.4–S Com Equip. (2) Ltr, Col Marriner, AAF Com Officer, to CSigO, 25 Sep 42, sub: Special issue of FM radio sets. AAG 413.4–Q Com Equip.

Plant Division, reported on 30 September 1942 that these 38 FM sets had been shipped the day before.[49]

Although the Air Forces insisted, some of the Signal Corps men responsible for new developments felt doubts. At least, they were doubtful of the need to develop radio link equipment for the sole purpose of closing gaps in wire lines (evidently the notion of far-reaching radio relay had not yet, in the summer of 1942, become firm). Developments of great importance so often begin only half-recognized or, worse, as tentative trials shrouded in the uncertainty which only time and tests can clear away. For example, both the subsequently indispensable handie-talkie and the SCR–299 had begun as tentative stopgaps.[50] FM radio itself long suffered from hesitant skepticism. In August 1942, when the idea of radio link was beginning to mature as a laboratory project (requested by the General Development Branch in the Washington office as a means of jumping carrier cable signals across an obstacle), the General Development Laboratory at Fort Monmouth regarded the need for so special an undertaking as "doubtful." [51]

The pressure for radio link prevailed and the new FM techniques swept away the objections which had been raised against militarizing AM radio link (the chief objection being that very high frequency AM radio connections would be impractical in any location but a fixed station under careful control). Now the picture changed almost overnight, according to John J. Kelleher, a radio engineer in the Engineering and Technical Division of the Office of the Chief Signal Officer. It changed with the coming of VHF FM equipment. The new development, Kelleher asserted:

> . . . completely negated the prejudice against radio links; provided a radio transmission facility that had none of the faults of high frequency; was extremely small, rugged, easily portable, yet had many of the attributes of a high quality wire circuit. Audio levels could be maintained within close limits over long periods of time because fading was practically non-existent at those portions of the spectrum; signal-to-noise ratios were amazingly high, right out to the maximum range of the circuit; most important, multipath distortion was completely absent and the fidelity of the circuit could be held at a level that permitted relaying the signals by tandem

[49] Memo, Parker for Dir of Army Com Sv, 30 Sep 42, sub: Weekly digest of prog and problems, 23–30 Sep, Item 1 lc. SigC 319.1 Drawer 483 AC 133, Weekly Digest of Prog and Problems.

[50] See above, pp. 75–76.

[51] Signal Corps Technical Information Letter, No. 9 (August, 1942), pp. 21–22, reported as follows:

"Radio Link for Spiral-Four Cable"

"An investigation has been made at the request of General Development Branch of the need for special radio equipment to extend all the telephone and telegraph facilities of the Spiral-Four Cable over water crossings or unpassable terrain. It was found that the need for developing special equipment for the sole purpose is doubtful. General Development was informed of this and also that further information on the problem will be obtained when service tests have been made of three Signal Corps radio sets which provided single circuit radio extensions of wire lines."

Some Signal Corps men were for, some against, developing radio link. Colonel Magee in the Equipment Coordination Branch and Major Bagnall in Plant inclined to thumbs down. Colonel Thomas in War Plans Division and Colonel O'Connell in the General Development Division favored it. O'Connell, especially, thought radio link might be "extremely useful," even suggesting that it might be used "for the rapid extension of the carrier system beyond the end of the Spiral-Four Cable," this last usage suggesting what radio relay soon became. OCSigO R&W Action 2, Magee to Gen Dev Div, 13 Jun 42, sub: Intermediate radio link for carrier system spiral-four cable; Action 2, Bagnall to Equip Coord Div, 16 Jun 42, same sub; Action 2, Thomas to Equip Coord Div, 17 Jun 42, same sub; Action 1, O'Connell to Equip Coord Div, 23 May 42, same sub. SigC 413.44 Radio Link, 1942.

connected receivers and transmitters, far beyond the horizon range of a point-to-point circuit.[52]

In moving toward radio link, the Signal Corps General Development Laboratory at Camp Coles, near Fort Monmouth, sought to modify existing Signal Corps FM sets SCR–608 and 610, then turned to commercial equipment, to Western Electric's Model 31A and to Fred Link's Model 1498. By November the laboratory engineers, deciding that the Link model showed most promise, contracted with the Link Corporation for twenty development sets which Link would deliver in 1943 and which the Signal Corps would dub "antrac 1," that is, AN/TRC–1. It was a development of tremendous significance for the future of communications.[53]

Radio link, amplitude modulated, had existed commercially before the war in a few limited applications adapted for fixed operation. Now the Signal Corps converted it to frequency modulation, took it out into the field, reduced its girth, and toughened it for mobile warfare. Its first application to war would soon come in North Africa, and not merely in order to plug small gaps in wire systems but in order to relay radio signals over hundreds of miles, supplanting long lines of poles and wire.[54]

Whereas previously wire had been preferred, in particular because its use was familiar to the unskilled soldier and because its inherent security was high, now the new FM radio types, which became as simple to operate as telephones, were preferred. Moreover, in some equipment, such as radio relay and radioteletype, automatic security devices (code or, more accurately, cipher machines) rendered the communication as inaccessible to the enemy as were the messages carried by wires. In short, the user of radio relay equipment communicates by means of the familiar telephone or teletypewriter exactly as though wire made the connections. Indeed, some of the connections may be by waves channeled along wires while other portions of a circuit are linked by radio waves beamed through space. In the radio relay system, according to a Signal Corps officer, "we have a marriage of wire and radio." [55]

At the end of World War II, the members of the Institute of Radio Engineers were to hand a bouquet to the Signal Corps for its work in meeting the challenge that the communication needs of modern war presented. Field commanders would praise the superior equipment which the Signal Corps had provided, superior largely because of increasingly extensive use of frequency-modulated radio in the range of 20 to 100 megacycles.

Signal Corps Provides VHF Command Radio for Army Airplanes

The development of airborne radio and of all other airborne electronic equipment was, of course, the concern of the Signal Corps installations, especially the Aircraft Radio Laboratory, which served the Air Forces at Wright Field in Ohio. To the Signal Corps Aircraft Signal Service fell

[52] John J. Kelleher, "Radio-Relay and the War," *Signals,* I: 5 (May–June 1947), 37.

[53] SigC R&D Hist, VIII, Pt. 3, proj. 824–A, p. 9. In accordance with Army-Navy nomenclature, the T stood for *ground transportable,* the R for *radio,* the C for *communications,* both transmitting and receiving.

[54] See below, pp. 371–73.

[55] Maj William Marks, Jr., Capt Oliver D. Perkins, W. R. Clark, "Radio Relay Communication Systems in the United States Army," *Proceedings of the I. R. E.* (Institute of Radio Engineers), XXXIII (August, 1945), 502–03.

the whole business of developing, procuring, inspecting, storing, issuing, installing, and maintaining those Signal Corps items of radio, radar, communicational and navigational electronic equipment which went into airplanes. SCASS, which had been organized at Wright Field in May 1942,[56] proved effective. Until the Army Air Forces took over altogether toward the end of World War II, SCASS performed its task rather well, which was to co-ordinate the supply and maintenance functions of the Signal Corps with the matériel commands of the Army Air Forces.[57] The success of SCASS led General Olmstead to reorganize his Monmouth activities similarly. Combining the General Development Laboratories with the Radar, or Camp Evans, Laboratory, he created in December 1942 the Signal Corps Ground Signal Service (SCGSS) with headquarters at Bradley Beach, New Jersey.[58]

The most basic of the very many airborne radio devices which concerned SCASS was the command radio set, a medium-range radiotelephone indispensable to fighter planes. The United States aircraft command sets which received most use during the early months of the war were older high-frequency types, even the "ancient" SCR–183 and SCR–283, good sets in their day but now out of date. Many thousands were in use and on order. As late as 24 April 1942 the Air Forces had asked the Signal Corps to procure 13,708 SCR–183's and 717 SCR–283's, over and above an existing requirement which totaled 38,342 for both sets. By the end of May the Signal Corps had issued letters of intent to purchase these additional thousands from Western Electric and Philco. Both companies at once multiplied their efforts and their facilities, getting materials and parts and increasing their tools. Philco's additional tooling-up alone ran to $150,000.

If the AAF knew that high-frequency command sets were doomed, it gave no thought, apparently, to tapering off its orders so as to let down the Signal Corps and industry easily. These orders the airmen guillotined in June with dramatic, and disastrous, suddenness. The Signal Corps got the news informally at first, through a rumor picked up by the Scheduling Branch; then, in response to a formal inquiry, it learned officially on 27 June that the AAF now had no requirements for the 183 and the 283, of which it had wanted better than 50,000 only a few weeks before. More was yet to come. After the Signal Corps had canceled the orders and, along with the manufacturers, had written off the loss, the AAF again reversed its position and decided in July that it did want some SCR–283's, in fact 3,230 of them. Later the AAF decided it wanted still more of these sets and on 20 November 1942 ordered 5,000 additional 283's, together with 3,000 SCR–183's.

On Signal Corps' reckoning, the AAF's failure to know its needs and to state them promptly led, in the case of these two radios, to (1) the wastage of $75,000 in critical materials such as aluminum abandoned in a partly fabricated condition; (2) the loss of $150,000 in tools that had become useless; and (3) the irreparable loss of man

[56] (1) History of the Aircraft Radio Laboratory, 1 Oct 43, pp. 12–15. SigC Hist Sec File. (2) Ltr, CSigO to CG AAF, 20 Apr 42, sub: SigC reorgn. SigC 413.44 Radio Instl 3 (RB–1537). (3) CSigO, Annual Report 1943, pp. 41–43. (4) See also, above, p. 181.

[57] Rpt of Radar Div OCSigO, 1942 (unsigned), p. 3. SigC 319.1 Rpts Gen 1, May 38–Aug 42 (RB–781).

[58] Historical Report of the Signal Corps Engineering Laboratories (Ft. Monmouth, 1944), pp. 6, 28. SigC Hist Sec File.

hours spent in fabricating the now useless tools and half-finished parts. Moreover, while the production lines of two of Signal Corps' principal suppliers stood disrupted, the United States Government would have large bills to pay covering cancellation costs and tool costs: $100,000 to Western Electric and $150,000 to Philco.[59]

Everyone in the Army Air Forces certainly should have known that the high-frequency command radio was doomed. Air Forces officers themselves, following the example of the British, had condemned it. They had directed in mid-1941 that all fighters be equipped with very high frequency radio, copied from the British. Unfortunately, the newest and best contemporary American command set, SCR–274, just beginning to supersede the 183 and 283, was only a high-frequency set. The Air Forces hoped to convert it to VHF operation and in June 1941 had asked that the Aircraft Radio Laboratory develop a VHF component for it.[60] The laboratory's engineers were drawing up the specifications by mid-1942. They were laboring also upon other VHF airborne equipment, continuing their long research upon the American very high frequency SCR–264, and at the same time designing suitable test sets and developing other new equipment, compasses, radio ranges, beacons, and so on, which would operate in the hundreds of megacycles.[61] The principal task, however, was to copy the equivalent British equipment, the British VHF command set which the AAF had been demanding since February 1941. For BOLERO it now seemed mandatory, to be installed in both fighters and bombers flying into England, where command radio operation, both plane-to-plane and air-to-ground, was universally VHF. Production of it as the SCR–522 commenced at Bendix in March 1942.[62]

Hardly had the first SCR–522's flowed from Bendix into the field than complaints came foaming back, a veritable flood of them, beginning in May 1942. Shocking percentages of the first SCR–522 installations were defective, practically immobilizing otherwise perfect aircraft. Very much to-do ensued throughout the summer, with recriminations and unpleasantness all along the line—from the airmen, from the Signal Corps, from the radio and aircraft builders, even from the British. Trouble shooters went forth from the Inspection Section of the Aircraft Radio Laboratory and from Bendix. Bendix blamed the inexperience of the civilian and military personnel at the air bases. The military were inclined to blame Bendix. Since SCR–522 was a copy of a British original, poor design was attributed to the parent set. The chief troubles were failure of the dynamotor, PE–94, which powered the set, and defectiveness of the

[59] Incl, Tab B, Item 5, SCR–183; SCR–283, with 1st Ind, Somervell to CG AAF, 24 Nov 42, on Ltr, Arnold to CG SOS, 10 Nov 42, sub: Delayed proc of critical radio and related equip required by AAF. (SigC (EO) 475 SigC Equip Gen, 1942–44.

[60] Ltr, Chief of AC to CSigO, 7 Jun 41, sub: VHF SCR–274 comd set. AAG 676.3–A Wireless Radio Systems.

[61] ARL Prog Rpts, Jul 42, proj. 41, p. 20; proj. 47, p. 21; proj. 51, p. 22; and proj. 67, p. 28. A minor matter of VHF development, but troublesome, was the command set antenna, built into a short antenna stub which projected vertically from the aircraft fuselage. Buffeted by the air flow, subjected to extreme vibration and strain, the stubs frequently snapped off, until the ARL developed a maple plywood type, impregnated with phenolic resin under extremely high pressure. CSigO, Annual Report, 1943, p. 137.

[62] (1) Ltr, TAG to CSigO, 25 Feb 41, sub: Equip for Air Defense. AG 413.68 (1–27–41) M–D. SigC CE Drawer 526, AWS, 1941. (2) AAF R&R, Col Marriner to AFRDB, 15 Jun 42, sub: Radio sets in bombardment planes for BOLERO. AAG 413.4–M Com Equip. (3) See also pp. 79–81, above.

amplifier tubes 832 (VT–118). Moreover, many installations were made very badly; tuning adjustments were way off. Everyone agreed to tighten up on inspection, and to improve the training of the workers. Production manager E. F. Kolar, after inspecting SCR–522 troubles at the Bell Aircraft plant in June, had urged Bendix to institute additional precautions at the factory "to insure the highest quality workmanship," and to send a representative to each aircraft factory in order to train personnel there in the niceties of installation and tuning.[63]

Improvements came slowly. In September W. L. Webb, Chief Engineer of Bendix Radio Corporation, and Maj. W. D. Inness, inspecting matters at the Curtiss Aeroplane Corporation at the Buffalo airport, were shocked to behold the careless handling of the SCR–522's as they came in. They were strewn around a disorderly radio shop where two girls poked over their wiring and adjustments to see if anything was loose. The girls "weren't real sure what they were looking for." Obviously, they might damage a set by tightening a tuning adjustment which they might suppose loose.[64] Test methods were bad, and no wonder. There was no suitable test equipment—quite a chronic defect touching new electronic devices. This was especially true of radar during 1942 when basic equipment was being rushed to the field before test and tool sets were available or even designed. The Aircraft Radio Laboratory was busy developing test sets, but not until 9 September 1942 did the first SCR–522 test set, IE–19A, reach the radio installation people at Curtiss.[65]

When Webb and Inness inspected the Curtiss Aeroplane plant on 7 September, they were told by the AAF representative there, Colonel Mitchell. that lack of experience with the VHF SCR–522 was indeed the chief source of trouble, augmented by lack of test equipment and by one very real mechanical defect involving the dynamotor. He mentioned, too, that an average of three antenna mast stubs broke on every eight to ten flights. The American copy of the British dynamotor simply had not worked out well. As General Olmstead informed the Air Forces some months later, the dynamotor design was unsuited to American manufacture, which employed American materials and methods. Bendix had objected to copying it in the first place, but at that time, in 1941, all had agreed that the only way to meet desired production schedules was to copy it anyway, while developing a new design. Aircraft Radio Laboratory engineers were now working out the new dynamotor. By December they would complete it; tooling for production would begin, and in 1943 the AAF would receive improved, trouble-free dynamotors for its

[63] (1) Rpt, W. L. Webb, Chief Engr of Bendix Radio Corp, SCR–522 Field Troubles, 2 June 42; (2) Ltr, John J. Finocharo, Principal Adm Proc Inspector, to Capt Koerner, Chief of Inspec Unit ARL, 5 Jun 42, sub: Rpt of trip to Grenier Fld, Manchester, N. H.; (3) Ltr, J. D. Woodward (Bendix employee) to W. L. Webb, 6 Jun 42; (4) E. F. Kolar, Rpt of SCR–522 Trouble at Bell Aircraft, 6 Jun 42, and other papers. SigC 413.44 (SCR–522) 4, Mar–Jun 42. Woodward claimed that "by far the greatest source of difficulty was due to a complete lack of working knowledge of the equipment on the part of the military personnel at the Air Base."

[64] W. L. Webb, Report of Trip to Curtiss Aircraft, Buffalo, 7 Sep 42. SigC 413.44 (SCR–522) 6, Sep–Oct 42. Webb described the radio shop at Curtiss as in about the same condition as that of Bell Aircraft two months earlier, namely, "very badly organized and in a bad state of confusion."

[65] R. L. Daniel, Report of Trip to Curtiss Aeroplane Corporation, Buffalo Airport, 3–11 September 1942, 18 Sep 42. SigC 413.44 (SCR–522) 6, Sep–Oct 42.

VHF command radio SCR–522.[66] Until then, throughout 1942 and early 1943, the Eighth Air Force in England obtained much of its VHF radio equipment, dynamotors especially, from the British. Until improvements were accomplished in the American equipment, radio communications in Army Air Forces P–47's had sometimes been impossible.[67]

Thus, Signal Corps' introduction of VHF into army airplanes brought a great deal of fuss and trouble, just as the advent of radar was doing. VHF brought headaches to the Aircraft Radio Laboratory, to the manufacturers both of the electronic equipment and of the aircraft themselves, and to the Army Air Forces personnel who operated it. The reasons all stemmed from its novelty. Apart from a few experimenters and researchers, the Americans were so generally inexperienced in the very high frequencies that they lacked even the essential test equipment which could function accurately at frequencies above 100 megacycles. But all these deficiences the Signal Corps was fast mending in 1942, bringing air radio up to date, whether between aircraft, or between aircraft above and the AACS stations below, joining them all in one dependable net of radio communications.

Such are the principal threads of the history of the problems and accomplishments touching Signal Corps wire and radio equipment during the months immediately prior to TORCH, the Allied invasion of North Africa. During the same period the Signal Corps concerned itself intensely with problems associated with radar, the military importance of which was as incalculable as that of the more conventional types of electronic devices.

[66] Ltr, CSigO to Dir of Com AAF Hq, 4 Dec 42, sub: Maint of PE–94 power units for SCR–522. SigC 413.44 (SCR–522) 7, Nov–Apr 43.

[67] Wesley Frank Craven and James Lea Cate, eds., *The Army Air Forces in World War II*, II, *Europe: TORCH to POINTBLANK, August 1942 to December 1943* (Chicago: The University of Chicago Press, 1949), 335, 610.

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CHAPTER IX

Signal Equipment: Radar (June–October 1942)

Airborne Radars on the Increase

During 1942 airborne radars multiplied, and multiplied again, as newer and better sets emerged from the laboratories, tending always toward shorter wavelengths. The seemingly endless variety of their types and applications, the overwhelming quantities in which the Air Forces demanded them, amazed and sometimes stupefied the initiate hardly less than the occasional outsiders who were favored with glimpses of these highly secret developments.[1]

IFF—Identification: Friend or Foe Radar

One of the airborne radar types to which BOLERO, the American build-up in England, gave an immediate and mighty boost in 1942 was IFF. American aircraft flying over Britain had to be identified in the oscilloscopes of the ground radars which kept vigil over all the approaches. The agreed-upon IFF for BOLERO was the British Mark II, which, pending the development of the more advanced IFF Mark III, the Signal Corps copied as the SCR–535. Colonel Marriner in the Air Forces Communications Directorate had assured the British on 8 May that "the American SCR–535 will be installed in all aircraft assigned to BOLERO in lieu of the British Mark II (R. 3003)." [2]

The SCR–535 could pick up radar beams on the SCR–270's frequency band and also on the bands of both the SCR–268 and the numerous British radar types. It threw back an intense echo, which would flash prominently on the oscilloscopes of ground search radars and thereby serve to identify the aircraft as friendly. Despite production troubles and shortages, Philco produced thousands of SCR–535's during the year. By 30 July 1942 the Air Forces had on order 18,000 of these radars.[3] Although IFF

[1] See the listing of airborne radars under both "Military Operations" and "Navigation" in Terrett, *The Emergency,* Appendix: Signal Corps Equipment, World War II.

[2] Ltr, Marriner to Group Capt G. H. Randle, RAF Delegation, British Air Commission, Washington, 8 May 42. AAG 413.4–J Com Equip.

[3] Ltr, CG AAF to CSigO, 30 Jul 42, sub: Additional proc of SCR–535A and SCR–535AZ IFF sets. SigC 413.44 SCR–729–RC–170 No. 1, Apr 42–Jan 43 (RB–1815). Five days after Pearl Harbor Philco had received a Signal Corps letter of intent to purchase 5,000 sets. With utmost effort Philco delivered 26 handmade samples to the Aircraft Radio Laboratory on 1 January 1942. By 14 January flight tests had okayed their models. Before the end of January, bolstered with an order for 15,000, Philco had already gotten more than 100 sets accepted by the Signal Corps inspector,

Mark II and SCR–535 were stopgap sets, serving in place of the more universally usable IFF Mark III, which the Allies had agreed to adopt ultimately, the 535's met all immediate requirements and their production kept up with the new aircraft, so that by the year's end the Signal Corps could assert that no airplanes had been delivered to combat areas without them.[4] Yet by then the SCR–535 was yielding to the Mark III SCR–595 and 695. As early as October, after purchasing some 38,000 SCR–535 components and after getting 18,000 SCR–595's through the Navy, the Signal Corps had also procured 62,000 SCR–695's.[5] The British Mark III would become the universal Allied IFF of World War II, replacing both Mark II and the so-called Mark IV, the last being IFF of American design—the American radio recognition sets SCR's–515, 532, and 533, which were held in readiness in case Mark III sets became compromised through capture.

Signal Corps Altimeters; Secretary Patterson's Objections

High-level bombing had always held a top place in Air Forces thinking. Therefore another airborne radar application that began to assume great importance as American aircraft moved outward to carry the offensive to the enemy was the radio altimeter, actually a radar whose downward rays and upward reflections could give exact clearance above the ground or water below. The year 1942 saw rapid developments touching the American pulse altimeter SCR–518.[6]

The Signal Corps had ordered 11,579 of these heavy 100-pound altimeters which were effective to at least 20,000 feet. It had ordered them well before Pearl Harbor on a letter contract with RCA dated 3 September 1941. Meanwhile, Signal Corps engineers in the Aircraft Radio Laboratory developed an improved version, the SCR–618, efficient to 40,000 feet and weighing only about 60 pounds. On the Air Forces' request, the Signal Corps now reduced the SCR–518 order to 6,114 and in February issued a letter of intent to RCA and a subcontractor, Stewart-Warner, for 15,000 SCR–618's. In mid-1942 the AAF placed its entire 1943 altimeter requirements at 24,527 SCR–618's and only 7,989 SCR–518's.[7]

By this time research successes again further complicated procurement problems by developing a still better and lighter weight set, the SCR–718, which weighed only some 30 pounds. The fighting men must have the best, and once more the AAF altered its altimeter orders. It now asked for several thousand 718's and cut its SCR–518 needs to 2,000 sets. This the AAF did on 20 September. Three weeks later, on 14 October, it asked the Signal Corps to stop produc-

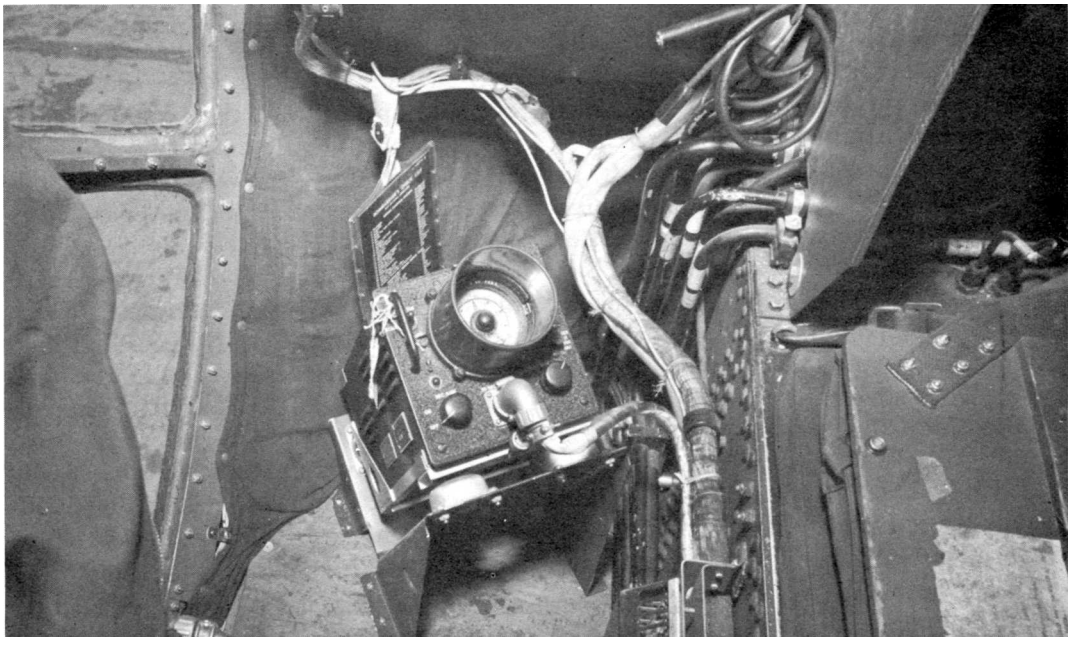
had nearly completed the conversion of their Sandusky, Ohio, plant to large-scale production and were justifiably proud of their "all-out effort." Ltr, Balderson, vice president Philco Corp., to Col Rives, 28 Jan 42. SigC 413.44 SCR–535–A, Jul 41–Jul 42, No. 1 (RB–1517). See also Terrett, *The Emergency*, p. 266.

[4] Memo, CSigO for J. J. Pilliod, Expert Consultant, SigC Sec Prod Sv Br SOS, 15 Dec 42. SigC 413.44 SCR–535 No. 1, 1942–44 .

[5] Ltr, Lt Col John W. Sessums, Jr., ACofS, to Dir of Com AAF, 31 Oct 42, sub: Replacement of IFF SCR–535 with SCR–595 and SCR–695. AAG 413.4–S Com Equip.

[6] See above, pp. 84–85.

[7] Production of the 518 was just beginning. By 16 July the Signal Corps delivered the first 195 sets to the AAF. Memo for Radar Div (unsigned), 16 Jul 42, sub: Weekly prog rpt of Radar Br. SigC 319.1 Rpts Gen 1, May–Aug 42 (RB–781).



THE SCR-718, RADIO ALTIMETER

tion altogether on the 15,000 SCR–618's which had been ordered in February.[8]

Thereupon, procurement people in the Signal Corps and in the Office of the Under Secretary of War protested that established programs, factory dispositions, and money spent on tooling and materials were lost or largely wasted. But such was the inevitable toll exacted by progressive technology. In this particular example of lost motion and money, General Somervell, head of the Services of Supply, getting his figures no doubt from the Signal Corps, estimated that $960,000 in critical materials, now abandoned in a partly fabricated condition, had been wasted; likewise, $210,000 in tools, jigs, and dies—to say nothing of a loss of 70,000 man hours spent in fabricating the wasted material. He estimated, too, that it would cost $472,500 to change the factories over to other types of manufacture. On top of all this he piled "cancellation cost and tool costs to the United States in excess of $1,600,000, with nothing to show for it." [9] This case, and several others like it, all bore out a prophecy which Col. Tom Rives, head of the Radar Division in the Office of the Chief Signal Officer, had made in April 1942, when he said, "The Air Corps' plans for use of signal equipment are changing so rapidly that purchases based on past require-

[8] The AAF asked for 4,200 SCR–718's in the first order of this latest set. Ltr, CG AAF to CSigO, 14 Oct 42, sub: Proc of radio altimeter tentatively known as the "Lark." AAG 413.4–R Com Equip.

[9] Incl, Tab B, Item 3, Radio Sets SCR–518 and SCR–618, DP 42–2289 and DP 42–S–36, with 1st Ind, Somervell to CG AAF, 24 Nov 42, on Ltr, Arnold to CG SOS, 10 Nov 42, sub: Delayed proc of critical radio and related equip required by AAF. SigC (EO) 475 Sig Equip Gen, 1942–44.

ments are likely to cause appreciable trouble." [10]

For exact determination of altitude at low levels, the pulsed high-level altimeter, such as the SCR–518 and SCR–718, would not do. At levels measured in the tens and hundreds of feet of altitude, a pilot had to have another kind of radar altimeter, the continuous-wave, frequency-modulated (FM) type. In this radar variety, the Air Forces had previously taken slight interest. But now in mid-1942, submarine warfare all of a sudden menaced American shores, and the airmen found themselves called upon to help combat the new peril. They needed the low-level altimeter for pressing close-in attacks upon subs. "Our operational people have indicated," Col. Robert G. Breene, director of the AAF Technical Services, informed the Joint New Weapons Committee on 29 June, "that an accurate absolute altimeter of this type is almost as important as the ASV equipment." Navy men had had such an altimeter developed and in production, their AYB, extremely accurate from zero to several hundred feet and especially useful to them as a landing aid for carrier-borne aircraft. By mid-July Colonel Marriner had asked General Olmstead for 1,000 sets to meet the new needs. On 21 September the device received approval for standardization from the Signal Corps Technical Committee and became the RC–24, subsequently the AN/APN–1.[11]

Thus, still another radar joined the large numbers of electronic gadgets crowding the Army's airplanes. Airborne radar and radio were multiplying almost by the day, to the pleasure of some, to the dismay of others. Electronic diversification into myriads of new military applications merely paralleled in the air what was happening on the ground—the whole constituting a tide which rose as inexorably against the command of military lords in World War II as the ocean had once defied King Canute.

A year earlier, shortly before Pearl Harbor, the Chief of Staff, General Marshall, had given Olmstead an inexecutable order—to simplify and reduce Army's radio types.[12] Obediently, Olmstead had sought to comply, but his efforts were in vain. Now, in September 1942, Robert P. Patterson, Under Secretary of War, repeated Marshall's wish, with respect to airborne equipment especially. He directed his comments not to Olmstead directly, as Marshall had done, but to the Chief Signal Officer's new superior, General Somervell, who of course merely passed them down to the Signal Corps for reply. Specifically, Patterson wrote that he constantly questioned "the need for so much and so many types of radio, especially for airplanes." He expressed the hope that David Sarnoff, president of the Radio Corporation of America, who had recently joined the War Department for a 30-day tour of duty as a

[10] OCSigO R&W Action 1, Col Burns, Exec Radar Br, to Col Eugene V. Elder, Proc Div, 17 Apr 42, sub: Airborne Radar Equip, ASV Mark II and ASV–10 curtailment of purchases. SigC 413.44 Radar Equip 1 (RB–1396). For other examples of waste incurred as Air Forces plans changed, see Terrett, *The Emergency*, Ch. X. See also, above, pp. 238–39.

[11] (1) Interv, SigC Hist Sec with Maj E. A. Massa, O/C Detection Br, Electronics Div ARL, 9 Oct 44. (2) Memo, Breene for Joint New Weapons Committee, 29 Jun 42, sub: Antisubmarine weapons, p. 5. AAG 413.4 Radar Gen. (3) Ltr, Marriner to CSigO, 14 Jun 42, sub: Proc of altimeters type RC–24. AAG 413.4–M Com Equip. (4) OCSigO Engr and Tech Div, History of Signal Corps Research and Development in World War II, II, Pt. 1, projs. 201–A and B, p. 5. Following the Army-Navy nomenclature system, the A stood for *airborne*, the P for *radar*, the N for *navigational aid*.

[12] See Terrett, *The Emergency*, pp. 294ff.

Signal Corps colonel, might help to review air electronic military requirements, in the interests both of decreasing airborne weight and of easing the shortages which plagued factory production. Acquiescing in the demand, General Olmstead's deputy, General Code, suggested possible simplifications. Code listed the twelve items which the Signal Corps was currently installing in bombers, the eight items that went into transport planes, and so on, down to the single interphone set installed in primary trainers. He then proposed various reductions, especially in the nine types of radio compasses, which he thought might be simplified into two. As for altimeters, he suggested eliminating the high altitude SCR–518 from airplanes equipped with ASV radar and using the low level RC–24 only. On the whole, Code felt that the "situation is well in hand," for already the number of aircraft radio types had been reduced from forty-one to sixteen. Presumably he was thinking only of radio communication and navigation sets, not of radars, which were now irresistibly on the increase.[13]

The AAF responded at once, and vehemently. It rejected any notion that airborne electronic devices be simplified or reduced. It wanted more, not fewer, of them. Brig. Gen. Harold M. McClelland, in Air Forces Headquarters, after reading a copy of Signal Corps' proposed simplifications, wrote emphatically to the Chief of the Air Forces. General Code, McClelland commented, was giving Somervell and Patterson a false impression. A reduction in the number of radio compass types, for example, would not reduce the total *quantity* needed and would not therefore alleviate the load on industrial production, which was Patterson's chief concern. Moreover, Maj. Gen. Carl Spaatz and other air commanders in the field wanted more and more equipment, of all types. "Send everything," was the tenor of their reports, "we will decide what to leave out"—a demand which, McClelland dryly observed, offered no relief to production problems. He agreed with Spaatz that the Air Forces had to have more radio and radar, and he passed on to General Arnold his belief that those responsible for producing this equipment had "held their sights too low." The Air Forces, he believed, far from following the Signal Corps' effort to comply with Patterson's wishes, should demand greater production. McClelland was emphatic:

> Insist that the SOS (Chief Signal Officer) take steps (similar to those taken by you when you saw the need for more aircraft plants); which will result in the provision of production facilities to meet the increasing demand for radio equipment. It is apparent to me that those responsible for procurement of radio have held their sights too low and have not anticipated demand. The development of radar is finding increasing application to airborne use. Such use is very materially enhancing the potency of the airplane e. g., sea search, blind bombing, air gun laying, etc. We are certainly not going to go without these important devices and we can expect no compensating reduction in the normal communication sets. Therefore, we should face the fact that we need increased production facilities, make the best estimate we can, and start getting new plants built.[14]

[13] Hq AAF R&R, Col Benjamin W. Chidlaw, ACofS AC, to AFTSC, 15 Oct 42, sub: Aircraft radio equip with Incl 1, Ltr, Code to CG AAF, 9 Oct 42, and Incl 2, Memo, Code for CG SOS, 9 Oct 42, also Incl 3, Memo, Patterson for CG SOS and CG AAF, 24 Sep 42, sub: Radio equip program. AAG 413.4–R Com Equip.

[14] [AAF R&R] McClelland to Arnold, 17 Oct 42, sub: Aircraft radio rqmts. AAG 413.4–R Com Equip.

AI—Airborne Interception Radar

Not until the late spring of 1942 had Signal Corps' copies of the puny British AI IV (long wave) begun at long last to come off Western Electric's production lines as SCR–540. Only 580 sets had been ordered; no more were wanted, so the AAF had asserted in May.[15] Late in June the AAF issued a priority schedule for delivery of the first SCR–540's: to Navy, 3 sets; to the ARL, 1 set; to the Douglas Aircraft Company, 1 set; to the Hawaiian Department, 3 sets; to the Signal Corps School, 6 sets; to the AAF Technical School No. 2, 6 sets; to the Western Electric Training School, Kearny, New Jersey, 5 sets; then 6 more sets to the AAF Technical School No. 2. Finally, after all the above had been delivered, 59 sets would go to the Douglas Aircraft Company.[16]

Airmen installed their 540's in oversize fighter planes such as P–70's, converted from the twin-engined A–20 attack bomber. By the end of August, 25 sets had been marked for Hawaii, consigned to the signal property officer at the air depot there. Ten days later, Colonel Marriner asked the Signal Corps to allocate another 25 sets to Hawaii for spares. Simultaneously, he asked also for 7 spare sets to go to Panama. On 12 September the Navy Bureau of Aeronautics asked for 12 sets for the Marine night fighter squadrons.[17]

No sooner did the airmen begin to receive this highly complicated airborne equipment than dire difficulties respecting maintenance arose, difficulties touching all airborne radar alike, IFF and ASV as well as AI. Two Signal Corps lieutenants who had served in England as members of the Electronic Training Group and who were now contributing their experience to the ARL recommended to Colonel Bayer, the chief of the Radar Division at the laboratory, that each Air Corps squadron be assigned maintenance men who could make minor repairs on the spot. In their opinion, each squadron should adopt the British practice and set up a maintenance section of a score or so men equipped with the "megger" (which was a special device to test insulation), together with test set I–48, the multirange volt-ohmmeter TS–189, and suitable signal generators and oscilloscopes. Colonel Gardner, director of the laboratory, agreed, excepting only the signal generators and oscilloscopes which he believed should be reserved for maintenance work at depots.[18]

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[15] 1st Ind, CG AAF to CSigO, 21 May 42, on Ltr, CSigO to Dir of Com Hq AAF, 18 May 42, sub: Proc of additional SCR–540 Equip. SigC 413.44 SCR–540 No. 2, Apr 42–Jan 43 (RB–1706). For the background of SCR–540 see above, pp. 86–87.

[16] Ltr, CG AAF to CSigO, 20 Jun 42, sub: Allocation of radar sets SCR–540. SigC 413.44 SCR–540 No. 2, Apr 42–Jan 43 (RB–1706).

[17] (1) Ltr, CG AAF to CSigO, 31 Aug 42, sub: Shipment of radio sets SCR–540; (2) Ltrs, CG AAF to CSigO, 11 Sep 42, sub: Shipment of radio sets SCR–540–A, both attached to OCSigO R&W Action 1, Lt Wheeler, Radar Br. SPSRB–3, to Proc and Liaison Br, 15 Sep 42, same sub; (3) Ltr, Capt R. Davison, Asst Chief of BuAir, to CSigO, 12 Sep 42, sub: Proc of airborne radar equip. SigC 413.44 SCR–540 No. 2, Apr 42–Jan 43 (RB–1706). The 7 spares to Panama were shipped on 23 September; the 25 spares for Hawaii in mid-October. Ltr, CSigO to Dir of Com Hq AAF, 29 Oct 42, sub: Shipment of Radio Sets SCR–540–A. In same file.

By 5 October the Air Forces had allocated 60 airplanes equipped with SCR–540, thus: 24 to the Fighter Command School, Orlando, Florida; 25 to the Hawaiian Department; 7 to the Caribbean Defense Command; 1 to the Air Technical School, Boca Raton, Florida; 2 to Wright Field; and 1 to the Air Corps Proving Ground, Eglin Field, Florida. Ltr, CG AAF to CG Fld Svs ASC, 5 Oct 42, sub: Radar equip in P–70 airplanes. AAG 413.4–C Radar Equip 1942.

[18] Ltr, Gardner to CSigO, 2 Jul 42, sub: Maint of SigC equip (radar) with Incl, Memo, 2d Lts

Test and maintenance equipment constituted but one trial. Another, especially severe in airborne radar, was training equipment. Airborne radar required that operators be well trained, or else the costly equipment was useless. Yet to train men in actual flight was out of the question. There were not enough airplanes, and what radar existed was desperately needed for patrol and combat operations. The answer lay in sets which could simulate airborne operation in a classroom. The British had devised such radar trainers. The ARL, also, had long before asked the Link Aviation Devices Company, manufacturers of the well-known Link trainer for pilots, to develop a radar crew trainer, RC–110, to train men in AI (SCR–540) operation. But before production of the trainer had begun, the 540 itself was becoming obsolete for air intercept, being replaced by the much larger microwave AI radar, the SCR–520, which called for a quite different trainer set. Because this new radar was already well developed, Colonel Marriner was able to cancel further work on the development of the 540 trainer.[19]

By October 1942, therefore, America's first air intercept radar, the SCR–540, was obsolescent. Further, it suffered from many defects. Maj. James W. McRae, charged with the Airborne Radar Section in the Radar Branch of the Office of the Chief Signal Officer, reported concerning SCR–540's which had been installed in P–70's at the Orlando air base, Florida, that though "the external appearance and general impression created on first examining the SCR–540A equipment is one which augurs well for the future . . . unfortunately it is not borne out in practice." He attributed many breakdowns to inferior materials used in its construction, especially in the cables interconnecting the components of the radar. He noted defects in the cathode ray tubes which were "seriously astigmatic," so that accurate focusing of target echoes was impossible. Some breakdowns he blamed upon bad installation (as in the case of the VHF command radio, SCR–522) and others he attributed to poor workmanship or even sheer carelessness on the part of crews.[20]

Fortunately, night fighter aircraft no longer had to depend upon the long-wave SCR–540 to hunt down enemy planes. Since early in 1942 the Radiation Laboratory, where scientists worked on radar for Division 14 of the National Defense Research Committee, had been building numbers of its prize AI–10. The Army's version of this big microwave American radar, the SCR–520, was so superior to the older British long wave AI IV that the British themselves pressed eagerly to get quantities of it in a special form suited to their planes, designated SCR–520-UK.[21] When factory pro-

Jason E. Newman and Richard E. Langworthy for Chief of Radar Div, 1 Jun 42, sub: Recommendations for maint secs on ASV-equipped squadrons. SigC 413.44 SCR–540 No. 2, Apr 42–Jan 43 (RB–1706).

[19] Ltr, CG AAF to CSigO, 22 Oct 42, sub: Cancellation of Link Aviation Devices crew trainer for SCR–540. SigC 413.44 SCR–540 No. 2, Apr 42–Jan 43 (RB–1706).

[20] Maj. J. W. McRae, Report on SCR–540A Equipment and Installation in P–70 Aircraft Located at Orlando Air Base, Florida, Covering the Period from July 31, 1942, to October 1, 1942, attached to OCSigO R&W Action 1, Maj Fell, Dir of Planning, to Dir of R&D Div, 20 Oct 42. SigC 413.44 SCR–540 No. 2, Apr 42–Jan 43 (RB–1706).

[21] Memo, Gilbert L. Wehner, Asst Radio Engr, OCSigO, for O/C Radar Div, 2 Feb 42, sub: Rpt on conf with British Air Commission ARL and Western Electric Co., Radio Set SCR–520–UK. SigC 413.44 SCR–520 No. 2, Jan–Dec 42 (RB–1705).

duction began in late spring, the Air Forces set up priorities for the first deliveries: the first two sets to the Northrup Aircraft Corporation and thereafter one to Western Electric (the manufacturer), one to the Douglas Aircraft Company, thirteen to the Air Forces Technical School No. 2, six to the Signal Corps School, and four to the Signal Corps Maintenance School at Kearny, New Jersey.[22] Most of these SCR–520's were destined to be delivered, not as AI's, air intercept radars, but as air-to-surface-vessel sets. They would be converted into SCR–517's, to serve in the capacity which the immediate needs of the war most urgently demanded—aircraft search for enemy submarines.

ASV—Air-to-Surface-Vessel Microwave Radar

This most important airborne radar development during 1942 was directly stimulated by the necessity to clear the seas. ASV, air-to-surface-vessel radar, was the electronic instrument which contributed more than anything else to the defeat of German submarines. ASV first helped in the attack on raiders along the Atlantic seaboard; then, in British hands, it aided the passage of the Allied invasion fleets through the Bay of Biscay and on toward North Africa. Now, in mid-year, production of the original long-wave ASV, British ASV–II, copied by the Signal Corps as SCR–521, was well under way. But the microwave ASV was a much better set, and by September the AAF was planning to replace ASV II (SCR–521) with the new SCR–517.[23] Combat needs could not await factory production of the SCR–517. The British received the Radiation Laboratory's prototype microwave ASV, DMS–1000—mounted in a B–24—dubbed Dumbo I, followed by several more crash-built sets, that is, hastily handmade by the laboratory's own shop, the Research Construction Corporation. Dumbo I, and its dozen or so successors, called Dumbo II's, went to work in the hands of the English against subs in the Atlantic and in the Bay of Biscay late in 1942, winning British acclaim as "the first substantial radar contribution made directly to Britain's war effort by the United States." [24]

Secretary of War Stimson and his technical advisers had sensed early in 1942 the great importance of ASV radar. So had the AAF which, burdened with the general responsibility for shore-based air operations, was very much interested indeed. When the Radiation Laboratory fitted its first experimental microwave ASV into a B–24 Liberator bomber and flew it in the spring of 1942, Stimson himself rode on a demonstration flight. Henry Guerlac, historian of the Radiation Laboratory, writes that when the scientists took their ten-centimeter ASV to Washington in April 1942:

> . . . not much interest was shown in the higher reaches of the Pentagon until the Secretary of War was induced by his radar adviser to fly with the equipment. This he did, before his generals had responded to the invitation, in a plane loaded with depth charges in case an enemy submarine should actually be sighted. Without difficulty the radar located a ship and the plane was able to home on it so that the Secretary could look out of the window and see the results of the pursuit.

[22] Teletype Msg (SPSRA–C–3), Olmstead to ARL, Wright Fld, 3 Apr 42. SigC 413.44 SCR–520 No. 2, Jan–Dec 42 (RB–1705).

[23] Memo, Marriner for Dir of Tech Svs, 2 Sep 42, sub: Replacement of Mark II with ASV–10. AAG 413.44 ASV Gen 2, Oct. 42.

[24] (1) Dr. Henry E. Guerlac, Hist Div OSRD, Radar, 1945, p. 434 (Sec C, Ch. II, p. 10). (2) Baxter, *Scientists Against Time*, pp. 42–43. (3) Craven and Cate, *The Army Air Forces*, II, 382–83.

He was convinced. "That's good enough for me. Let's go home." The next day General Marshall and General Arnold found identical notes on their desks from Mr. Stimson saying, in effect: "I've seen the new radar equipment. Why haven't you?" [25]

The Navy did not welcome the use of Army patrol bombers to sweep the Atlantic shipping lanes. Admiral Ernest J. King stated to General Marshall that in escort ships alone lay the promise of success against U-boats and raiders. The Navy doubted the efficacy of aircraft as submarine killers and wished to restrict Army aircraft to the control of the several Sea Frontier commands, to be employed by the Navy to cover convoys.[26] But ASV-equipped Army aircraft emphatically disproved the Navy's doubts, beginning with the first ten preproduction ASV–10's, which had been hastily converted from AI–10's and mounted in B–18 bombers during the early months of 1942.

By May Western Electric, the manufacturer of the first microwave sets, was struggling to convert most of its production of AI–10 (SCR–520) into ASV–10 (SCR–517–A). Production sets 3 through 102 were thus to be converted. "This action," wrote 1st Lt. Wilbur H. Vance, Jr., in the Radar Division of the Office of the Chief Signal Officer, "was directed by the Secretary of War approximately April 7, 1942, because only 2 SCR–520 (AI–10) equipments are needed during the months of April and May, whereas 100 ASV–10 equipments can be used during the same months." Actually it was to be well past mid-summer before production totaled 100. The conversion, Vance explained, was a matter "of changing the short range AI equipment so that it will function as an ASV long range surface vessel detection equipment. The modifications necessary consist of changing the speed of rotation of the Spinner and the angle of tilt of the Reflector. The production of the SCR–517–A equipment," Vance added, "has been made greater than the original delivery schedule planned for the SCR–520 equipment because of the higher priority rating assigned to the converted equipment." [27]

The work progressed slowly, both because severe engineering problems had to be solved and because changes were introduced into the equipment itself. Large-scale production would come, but with agonizing slowness, only as submarine outrages multiplied. Production engineers and Army officers who blandished each other and the War Department heads with fair promises either did not realize how complex ten-centimeter ASV radar was or else were indulging in wishful thinking.

For example, on 30 January 1942, Robert A. Lovett, Assistant Secretary of War for Air, had written to Colonel Marriner saying he understood the performance of the American microwave ASV was "very excellent." "Will you please advise me," he asked, "how many of these we have on order and how soon we are to receive the first items. I am told," he added, "that the British are putting in for a large number and I want to make sure that production is ac-

[25] Guerlac, Radar, p. 433 (Sec C, Ch. II, p. 9). For Stimson's own account, see Stimson and Bundy, *On Active Service in Peace and War,* pp. 509–10.

[26] (1) Stimson and Bundy, *On Active Service in Peace and War,* p. 511. (2) Morison, *The Battle of the Atlantic,* pp. 309–10. (3) Craven and Cate, *The Army Air Forces,* I, 545; II, 380. The AAF historians, while primarily concerned with the contest between the Army and Navy over the command of antisubmarine aircraft, touch frequently upon the radar which made such aircraft effective. *Ibid.,* I, Ch. XV, *passim;* II, Ch. XII, *passim.*

[27] OCSigO R&W Action 1, Vance, Radar Div SPSRA–3, to McRae, 1 May 42, sub: Delays in deliveries of prod equip resulting from design changes. SigC 413.44 SCR–520 No. 2, 1942 (RB–1705).

celerated to meet our urgent present needs, even if we have to use hand-built sets at the outset and until the production line comes into being." Marriner replied, giving the delivery schedule which Western Electric had set up for the 50 sets on order: 10 to be delivered in February and 20 in each of the next two months. Then he added brightly, "Believe this schedule will be met with no delays." Two months later there was still no production of ten-centimeter ASV's. Thereupon, at the end of March, Brig. Gen. Bennett E. Meyers, executive officer of the AAF's Materiel Command, addressed a frantic note to Marriner. Lovett was on the warpath for ASV. "Mr. Lovett," Meyers wrote, "is very concerned about ASV equipment . . . will you please," he besought Marriner, "give me a squib that I can hand on to Mr. Lovett. I promised this information today but I had been unable to get together with you. Please take a couple of minutes and write up a brief for me." Meyers explained Lovett's impatience touching the ten-centimeter ASV: Lovett now was expecting that the first production set would be ready by 15 May, that 15 sets would be built by 15 June, 300 sets every month thereafter! [28]

Radar engineers and production experts at Western Electric had their hands full with Signal Corps' two microwave AI and ASV radars, the 520 and the 517 respectively. By the end of May Western Electric had given the Signal Corps to understand that it could provide the Navy during June with 60 SCR–517's, designated ASC radar, followed by 40 in July; the Army Air Forces with 28 SCR–520's in June, 35 in August; the British with 60 SCR–520–UK's in July, 100 in August, and 40 in September. All of these figures were thoroughly reshuffled several times during the summer of 1942, as demands shifted from AI (SCR–520) to ASV (SCR–517) and as production goals proved totally impossible. By 30 June, for example, ". . . the delivery dates on the SCR–520–UK [had] been changed a number of times because of their interference with delivery of the SCR–517–A. . . . The Office of the Secretary of War and the Army Air Forces [had] indicated that still more SCR–517–A's [might] be ordered, in which case, the schedule for delivery of the British SCR–520–UK equipment would again be changed." [29]

Meanwhile a new customer had appeared among those who desired the SCR–517 airborne sea search radar. It was the Navy. Yet the Navy did not want SCR–517's for airborne use at all. Instead, it intended to mount them on small subchasers. This usage would have sharply curbed the potentiality of ASV. Obviously an airplane flying a mile high could scan a far greater area than could any surface craft from masthead height. Nonetheless, the Vice Chief of Naval Operations, Rear Adm. Frederick J. Horne, wrote to General Arnold in May asking that a number of SCR–517's be diverted for use in naval submarine chasers.[30]

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[28] (1) Memo, Lovett for Marriner, 30 Jan 42, sub: ASV equip; (2) Memo, Marriner for Lovett, 9 Feb 42, sub: Summary of info regarding ASV equip as of this date; (3) Memo, Meyers for Dir of Com ("Si Marriner," Meyers penned additionally), 28 Mar 42, sub: ASV equip. AAG 413.4 ASV, Gen 1, Apr–Jul 42.

[29] (1) OCSigO R&W Action 1, Col Burns, Exec SPSRB, to Radar Div (Col Metcalf), 25 May 42, sub: Delivery schedules SCR–517–A, SCR–520–A, and SCR–520–UK; (2) OCSigO R&W Action 2, Vance, Radar Br SPSRB–3, to Proc Div Purchase Sec Secret Subsec, 30 Jun 42, sub: DP 42–2162, Order 1123–PH–42–SCR–520–UK. SigC 413.44 SCR–520 No. 2, 1942 (RB–1705).

[30] Ltr, Horne to CG AAF, 19 May 42, sub: Radar request for Army type SCR–517–A. SigC 413.44 SCR–517–A No. 2, Jun 42 (RB–1376).

Accordingly, Colonels Rives and Metcalf of Signal Corps Radar Division conferred with representatives from the Air Forces, from Western Electric, and from Navy's Bureau of Ships. The Navy group, headed by Rear Admiral C. A. Jones, "explained that there was an extreme need for Radar Equipment on small surface craft to be used in searching for submarines on our East coast and the Gulf of Mexico." Naval officers had found that ASV–10, in the form which Western Electric was building as SCR–517–A, could "be used with considerable effectiveness on shipboard for the detection of submarines." The Navy had quantities of long-wave shipboard radar on order as SW2C from War Supplies Limited but admitted that "the Army SCR–517–A is about twice as effective as these are." Further, the naval officers explained that "the delivery of the SW2C is far behind the production rate of the ships . . . acquiring SCR–517–A equipments would help the Navy solve the present shortage in the most rapid way possible; and also will give them an instrument which is more effective against submarines." When they asked Rives if the Signal Corps would give them some sets, one hundred in fact, he naturally replied that that was a matter for the Air Forces to decide.

This request for sets the AAF did agree to, a considerable favor in view of the fact that airmen were already sending out antisubmarine bombers equipped with ASV–10 under Col. William Dolan's command. It would seem a waste to install any of the valuable airborne search sets on surface vessels. The ranking AAF representative present at this May conference, Col. J. K. DeArmond from the Directorate of Communications, granted "that the Air Forces would release these 100 SCR–520's [to be converted to 517's] provided that first, the delivery schedule of the 100 SCR–517's ordered by the Army was not altered; secondly, that a quantity of 25 or 30 SCR–520 equipments were delivered to the Army for service tests before delivery began on the quantity of 100 SCR–517–A's to be delivered to the Navy." [31]

The Navy was not blind to the idea of submarine search from aircraft, however. Admiral Jones and his subordinates explained at this conference that they too had been getting some microwave ASV equipment, which Western Electric was building as Navy Type ASC, an ASV–10 set almost identical with the Army SCR–517–A. Five sets were expected in June, 5 in July, none in August, 25 in September, and 55 in October.[32] They would be getting it, at this rate, much more slowly than the Signal Corps and the Army. But following Admiral Horne's request and Colonel DeArmond's acquiescence, the AAF agreed that 100 "of the 300 SCR–517–A equipments so obtained . . . be turned over to the Navy. . . ." By now, in mid-1942, the AAF total requirement for improved types of the SCR–517 (B and C versions) stood at 2,450.[33]

Meanwhile, nobody was getting many microwave ASV's or AI's either, principally because one essential component was in short supply. This was the spinner, the rapidly rotating and highly accurate antenna mechanism which enables the narrow beam of a microwave radar to scan a wide area. On 17 June 1942, at another conference with

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[31] Memo for File, Gilbert Wehner, Assoc Radio Engr, Radar Br OCSigO, 25 Jun 42, sub: Conf at Navy Dept on radio set SCR–517–A, 19 May 42. SigC 413.44 SCR–517–A No. 2, Jun 42 (RB–1376).

[32] *Ibid.*

[33] 1st Ind, CG AAF to CSigO, 22 Jun 42. (Basic missing.) File cited n. 31.

Navy, Air Forces, and Western Electric representatives, Signal Corps spokesmen "explained that the schedule for the delivery of SCR–517–A's to both the Army and the Navy was being held up because of the lack of Spinners produced by the General Electric Company. The Spinner Production," they added, "has been far behind the promised schedule because of the lack of certain vital tools and machinery and it has been necessary to divert these machines from other users by obtaining higher priorities for them. Philco has been set up as a secondary source of Spinners." [34]

According to Comdr. A. M. Granum from Navy's Bureau of Ships, Secretary of Navy Frank Knox, and his assistant, James V. Forrestal, together with Admiral Jones, had given notice to General Electric that the production of the SCR–517–A's, for use in PT boats, "was a national emergency." The Navy wanted to divert a number of the 517's from the AAF that very month of June, but Colonel DeArmond asserted that "there were 11 Army airplanes completely equipped with all SCR–517–A parts except the Spinners," and he added that "this deficiency will have to be supplied before any Spinners can be diverted anywhere else." He did make some concessions, so that in the end the Navy might get some of the earlier types of microwave ASV, the early, 750-pound version, SCR–517–A, while the Army would receive the SCR–517–B and C, the latter of which would be much lighter in weight.[35]

By August Fred Lack, vice president of Western Electric, wrote to Col. William M. Mack, in the Wright Field Signal Corps Procurement District, saying that his company had delivered, as of the first of the month, 199 sets of SCR–517–A and 4 sets of SCR–520–A. General Electric's production of spinners and antennas had improved during July, Lack said; but to meet the Signal Corps requirements of 1,142 sets in 1942, 939 more would have to be built. And as usual, obstacles to this rate of production had already risen; for example, the Army had asked that beacon and IFF features be added to the SCR–517–A at once, constituting a new version, SCR–517–B. This was in addition to a "small package set," the SCR–517–C, delivery of which was to begin in October. Naturally, these changes did not simplify production problems. Lack asked for more help from Signal Corps expediters in order to increase his company's supply of mica and of such components as switches, condensers, and potentiometers.

By 3 October 200 517–A's had been procured, inspected, and shipped, 100 each to the Air Forces and the Navy; 48 of the new 517–C's had also gone to the Air Forces. Colonel Marriner informed the Chief Signal Officer on 11 September that 91 517–A's

[34] Memo for File, Wehner and Vance, 10 Jul 42, sub: Conf on 10-centimeter airborne radar equip. SigC 413.44 SCR–517–A No. 3, Jul 42 (RB–1377).

[35] *Ibid.* The conferees concluded: ". . . that Navy and Army representatives will stay at the General Electric plant to oversee the expediting of spinner production in order that the tools which are available may be used to their utmost capacity rather than making an attempt to order more tools and machines to increase production in time to supply the immediate demands [and] that the Army will not take delivery on the heavy and bulky SCR–517–B equipment, but [that] the Navy will accept 232 ASC equipments of the large type construction. The lightweight SCR–517–C program will be expedited in order that installation of them may be made in Army planes which are not suitable for the installing of the bulkier SCR–517–B."

See also Memo, Burns for Exec Control Div, 7 Aug 42, sub: Weekly digest of prog and problems, Radar Div, week ending 6 Aug 42, p. 4. Weekly Achievement Rpts, 17 Jul–19 Aug 42. SigC Central Files.

had come to the Air Corps, 62 of which had been installed in B–18A bombers; the remainder had gone to schools or had been used as spares because—Marriner added the universal complaint whenever new equipment came in—there were no spare parts. The Air Corps had to cannibalize some of its new ASV's in order to provide spare parts to keep other sets in operation.[36]

Thus all through the summer of 1942 ASV production problems sputtered and smoked. There was too much promising, too little production. Air Forces officers prepared a case history for the Services of Supply at the end of the year, checking off against the fair promises the dismal quantities actually delivered. The report commented:

> . . . only properly evaluated production schedules should be set up. Production schedules were established which actual deliveries of equipment have never paralleled. Through failure to receive the equipment as scheduled, it has been impossible to vigorously prosecute that campaign of anti-submarine warfare which is dictated by the sinkings of surface vessels along our sea frontiers and in other areas in which we are vitally interested. Failure to receive equipment on scheduled dates results in loss of use of aircraft or ineffective use. When installations are contemplated, it is necessary to order airplanes to depots in advance of receipt of equipment. Failure to receive the equipment as scheduled requires the aircraft to remain at the depots for unnecessarily long periods during which time the Air Forces lose both the services of the crew and the plane.[37]

ASV production during the summer of 1942 had probably been about as good as the state of the radar art and the experience, or rather inexperience, of both the manufacturers and the military users allowed. The demand was terrific, especially on the part of those who did not comprehend all the difficulties. Meanwhile AAF users, under the spur of Secretary Stimson and his adviser, Dr. Edward Bowles, worked out the tactics whereby Army bombers might best thwart the submarine menace. The bombers would fly over the sea to seek out submarines, not defensively merely, accompanying convoys to protect them, as the Navy wished, but offensively, sweeping the seas far and wide. Once a submarine was discovered, if not immediately bombed to destruction it could be hounded. It would have to come to the surface eventually to recharge the storage batteries upon which it depended for underwater propulsion. If continually forced under, it would be rendered helpless.[38] A scant ten B–18's had been working out such operational tactics under Col. William C. Dolan, using the first preproduction ASV–10's, that is, SCR–517–A's converted from the ten-centimeter AI radar SCR–520. General Arnold had told Secretary Stimson that Dolan's pilots flying four ASV–10's from Langley Field and two from Jacksonville, Florida, were "enthusiastic over the possibilities of this equipment." A month later Dr. Bowles urged the Secretary to set

[36] (1) Ltr, Fred Lack to Col Mack, 26 Aug 42, sub: SCR–517–520 Radar Sets; (2) OCSigO R&W Action 1, Maj McRae, Radar Br SPSRB–3, to Dir of Planning, 3 Oct 42, sub: Accumulative status rpt on ASV equip as of 3 Oct 42; (3) Ltr, Marriner to CSigO, 11 Sep 42, sub: Spare parts groups for SCR–517–A. SigC 413.44 SCR–517–A 4, Aug–Nov 42 (RB–1513).

[37] Ltr (originating in AFTSC) to CG SOS, 7 Dec 42, sub: Critical shortage of radar equip. SigC 413.44 Airborne Radar Equip 1, Jun 42–Mar 43 (RB–1908).

[38] Incl, Exhaustion System of Search for Submarines, Col DeArmond (bearing penciled note "This is Dolan's suggestion"), 8 May 42, with AAF R&R, Col L. S. S., to AFACT, 15 Jul 42, sub: Airplanes with ASV equip at microwave school. AAG 413.4–M Com Equip.

up a "special bombardment group for submarine destruction." [39]

Bowles, backed by Dolan's ten B–18's and their repeated successes in sighting and attacking submarines, got action. By the summer of 1942, the Army set up the Sea Search Attack Development Unit (SADU), soon renamed the First Sea Search Attack Group, "at Langley Field to be an operational testing ground for new types of antisubmarine weapons. It is planned," Capt. A. B. Martin wrote on 25 July, "that it be of an experimental nature. However, at the present time due to the concentration of ASV equipment and trained personnel at Langley Field a certain amount of training of ASV–10 operators and mechanics is being carried on. In addition SADU is called upon from time to time by the First Bomber Command to undertake tactical antisubmarine missions." [40]

By the end of 1942 Secretary Stimson's firm stand on behalf of ASV radar for patrol airplanes, and not just for seacraft, seemed vindicated. "Experience in combatting submarine activities along the North Atlantic and Caribbean sea frontiers," an AAF spokesman wrote on the first anniversary of Pearl Harbor, "has demonstrated that the most effective means of curbing this type of enemy activity is through the use of radar equipped patrol aircraft. Such activities have been materially reduced in those zones in which the Army Air Forces have been in a position to provide airplanes equipped with sea-search radar sets for patrol work." [41]

Although ASV radar would soon fall from its high place in Air Forces and Signal Corps interests, going over to the Navy, it nonetheless set off a long train of developments. In particular, it led to blind bombing of land targets by air, BTO (bombing-through-overcast) radar. Even the earlier, long-wave ASV–II (SCR–521) had proved valuable for "seeing" the ground. So General Stoner, Acting Chief Signal Officer, informed General Arnold on 22 August 1942, adding that he now had on hand some 250 complete sets ready to ship wherever the airmen might want them.[42] In the Aleutians the SCR–521 had proved valuable not so much for vessel search as for locating islands and coast lines, and so aiding navigation amid cloud and fog. "All airmen in the Aleutians," commented one AAF officer, "are enthusiastic about ASV radar, with which they can 'see' mountains and prominences and thereby locate themselves. Their interest in ASV for search purposes," he added, "appears secondary." [43]

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[39] (1) Memo, Arnold for SW, 17 Apr 42, sub: Rpt relative to ASVs. AAG 413.4–I Com Equip. (2) Memo, Bowles for SW, 20 May 42, sub: Vitalization of ASV submarine destruction program. AAG 413.4–K Com Equip. (3) Guerlac, Radar, p. 996 (Sec E, Ch. I, p. 14).

[40] (1) Memo for File, Capt Martin, AC, 25 Jul 42, sub: SADU. AAG 413.4–N Com Equip. (2) Guerlac, Radar, p. 430 (Sec C, Ch. II, p. 6). (3) Craven and Cate, *The Army Air Forces,* I, 550–51; II, 401.

Dolan's command expanded in October 1942, becoming the Antisubmarine Army Air Command under Brig. Gen. Westside T. Larson. It would cease to exist however, in mid-1943, as all Army participation in the sub war would begin to yield to the Navy, when the Tenth Fleet, Navy's antisubmarine command, at long last, came into being. Thereupon, Army's interest in ASV radar, and therewith Signal Corps' interest too, would terminate. Morison, *The Battle of the Atlantic,* pp. 242–45.

[41] Ltr cited n. 37.

[42] Memo, Stoner for CG AAF, 22 Aug 42, sub: SCR–521 for ADC. SigC (EO) 413.44 Radio Sets Gen 1942–44.

[43] (1) Memo, Maj Thomas S. Barnes, AC Installation and Maint Dept, for Chief of Radio Div, 16 Oct 42, sub: Rpt on LRN siting trip, 18 Aug–12 Oct 42. AAG 413.4–R Com Equip. (2) Craven and Cate, *The Army Air Forces,* I, 466.

At about the same time General Olmstead asked that the National Defense Research Committee set up a project at its Radiation Laboratory in order to "determine the most desirable procedure for the use of existing ASV equipment over land." The radar maps which the Plan Position Indicator, PPI-type oscilloscope, made possible, "would obviously be useful," he wrote, "guiding ASV equipped bombers to particular cities or targets." Three-centimeter gear, he suggested, would be even better than the existing ten-centimeter radar.[44]

Thus the last months of the year 1942 found ASV microwave radar, far from being an end product, rather the beginning of more and more microwave developments in airborne applications. Ten-centimeter equipment would yield to sets operating on less than one-third as long a wavelength—on three centimeters or about one inch—whereas the wavelength of Signal Corps' first radars was measured in feet. Numerous new microwave radar types were on their way, such as BTO, bombing-through-overcast; LAB, low-altitude-bombsight; ARO, airborne-range-only; AGL, airborne-gun-laying. All these constituted luxuriant proliferations of the flourishing radar growth which would confound the critics of electronic expansion in the air and bemuse even the advocates.

Ground Radar Potentialities Multiplied by Microwave Techniques

American ground radars for air defense—first, searchlight directors (SCR–268); next, long-range aircraft detectors (SCR–270 and 271); then, following British experience, radars suitable for GCI (SCR–516, 527, and 588)—all formed but one family of radars, all for use on the ground but all in some way involving aircraft.[45]

SCR–296, Seacoast Artillery Fire Control Radar

There was another application for ground radar, unrelated to aircraft, in which the Army, specifically the Coast Artillery Corps, had had an interest since 1937. This was a radar which could assist the Coast Artillery Corps' mission of coastal defense and which could detect approaching vessels, in the first instance giving advance warning and in the second providing range and azimuth data to shore batteries. In 1937 the Coast Artillery Corps had asked for such a set. The Signal Corps had typed it as SCR–296.[46] But then, deferring to the greater need for air defense, specifically for the need to develop long-range detectors of aircraft, the Coast Artillery Corps had permitted the Signal Corps

[44] Ltr, CSigO to WD Liaison Officer with NDRC, through CG SOS, 28 Aug 42, sub: Request for initiation of project on use of airborne radar over land. SigC 413.44 Radar Equip 1, Oct 41–Sep 42 (RB–1396).

[45] For details about these long-wave ground radars early in 1942, see above, pp. 93ff.

[46] This was the third Signal Corps radar type, after the 268 and the 270. Coast Artillery had originally in mind thermal means of detection for this purpose, until the 268 prototypes pointed to the superiority of radio echoes. Capt Harry M. Davis, Signal Corps Development of U.S. Army Radar Equipment, Pt. II, 1937–1941 (1945), SigC historical monograph A–2, p. 32. SigC Hist Sec File.

to concentrate on the 270 and did not reopen the matter of the 296 until late 1940.

Development got under way in 1941 when the Signal Corps Laboratories obtained a 296 from Western Electric and added lobe-switching mechanism so that it could track a target. After putting it to service tests, the Coast Artillery approved it, had it standardized, and placed an order for 20 sets. All this occurred before Pearl Harbor. Immediately after that attack, although fear of air onslaughts transcended all other fears, there also arose apprehension for the safety of harbors and anchorages, into which the enemy might send small forays of deadly torpedo boats or submarines. Therefore, on 18 December 1941, Admiral Harold L. Stark had asked General Marshall to consider the use of detector systems to stand guard at harbors and anchorages. The chief of Coast Artillery, to whom the inquiry was referred, replied that while he did have searchlights which could illuminate a motor torpedo boat up to 7,000 yards, he did not have radio detection equipment able to discern such surface craft. The SCR–268, which he was now receiving in quantities, was "not designed to operate at zero elevation," he explained. But he did expect that the SCR–296 would prove to be an effective detector of small surface vessels. Delivery of the 296, he believed, would commence in the spring of 1942.[47]

[47] (1) Incl, Ltr, Admiral Stark, CNO, to CofS, 18 Dec 41, sub: Detector systems at harbor entrances (Op–30C1–FH) (SC) HL–16 Serial 0140030; (2) Incl, Ltr, Chief of CAC to ACofS WPD, 28 Dec 41, same sub, Ltr, TAG to CSigO, 13 Jan 42 (AG 660.2 [1–9–42] MSC–E). SigC 413.44 SCR–296–12G No. 2 (RB–1372). (3) Incl 1, with 1st Ind, SCEL Hq to Chief of Tech Info, OCSigO, 30 Jun 52, Ltr, CSigO to CG SCEL, 5 Feb 42, sub: Review of SigC hist material. SigC Hist Sec File. (4) Lt Col Leonard M. Orman, "Radar, A Survey," *Coast Artillery Journal*, XXCIX: 2 (March–April, 1946), 3.

Production began slowly, the first set being delivered in April 1942, the second in July. By then the Coast Artillery order stood at 176 sets, to be delivered before mid-1943. This radar served for fire control functions through most of World War II, although it had several defects, arising especially from the rather long wavelengths it employed at a frequency of about 700 megacycles. Before the end of 1942, the Signal Corps embarked upon the development of a better tracking set for coastal defense, the SCR–598. This radar would lead, before the war's end, to a superb three-centimeter microwave Coastal Artillery radar, the AN/MPG–1, operating at the extremely high frequency of 10,000 megacycles. These refined sets did not see service in the war. But another microwave radar did come to the aid of Coast Artillery in 1942. This was the ten-centimeter SCR–582, designed by the Radiation Laboratory in Cambridge, Massachusetts. It was one of the first ground applications of microwave radar using the new PPI, or Plan Position Indicator.[48]

SCR–582, Harbor Surveillance Radar

The Coast Artillery men first saw the 582, or rather its laboratory prototype XT–3, late in December 1941. A few days earlier a Signal Corps officer, Colonel Corput, had ordered 50 sets from the Radiation Laboratory's own shops, the Research Construction Corporation. Between 27 and 30

[48] (1) Incl cited n. 47(3). (2) Orman, "Radar, A Survey," pp. 4–7. (3) Col A. W. Clement, "Seacoast Artillery Radar," *Coast Artillery Journal*, XCI, No. 3 (May–June, 1948), 8–12.

AN/MPG, under Army-Navy nomenclature, signifies that the equipment is mobile (mounted in a vehicle), M; is radar, P; and is a gunlayer, G.

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December Lt. Col. James E. McGraw, of the Coast Artillery Corps Board, had tested the XT–3 on Deer Island (Fort Dawes) in Boston Harbor. He favored it, rather conservatively, with the opinion that the "SCR–582 is desirable equipment for use by the Coast Artillery in harbor defense observation stations." The eye of its constantly rotating four-foot dish antenna flashed upon the PPI a maplike view of the harbor area together with all the vessels therein. This it did with the detail which only microwaves make possible. Whereas the SCR–296 could track but one target at a time, meanwhile leaving the remainder of the harbor unsurveyed, the 582 could watch over all targets within its range. As a surveillance set it valuably supplemented the fire control and tracking radar SCR–296.[49]

In May 1942 the first of the 50 SCR–582's crash-built by the Research Construction Corporation underwent preliminary tests. The Coast Artillery men were deeply impressed. They expected the set "to be of exceedingly great value." Further service tests in July at Fort Story, Virginia, led the Coast Artillery Board to urge increased production, beyond the 55 sets already on order, these being the 50 from the Research Construction Corporation and 5 from the Crosley Radio Corporation. The board recommended that the 582 be restudied, in the light of its capabilities, "with a view to the widest possible justifiable application of this set." [50]

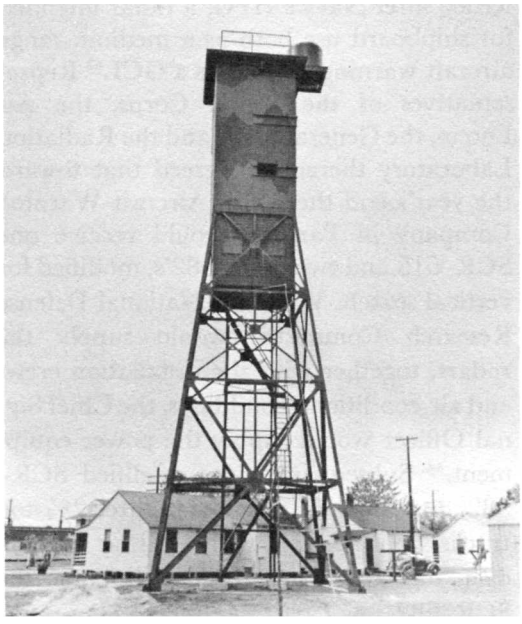
The 582 successes soon came to the ears of the Air Forces, whereupon in September General Arnold asked the Signal Corps to test the new microwave ground detector against aircraft. Though the first sets could not scan the sky since no provisions had been built into them for tilting the antenna dish upwards, nonetheless Coast Artillery men had noticed how well this radar was able to track low-flying craft, 500 to a 1,000 feet above the sea, out to ranges of 40,000 yards.[51]

Thus by the middle of 1942 the new microwave radars, all radiating ten-centimeter waves at about 3,000 megacycles, all American sets developed by the Radiation Laboratory out of descendants from the British cavity magnetron, were receiving tremendous favor. Added to the success of the ground set SCR–582 were the attainments of the ASV–10, which, in the form of the airborne SCR–517, was actually helping to sink submarines off American shores. Added to these was the scintillating promise of the gun layer SCR–584, or rather of its laboratory prototype XT–1. Microwaves were coming in for all radar applications, and long-wave radar was on the way out, though the long-wave types would continue to do duty all through the war because they

[49] (1) Ltr, Dr. Bowles, Secy NDRC and member of Microwave Sec, to Col Rives, 2 Feb 42, sub: SCR–582–T–1; (2) Ltr, CA Bd to Chief of CA, 4 Jan 42, sub: Preliminary rpt on sv test of radio set SCR–582. SigC 413.44 SCR–582 No. 1, Dec 41–Jun 42 (RB–1385).

[50] (1) Ltr, Col Francis L. Christian, Exec CAC, Hq Chesapeake Bay Sector, Ft. Monroe, Va., to CG Eastern Defense Comd and First Army, 20 May 42, sub: Radio set SCR–582 (general surveillance detector). SigC 413.44 SCR–582 No. 1, Dec 41–Jun 42 (RB–1385). (2) Ltr, Col W. S. Bowen, pres of CAC Bd, to Chief of Rqmts Sec AGF, 24 Jul 42, sub: Proc of radio set SCR–582. SigC 413.44 SCR–582 No. 2, Jul–Oct 42 (RB–1522). (3) Baxter, *Scientists Against Time*, p. 147.

[51] Ltr, CG AAF to CSigO, 16 Sep 42, sub: SCR–582, with Inds. File cited n. 50(2).



COAST ARTILLERY FIRE CONTROL RADARS. *The SCR-582 (upper left) and SCR-296 (upper right) at Charleston, S.C., and the SCR-296 and fire control towers at San Juan, Puerto Rico (below).*

had been developed first and were now in full production.

The Army put the new microwave ground radars to test in Panama. In mid-1942 Dr. Bowles, radar specialist on Secretary Stimson's staff, visited Panama, and was followed some weeks later by another radar scientist and director of the Radiation Laboratory, Dr. Lee A. DuBridge. There the army commander, General Andrews, who was still faced with the possibility of carrier-based air attack, asked that the Panama Canal Zone become the testing ground for the newest and best in radar. The Radiation Laboratory scientists therefore kept in mind, as they developed microwave applications, the problems of Panama defense, especially the problems presented by reflections from mountains. One of the scientists, Dr. Ralph Bown, wrote to DuBridge on 6 August: "We thought that the sharp beams characteristic of microwave equipment, such as Dr. Bainbridge's HPG, might be one way of solving the problem." Another way, which Colonel Corput suggested to Dr. Bown, was continuous wave doppler radar, of the "fence" type.[52]

Microwave radar would be tried first and would indeed prove much better able to detect aircraft over high land masses than long-wave radar. Panama, then, was the ideal place to try out the SCR–582 after it had been modified with a tilting antenna for aircraft detection. Accordingly, in September DuBridge recommended two 582's, so modified, and one SCR–615, the latter being still another microwave detector which the Radition Laboratory had under design patterned after Navy's HPG, a radar intended for shipboard use both as a medium-range aircraft warning set and as a GCI.[53] Representatives of the Signal Corps, the Air Forces, the General Staff, and the Radiation Laboratory thereupon agreed that toward the year's end the 708th Aircraft Warning Company in Panama would receive one SCR–615 and two SCR–582's, modified for vertical search. While the National Defense Research Committee would supply the radars, together with the installation crews and air-conditioned buildings, the Chief Signal Officer would supply the power equipment.[54] Subsequently, the modified SCR–582, made mobile, installed in three 2½-ton trucks, and modified with a tilting antenna dish for aircraft detection, became the SCR–682, a Coast Artillery long-range early-warning radar employed in World War II against both surface vessels and aircraft.[55]

SCR–615, Microwave Radar for GCI, Ground-Controlled Interception

The SCR–615 was another Radiation Laboratory ten-centimeter radar, whose production, distribution, and maintenance worries the Signal Corps now inherited. The Radiation Laboratory had begun developing this SCR early in the year at the behest of Colonel Saville, Director of Air

[52] Ltr, Bown to DuBridge, 6 Aug 42, Incl with AAF R&R, Col Saville, Dir of Air Defense, to Comdt, Fighter Comd School, Orlando, Fla., 2 Oct 42, sub: Dev of radar equip. AAG 413.4–C Radar Equip 1942.

[53] (1) Guerlac, Radar, pp. 611 ff (Sec C, Ch. VII, 9 ff). (2) Memo on Proposal for Use of Microwave Equip in Panama, Dr. DuBridge, 24 Sep 42. SigC 413.44 SCR–615 No. 1, Jun 42–Jan 43 (RB–1813).

[54] Memo for Rcd, Maj Fell, Directorate of Planning, 26 Sep 42, sub: SCR–615 and SCR–582 (Modified). SigC 413.44 SCR–582 No. 2 (RB–1522).

[55] (1) Guerlac, Radar, p. 615 (Sec C, Ch. VII, p. 13). (2) Orman, "Radar, A Survey," *Coast Artillery Journal*, pp. 4–5.

Defense, who had frantically prodded the Signal Corps and the British for a GCI set. He had prodded all through 1941. Then early in 1942, realizing that the Canadian-built CHL/GCI (the SCR–588) would not be available for a while and that the SCR–527 (Signal Corps' copy of British GCI) would not come out of General Electric factories for quite some months, Saville turned to the National Defense Research Committee in a third effort to get some sort of GCI soon. He had hoped that the Radiation Laboratory scientists might quickly modify for GCI use the Navy's HPG.[56]

The scientists made the modification, but not so quickly as the impatient airmen wished—not until after the 588's became relatively abundant late in 1942 (but before the 527 appeared). And anyway, SCR–615 was far better, for it was a step in the right direction, into microwaves and away from the long waves which both the 588 and the 527 employed for long-range search. It was the first ten-centimeter GCI, a large fixed set having a six-foot antenna dish. Of the first two models, crash-built by the Research Construction Corporation, one underwent service tests at the Army Air Forces School of Applied Tactics (AAFSAT), Orlando, Florida, toward the end of 1942; the other went to Taboga Island, at the Pacific entrance of the Panama Canal, where it replaced an SCR–271 which had failed to work well there because of reflections from the rugged terrain round about.

This first microwave GCI opened some eyes, especially among the proponents of long-wave radars, though it had some drawbacks, too, and failed to win complete approval at first (unfortunately true of the initial installation in Florida). Its range was not inconsiderable, up to 90 miles, refuting Watson-Watt's insistence that only long-wave radar could fetch distance. Moreover, its coverage at low levels, always a problem with long-wave radar, was a revelation. Even the set in Florida, which had been poorly sited, tracked large numbers of flights below 5,000 feet, flights which other radars in the area, all radiating long waves, failed to detect at all. Similarly, in Panama, Lt. Gen. George H. Brett, successor to Andrews, got a surprise when he thought he would show up the radar detection system, as so often had been done before, by flying his plane in close to the water. On landing, he expected that his flight had been entirely "unseen" by the SCR radars in the zone. But he received a pleasant surprise when he was handed a plot of his flight, for which the SCR–615 crewmen and their microwave helpmate provided the data, and found that his plane had been kept in "view" all the way to its landing.[57]

SCR–602, Lightweight Warning Radar

Thinking in terms of defense had set the tone of American radar efforts early in 1942. Fear for the west coast and for the Panama Canal had led the military to demand long-range detectors and GCI radars, even the fixed long-wave gear of the early British CH and CHL/GCI sets. But as 1942 wore on, concern over passive air defense of the United States coast and possessions gave way to thinking in terms of Allied offen-

[56] (1) Guerlac, Radar, pp. 635–36 (Sec C, Ch. VII, pp. 32A–33). (2) See above, pp. 96–97.

[57] Guerlac, Radar, pp. 637–39 (Sec C, Ch. VII, pp. 34–36). Incidentally, it was the SCR's–582 and 615 in the Canal Zone which were first used extensively to detect distant storm clouds and so opened up the possibility of weather forecasting by radar aid. *Ibid.*, pp. 612–13 (Sec C, Ch. VII, pp. 10–11).

sives. A fresh reappraisal found long-range detectors necessary at only a few places, most notably, in Panama. In general the SCR–270 or 271 continued to prove good enough. Even Saville had acknowledged that the 270 was good in isolated uses, as on an island, for aircraft detection.

But Watson-Watt's belief that such long-wave radars alone could attain great ranges was soon disproved by the new microwave ground sets. And the Air Forces' original stress upon mobility, which had led to the first American aircraft detector, the mobile SCR–270, received renewed emphasis in 1942 as military men planned to invade hostile shores. Contemplating attack upon distant beaches where air raids could sow vast harm among congested landing areas, the airmen gave thought to a set which might be taken onto a beachhead in pieces, carried by a few men who could assemble the radar in an hour or two. Its power and range, of course, would be limited but would suffice. The AAF, with its predilection for British long-wave sets, turned to them once again, to the British LW, or lightweight warning radar which the Signal Corps copied as the SCR–602, in time for use in North Africa.

Early in 1942 Saville had set forth the airmen's requirement for an "equipment similar to the British light mobile or portable early warning set." But this LW radar prototype was not yet in production. Maj. Gen. James E. Chaney had cabled from England that the British would send two sets to the United States as soon as they became available.[58] In February 1942 General Olmstead asked for information about this British "light mobile and portable aircraft warning RDF set." Two months later he had gotten nothing, whereupon he had asked the Chief of Staff to make another petition. But even as he asked, the blueprints were at last on their way, followed late in June by one of the first British prototypes. On 25 June General Eisenhower in London notified Washington that Lt. W. W. Debenham, a Signal Corps officer who had been working with British radars, was that night leaving Prestwick, Scotland, the English terminus of the transatlantic air ferry. With him he had 1,000 pounds of lightweight warning radar.[59] While the Signal Corps Radar Laboratory at Camp Evans, Belmar, New Jersey, looked over this LW, the AAF asked in mid-July for 100 service test sets and 100 spares. The AAF doubled the figures before the end of the month, asking for 200 sets from American sources as well as for 200 sets from the British. These last the Signal Corps contracted for with the Canadian firm, Research Enterprises Limited, at $15,000 each, delivery to begin in the following January.[60] Thus the SCR–602 Type 1 became another British copy, the last copy of a British radar and the

[58] Memo, Norman Abbott, Assoc Radar Engr, for O/C Radar Div, 12 Feb 42, sub: Meeting to discuss American GCI equip. SigC 413.44 British Ground Control GCI (RB–2330).

[59] (1) Ltrs, CSigO to ACofS G–2, 25 Feb and 15 May 42, sub: 100 KW ASV transmitter (British); (2) Ltr, U. S. Embassy, London, Special Observer [Chaney] to CSigO, 14 Apr 42, sub: LW Set—RDF; (3) WD Msg 2332 (CM–IN 8254), Eisenhower to AGWAR, 25 Jun 42. SigC 413.44 SCR–602 No. 1, Feb–Nov 42 (RB–1526).

Lieutenant Debenham contributed much to the design of this radar before his death, somewhat later, at Fort Monmouth. Incl 1 with 1st Ind, SCEL to Chief of Tech Info OCSigO, 30 Jun 52, cited n. 47(3).

[60] Ltr, CG AAF to CSigO, 17 Jul 42, sub: Proc of light portable radar, radio set SCR–602; (2) Ltr, CSigO to CG AAF, 30 Jul 42, sub: Proc of radio set SCR–602, with 1st Ind, CG AAF to CSigO, 5 Aug 42. SigC 413.44 SCR–602 No. 1, Feb-Nov 42 (RB–1526).

last copy of a long-range set (wavelength about one and a half meters, on 212 megacycles) which the Signal Corps would have to produce for the AAF.

By mid-1942 the pressure for LW radar was becoming tremendous and, as so often happens with new developments, the demand built up suddenly with little advance warning to the laboratory and procurement officers. At the outbreak of World War II the American Army had no really portable early warning radar. It had only the heaviest kind of detectors. Even the mobile 268 and 270 could go only where heavy trucks could transport them. To ship them over water and to land them was no light matter. Obviously their weight and bulk would be handicaps in the island hopping, in the diversified landing and other highly mobile operations which would figure so prominently in World War II. What the Army needed was a detector which could be packaged for hand-carrying by a small number of men, landed with the first waves of an assault, and assembled quickly for operation whether in the early stages of an assault or in moving through jungles. LW radar was wanted now, wanted desperately, and the pressure for it led to an amazing variety. Contemplating invasions, the General Staff and the Air Forces wanted at once all the sets they could get (their plans already called for upwards of 1,000 sets). The Air Forces gave them priority over all other sets except IFF radar. They wanted them lightweight, and still lighter, and they wanted sets operating at different frequencies in order to minimize the likelihood of jamming, an art in which the enemy was becoming proficient, especially in the 200-megacycle bandwidth of the original British LW.

Before the end of the year the LW types numbered no less than ten, ten varieties of SCR–602, either in production or under development by Research Enterprises, by the Navy, by the International Telephone and Radio, by the Bell Laboratories, by Radio Corporation of America, by General Electric, and by the Signal Corps Radar Laboratory. The ten types varied in frequency from the 212 megacycles of the long-wave British prototype to 1,000 megacycles. They varied in weight, too, from the 1,200 pounds of Type 1, which was a copy of the British LW, to a 250-pound parachute set (SCR–602 Type 7) which General Electric was developing.[61]

Thus, though last of the long-wave radars, the SCR–602 was not least in anything but size. Indeed, in its several forms, it came to be one of the most important and numerous of aircraft detectors. Only the first 25 off the production lines of Research Enterprises Limited were exact copies of the British LW prototype. They were designated SCR–602–T1. The next 250 productions differed in design and in designation, which was SCR–602–T6. Thereafter, still further modifications of this Canadian-built British copy resulted in yet another change of designation, SCR–602–A. Of all these types of the SCR–602, it was Type 8, the unique Signal Corps development, that proved to be the best.[62]

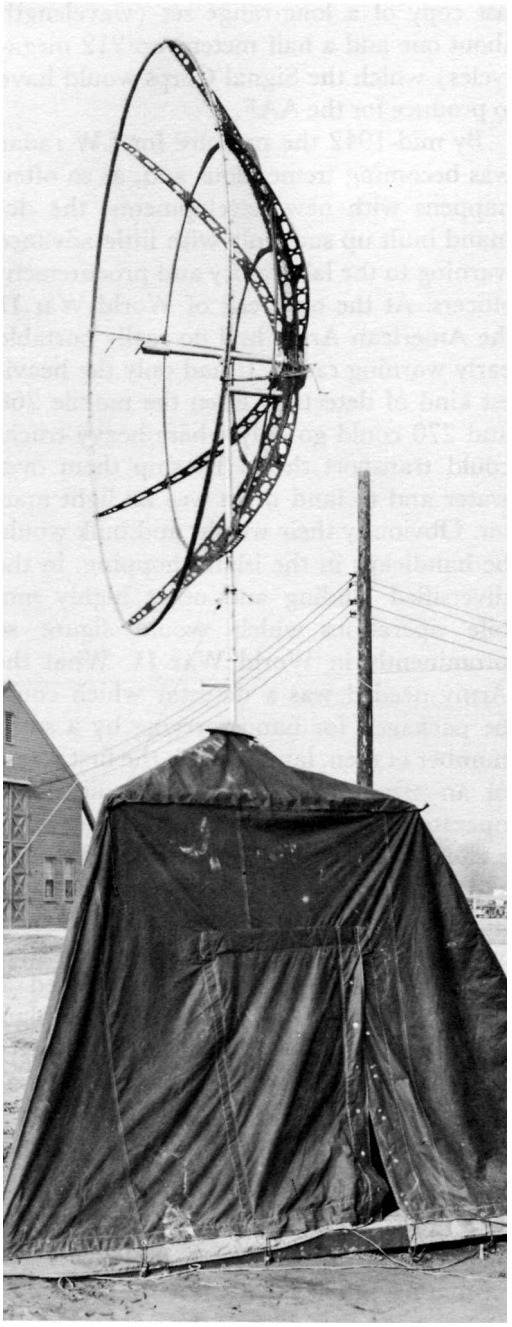
This Signal Corps creation, SCR–602–T8, was destined to become the most efficient set of its type, used late in World War II as the AN/TPS–3 (the subsequent Army-Navy terminology: T for transportable, P for radar, S for search). For some time prior to 1942 the Signal Corps Lab-

[61] Ground Radar Rpt 1, Wallace Clark & Co. to Gen Colton, 14 Jan 43, SCR–602. SigC 413.44 SCR–602 No. 2, Dec 42–Mar 43 (RB–1709).

[62] SigC R&D Hist, cited n. 11(4), IV, Pt. 3, projs. 426–A, B, C and D.

oratories had been working on 600-megacycle radar, radiating waves 50 centimeters long, intermediate between long-wave and microwave radar. Dr. Harold A. Zahl, a Signal Corps radio engineer, had developed vacuum tube VT–158 in Signal Corps' own thermionic laboratory (organized in 1940 in order to turn out radar tubes of types so complex that industry hesitated to attempt them). The VT–158 was capable of generating 50-centimeter waves with remarkable power output in the order of hundreds of kilowatts, remarkable power for a triode-type tube at that date. The Laboratories tried the tube in the various sets, such as in the SCR–268. But not until the AAF set up requirements for an LW did the VT–158 really find its place, in SCR–602–T8. Type 8, triumphing, would win even AAF as well as British acclamations, a triumph indeed for the Signal Corps. Asking for 200 sets, Air Vice Marshal of the Royal Air Force, R. B. Mansell, told General Colton that "this development is one of the most important in Ground Radar technique in recent years and that the designers are to be congratulated in producing a receiver, display and high power transmitter in a single unit measuring only 42 inches by 20 inches by 20 inches." SCR–602–T8, or the AN/TPS–3, was Signal Corps' most substantial contribution to radar after the ancestral Army sets SCR–268, SCR–270, and SCR–271.[63]

[63] (1) SigC R&D Hist, IV, Pt. 3, proj. 426–D. (2) Historical Report of the Signal Corps Engineering Laboratories (Ft. Monmouth, 1944), pp. 267, 297–303. (3) Capt Harry M. Davis, Signal Corps Development of U.S. Army Radar Equipment, Pt. III, Long Range Radar, SCR–270–271 (1945), SigC historical monograph A–3, p. 81. (4) Lt Col Harold A. Zahl and Maj John W. Marchetti, "Radar on 50-Centimeters," *Electronics*, XIX (January, 1946), 98ff. (5) Ltr, Mansell to Colton, 12 Jun 43, sub: Radar set SCR–602–T–8. SigC 413.44 SCR–602 No. 3, Apr–Jun 43 (RB–2027).



SCR-602 TYPE 8 LIGHTWEIGHT WARNING RADAR

The remainder of ground radar and all airborne radar in World War II is essentially, as far as the initial stages of research and development are concerned, a story of other institutions such as industrial laboratories and especially the Radiation Laboratory, under Division 14 of the National Defense Research Committee, within the Office of Scientific Research and Development. The Signal Corps kept in touch with the work and took over the final details of development, inheriting of course all the multitudinous adjustments necessary to meet military requirements and to fit the laboratory design for mass production. So it was, as already shown, with SCR–582 and 615. They were the Radiation Laboratory's offspring, although the Signal Corps made many tests and improvements upon them thereafter to suit military needs and saw to all the multifarious details of procurement and distribution. So it was also with two most significant ground radars which the Radiation Laboratory developed for use in World War II: the SCR–584 and the MEW, short for microwave early warning, or in AN terminology, the AN/CPS–1.

SCR–584, Microwave Tracking or GL, Gun-Laying Radar

The SCR–584 was a gun layer, the most successful single application of the microwave ten-centimeter technique to ground fighting in World War II. It could automatically track an unseen target at night or in cloud or fog, supplying range, azimuth, and elevation data to a gun director, which aimed the guns of a battery. It doubled the usefulness of big guns. From the time the 584 first appeared on the Anzio beachhead—where it enabled gunners to play havoc with the air attacks of the enemy, who had been successfully jamming the SCR–268's there— it was the indispensable aid to Allied antiaircraft gun batteries. The 584, in co-operation with the proximity fuze, which was actually a tiny radar built into a projectile, was to nip the buzz bomb menace and find new applications—detecting land targets, tanks, and vehicular convoys at night.[64] More 584's were to be built in World War II than any other American radar, except the first, the patriarchal SCR–268.

Subsequent to first tests of the SCR–584 at the Signal Corps Laboratories in December 1941, the XT–1, the experimental prototype of the 584, was returned to the Radiation Laboratory. There the scientists refitted it with a larger six-foot antenna dish and stepped up its range.[65] Next, the set went to Fort Monroe, Virginia, for further tests by the Antiaircraft Artillery Board, then under the Coast Artillery Corps. This in March 1942. Any skepticism which had arisen from the first tests at Fort Monmouth in December 1941, when the range of the set had proved disappointing, evaporated during these second tests at the mouth of the Chesapeake Bay. The range was now far greater than the 15,000-yard minimum the service users required. The accuracy was uncanny. And the set was stalwart, even in its laboratory-built prototype form. While it stood upon the sea wall at Fort Monroe, overlooking Hampton Roads, a violent storm came up; waves beat against the wall and salt spray doused the XT–1. But the morning after, as the set dried out, it went into action as usual, none the worse for its exposure. The Antiaircraft Artillery

[64] Baxter, *Scientists Against Time,* pp. 114–15, 145, 214, 235.

[65] Guerlac, Radar, pp. 699–700 (Sec C, Ch. VIII, pp 14–15).

Board concluded: "The Radio Set XT–1 is superior to any radio direction finding equipment yet tested for the purpose of furnishing present position data to an antiaircraft director." The Antiaircraft Artillery Board urged the Signal Corps to standardize the set and procure it in sufficient quantities to supply one to each Antiaircraft Artillery gun battery.[66]

Two weeks later General Olmstead recommended that XT–1 be standardized as gun layer SCR–584, simultaneously asking a change in the fifth supplemental national defense appropriation for the fiscal year 1942 whereby 622 sets might be purchased with funds that had been already allocated to another gun-laying radar, the SCR–545. This he had urged after a conference in his office a few days before with representatives of General Electric, Westinghouse, the National Defense Research Committee, and the Antiaircraft Artillery Command. General Electric and Westinghouse had been so optimistic as to estimate *completion* of the 622 sets by July 1943, whereas the bitter fact would be that by then actual *delivery* would scarcely have begun.[67]

There were cogent reasons for the delay of the SCR–584, reasons arising out of both preproduction engineering changes and priority problems during production itself. Some of these the Signal Corps inherited from the Radiation Laboratory; others resulted from the military characteristics which the users desired the Signal Corps to satisfy.

In the spring of 1942 the original XT–1, despite its potencies, was still a long way from a usable practical military set. When the Antiaircraft Artillery Board members wrote their report after testing the set in March 1942, they commented that the XT–1, being a laboratory model, contained many makeshift parts which rendered it unfit as it stood for field use. They recommended some sixteen changes needed to bring the set up to the military characteristics they desired in the production gun layer. For example, the Antiaircraft Artillery men wanted tracking to be as automatic in range as it was in azimuth and elevation (the laboratory model required hand-aided tracking in range). They wanted the antenna mount, its driving mechanism and pedestal, completely redesigned, a little matter that was to prove a severe engineering and production problem.[68] They wanted this set, intended for short-range gun laying, to include provisions for early warning, illuminating upon a PPI-type oscilloscope the reflection of planes many miles away, long before they came within gunshot.[69]

In asking this double function, early warning and gun laying combined in one radar, the artillerymen were not just con-

[66] Proj. 1218, Col Bowen, AAA Bd, CAC, 20 Mar 42, sub: Test of radio set XT–1. SigC 413.44 AAA Bd Rpt 1218 on SCR–584 XT–1 (RB–1524).

[67] 1st Memo Ind, CSigO to Chief of Standards Br, Resources Div, and Chief of Development Br SOS, 7 Apr 42 (basic missing). SigC 413.44 SCR–584 XT–1 No. 1, Dec 41–Apr 42 (RB–1386).

[68] Neither General Electric nor Westinghouse could undertake this task. The United Shoe Machine Corporation and the American Machine Foundry Corporation could not produce in sufficient quantities. Ultimately, the Chrysler Corporation did the job. As subcontractor to General Electric and Westinghouse, Chrysler produced for all SCR–584's the trailer and the precision mechanism to elevate the antenna dish, to stabilize and rotate the dish itself, and to spin the dipole antenna within the dish at nearly 2,000 revolutions a minute. Guerlac, Radar, pp. 703–04 (Sec C, Ch. VIII, pp. 18–19).

[69] Memo, SPSRB–1 for Lt Col George F. Metcalf, 17 Nov 42, sub: Development of radio set SCR–584 (NDRC Proj. XT–1). SigC 413.44 SCR–584 XT–1 No. 3, Sep–Dec 42 (RB–1523).

juring up engineering and production troubles to harass the Signal Corps. They were following a precedent. The SCR–545, which the Signal Corps and Western Electric already had under development for the Antiaircraft Artillery Command, incorporated this double function, as did the British GL–3. Both the British set and the American counterpart employed two different frequencies: (1) a low frequency emanating long waves for long-range early warning, and (2) a higher frequency radiating ten-centimeter microwaves for short range precise gunfire data.[70]

This use of two different frequencies for two quite different functions was a decided complication, which the designers of the 584 discarded. The Radiation Laboratory scientists found that they could extend the range of the microwave XT–1 up to 90,000 yards, quite enough for early warning purposes. Then, as targets flew within about 32,000 yards, the set could begin to serve as a gun layer; the antenna would lock onto the target's reflection, automatically follow it and feed azimuth and elevation data to the gun directors.

All this could be done without recourse to long waves. The ten-centimeter waves of the 584 could do everything longer waves could do, and do it much better. The SCR–584 was freed from the handicaps which inevitably accompanied long waves, siting troubles especially. There were no nulls or blind spots. There were no limitations upon low coverage, a boon when German buzz bombs began to fly in 1944, darting in level courses only a few hundred feet above the ground. The 584 tracked them, whereas long-wave radar would have failed utterly.

During the summer of 1942 the Signal Corps Radar Laboratory labored with the production design of the many components of the SCR–584. The laboratory report for August listed as complete the designs for: [71]

power unit
automatic tracking mount
receiver power
azimuth and elevation tracking mount
amplidyne mount
remote video amplifier
position indicator

Nearly completed were the designs for:

modulator
pedestal and antenna
receiver
magnetron
positioning control unit

Still in the development stage were the designs for:

connection diagram
equipment assembly
wiring
interconnection cables

Consider for a moment the complexity of such a device. Basically any radio or radar consists of three or four elements: a power supply, an antenna, a transmitter, and a receiver. As contemplated in the summer of 1942, the SCR–584 required about 140 electronic tubes, of about a score of types. The basic transmitter required only one tube, the very powerful cavity magnetron which made centimeter radar possible. The basic receiver did not require an excessive number, a total of 14. But around the receiver-transmitter core with its total of 15 tubes thronged a dizzy array of special circuits, each doing a vital job and each re-

[70] (1) Memo, Norman Abbott, OCSigO, for O/C Radar and Aircraft Com Br, 26 Apr 42, sub: SCR–545 mock-up. SigC 413.44 SCR–545 No. 1, May–Nov 42 (RB–1520). (2) Guerlac, Radar, p. 705 (Sec C, Ch. VIII, p. 20).

[71] SCRL Prog Rpt, Aug 42, proj. S–29.5, p. 40.

quiring its own gamut of tubes. For example: [72]

	Tubes
Azimuth and Elevation Tracking	16
Automatic Tracking Unit	5
Altitude Converter (Control Unit)	6
Altitude Converter (Power Unit)	8
Modulator	22
Range Power	10
PPI Power	7
PPI Unit	18
PPI Scope	1

All this mass, together with operational and maintenance accessories, was packed into a van which housed the operators. The van, its load, which included IFF equipment (RC–184), together with a trailer containing an electric generator driven by its own gasoline engine, constituted the SCR–584, ten tons in all. Small wonder that one half the total cost of a large 90-millimeter antiaircraft gun battery (four guns) went to the radar equipment, valued at $100,000.

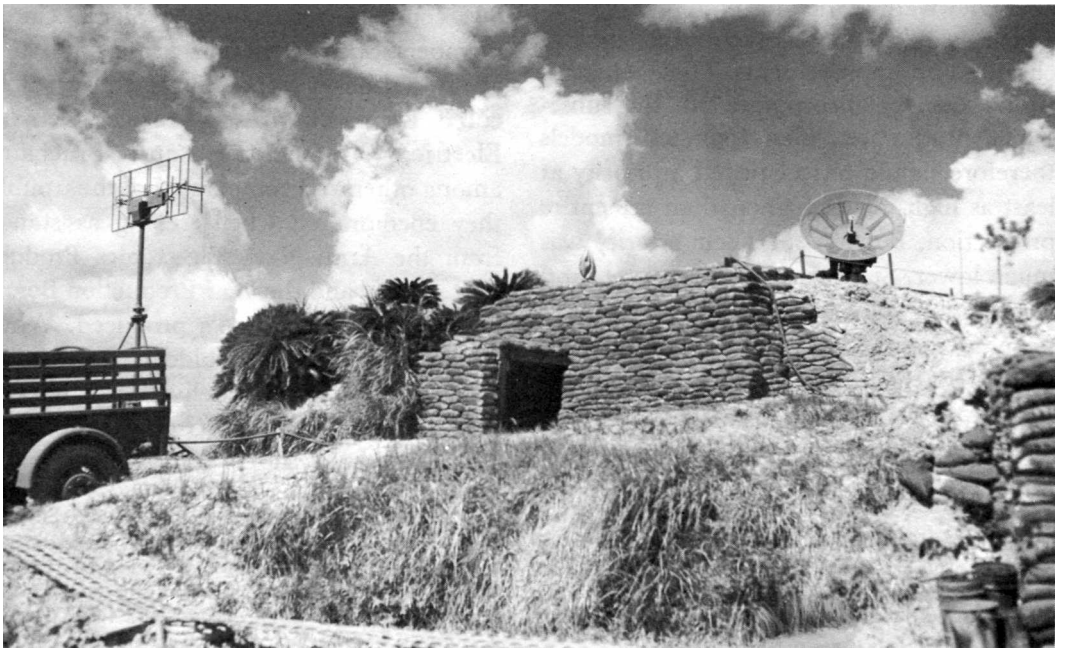
Despite its superiority, the SCR–584 did not go into production until mid-1943. This was not because of any failure on Signal Corps' part to push matters. It pushed hard from the very first. For example, the Signal Corps succeeded during April and May 1942 in getting the Army to stop production of a searchlight director radar, the ten-centimeter SCR–541, and to divert this effort into the 584. The Coast Artillery Corps had long pressed for a new searchlight director, lighter in weight and handier than the original SCR–268. But as the SCR–541 approached production in 1942, the Army found that in some ways the new microwave set would be no improvement over the 268; for example, it would be nearly as heavy. Furthermore, the 541 tied up components, production facilities, and raw materials which could be put to better account in the fabrication of the much more valuable SCR–584. As early as April, therefore, Rives, Metcalf, and others in the Signal Corps Radar Division in Washington had debated with representatives of the Services of Supply, Antiaircraft Artillery Command, Ordnance, Westinghouse, and War Production Board, with a view to recommending cancellation of a contract which the Signal Corps had made with Westinghouse for some four to six hundred SCR–541's. It was Signal Corps' contention that the radio parts accumulated for the 541, together with raw materials, factory production facilities such as tools, space, workers, and so on, should be channeled into the production of the new gun layer SCR–584.[73] This recommendation, as just noted, was carried out.

But another suggestion, the one General Olmstead had made a few days earlier, that 584's be purchased with SCR–545 funds, was not adopted. The order for 273 SCR–

[72] Ltr, CSigO to Dir of CESL, 10 Dec 42, sub: Vacuum tube list of SCR–584 with Incl, Vacuum tubes in radio set SCR–584–( ), 18 Dec 42. SigC 413.44 SCR–584 XT–1 No. 4, Jan–Mar 43 (RB–1707).

[73] Summary of Conf on Radio Set SCR–541 at OCSigO, 29 Apr 42, signed by Col Metcalf. SigC 413.44 SCR–584 XT–1 No. 1, Dec 41–Apr 42 (RB–1386).

SCR–541 and 547 were two of Army's earliest microwave radars. The 541 had developed out of the combined efforts of the Signal Corps, the Radiation Laboratory, and Western Electric. The 547 was a radar range finder. Such a set had been proposed for use with antiaircraft gun batteries at least as early as 1938. Not till mid-1941 did the NDRC and the Bell Laboratories bring out the SCR–547 operating on ten centimeters. Called Mickey Mouse because of its two earlike dish antennas, SCR–547 saw service in the war until replaced by the SCR–584. (1) Incl 1, with 1st Ind, SCEL Hq to Chief of Tech Info, OCSigO, 30 Jun 52, cited n. 47(3). (2) SigC R&D Hist, IV, Pt 2, proj. (413)12–17.1.



RADAR SETS SCR-545 (ABOVE) AND SCR-584 (BELOW). *Note IFF antenna in left foreground of each photograph.*

545's remained, and they would begin coming off production lines in 1943 a few weeks before the 584's. No more were ordered, however. Meanwhile, the 584 went on order, to the number of nearly 3,000, with high hopes from Maj. Gen. Joseph A. Green, Antiaircraft Artillery commander. "By use of this equipment," Green commented, "antiaircraft gun batteries will, for the first time, be capable of directing accurate fire against unseen targets." One set he considered a must for each gun battery.[74]

Neither the 3,000 or so sets which General Green hoped to get in 1943 nor even General Olmstead's more sober figure of 1,175 would attain completion by 1943's end. As already pointed out, priority quirks during 1942 were one cause. Priorities which were supposed to speed the things most needed in this case caused delay. Four test models had been put on order with General Electric in April 1942 for early delivery. They were needed for preliminary tests, which would inevitably reveal desired changes and improvements. These changes would then be incorporated in the subsequent production. The four test models therefore should have enjoyed a priority at least as high, if not higher, than the entire production. But not so. Their priority was much lower. Summer came and went, and yet the four pilot test models failed to appear. General Olmstead thereupon complained to the Army and Navy Munitions Board priority makers that the reason was clear—production of the four sets suffered from a lower priority, AA–3, than the rest of the 584 program, which enjoyed nearly a top priority of AA–1. Illogical that the test models, upon which the entire production awaited, should languish unrecognized by the very priority makers who evaluated the rest of the program at AA–1. The commanding general of the Army Ground Forces was aroused. He particularly wanted the first four sets in order to initiate training. Otherwise, the first procurement sets now expected in April 1943 would have no one who knew how to operate them, however desperate the need of combat Antiaircraft Artillery units. He asked General Somervell to grant the manufacturer, General Electric, top AAA priority.[75]

One reason for the low priority was secrecy. Priority makers in the Army-Navy Electronics Production Agency and the War Production Board could not get the facts. The Signal Corps' contracts with manufacturers stipulated, for example, that delivery schedules and other data touching the 584 could be made only to Signal Corps members. Such restrictions arose again and again, whenever secret equipment was procured. Representatives of Chrysler, General Electric, Westinghouse, and Fruehauf, among others, all complained of the trouble they encountered when seeking assistance from the Army-Navy Electronics Production Agency and the War Production Board toward getting the 584's produced. Why? Because they were forbidden to provide these agencies with the delivery schedules of highly classified Signal Corps equipment. Yet how could the priority judges make

[74] Ltr, Green, Hq AA Comd, to CG AGF, 1 May 42, sub: Increased proc of radio sets SCR–584 in lieu of radio sets SCR–541, with three Inds. SigC 413.44 SCR–584 XT–1 No. 2, Jun–Aug 42 (RB–1387).

[75] (1) Ltr, CSigO Chairman of ANMB Priorities Sec, 24 Aug 42, sub: Priorities on radio set XT–1A (SCR–584); (2) Ltr, CG AGF to CG SOS, 8 Sep 42, sub: Priority rating on contract for radio sets XT–1 (A). SigC 413.44 SCR–584 XT–1 No. 3, Sep–Dec 42 (RB–1523).

equitable judgments if they could not be adequately informed? [76]

The Signal Corps' complaint about the lower priority of the first four 584's touched off a minor explosion over the GL radar program. The explosion uncovered some interesting things, as, for example, the fact that the allocation of machine tools to electronic production was nearly nil. The men who made allocations were vastly impressed by the need for aircraft, and they allotted 60 percent of all machine-tool facilities to aircraft plant expansion in 1941–1942, but none to plant expansion for the manufacture of the electronics equipment which the aircraft needed. Yet this equipment represented a large percent of a bomber's cost (it would approach 33 percent by the war's end). Likewise, ordnance got large allocations, but not GL radar, though, as pointed out earlier, it would soon constitute one half the cost of a 90-millimeter gun battery. Not till late 1942 did Signal Corps production needs begin to win recognition among machine-tool allocators, when the Corps was granted a parsimonious 4 percent. No wonder manufacture of the huge radars and of other complex electronic devices lagged, while the Army screamed for them and glowered at the Signal Corps as the most laggard of suppliers. Ignorance and secrecy doubtless helped to prolong the delay. Everyone knew airplanes needed aluminum and guns needed steel, together with myriads of machine tools to fabricate the metals. But not everyone knew about the electronic devices that controlled and guided the massive metal mechanisms coming off aircraft and ordnance production lines. It was easy to see the growing body of the war juggernaut and add to it, but it was not so easy to perceive that it had eyes and a network of electronic nerves of radar. Besides, many of the electronic components, and all of the radar, were secret. Most men, even those in uniform, were not permitted to see it, or only dimly.

Airmen concerned over air defense had for many months been making clear their need for electronic equipment. Colonel Saville, for example, had been especially insistent, with the strong support of the Secretary of War. Yet it was not till late 1942 that General McClelland in AAF headquarters asked General Arnold to demand more money, more factories, more tools for electronics, just as the AAF chief had done months before for aircraft. By now, late in 1942, the artillerymen began to clamor too, having just begun to learn the possibilities which GL radar offered. At the same time the Air Forces, backed by Secretary Stimson himself, had gotten the best priorities obtainable for much of their airborne electronic needs. But the priority makers had not yet given much thought to ground radar for artillery and very little thought at all to the necessary preliminaries to the allocation of raw materials and machine tools. At the level of the Joint Chiefs of Staff, Army Ground Forces needs in electronics

[76] Memo, George P. Allison, Electronics Br OCSigO, for Allison, 9 Mar 43. SigC 413.44 SCR–584 XT–1 No. 4, Jan–Mar 43 (RB–1707). Similarly, production of spiral-four desperately needed for the North African invasion lagged in the summer and autumn of 1942 because "the secrecy surrounding the operation was so great that this requirement could not be discussed sufficiently to obtain the needed priorities." Here the block was the secrecy blanketing the invasion rather than the equipment. But the adverse effect on production was the same. Capt Sidney L. Jackson, Fixed Wire, NATOUSA: Chapter I of Theater Fixed Networks (1944), SigC historical monograph E–1a, p. 12. SigC Hist Sec File.

were consistently overridden during 1942 by the Navy and the Air Forces.[77]

During the autumn of that year, correspondence flew back and forth between the heads of the Antiaircraft Artillery and the Army Ground Forces recounting the significance of the new gun-laying and other ground radars in a manner which reveals how new it all was to the ground Army. The high-ranking correspondents took pains to explain the sets, what they were, and what they did. The sets, they wrote, were essential for protection of harbors and of invasion efforts generally.

Mighty important, then, was this new application of radar if overseas invasions must depend on it. General Eisenhower would soon be writing back from North Africa saying that he must have something better than the SCR–268 for gun laying, a refinement for which the 268 was never intended, but for which it proved better than no radar at all.[78] Thus the land Army was slow finding out how badly it needed gun-laying radar, just as the Air Forces had not appreciated airborne radar until the turn of 1940–1941. And until the Army found out its needs and brought pressure to fill them, the funds and the support which the Signal Corps had to have in order to develop and produce the equipment simply were not forthcoming. When the Army belatedly found out what it wanted and how badly, then it wanted the equipment immediately, if not sooner. Naturally and lamentably, it had to wait, and the Signal Corps had to endure its fulminations, a state of affairs to which military supply agencies must, in the nature of things it seems, become resigned.

On 8 October General Green, in the headquarters of the Antiaircraft Artillery Command, complained to the Commanding General, Army Ground Forces, that on information from the Chief Signal Officer he had discovered he would not get any GL's, either SCR–545 or SCR–584, until some six or seven months after the delivery date originally promised. If the sets arrived too late, it would be too bad, to state it mildly. As Green put it:

> If radar equipment is to be used to advantage in this war, the development and procurement of newer types of radar equipment must be pressed to the utmost, and the importance and urgency of this work should be impressed on all concerned. It is strongly recommended that every effort be made to expedite the antiaircraft radar program, both in development and procurement, and that particular stress be placed on the procurement of gun control sets and the development and procurement of a new searchlight control set.

General Moore, writing for the Commanding General, Army Ground Forces, agreed. Adding details about other Coast Artillery radars, the 296 and the 582 (whether for his own enlightenment or for that of General Somervell to whom he addressed a first indorsement on Green's letter), he attributed the delay to the action of the priority makers.

> This procurement program [of the 296, 545, 582, and 584] was disrupted by the action of the Precedence Committee of the Com-

[77] "In the Precedence Conferences, Joint Communications Board, JCS, the Ground Forces were consistently voted down," commented Col. Byron A. Falk, who was the chief of the Precedence Branch of the ANEPA during the last half of 1942. OCMH Critique of MS, p. 29. SigC Hist Sec File.

[78] (1) Ltr, Lt Gen Lesley J. McNair, AGF, to CG SOS, 13 Feb 43, sub: Emergency program for the early proc of a limited number of SCR–584 and SCR–545 antiaircraft radar sets. SigC 413.44 SCR–584 XT–1 No. 4, Jan–Mar 43 (RB–1707). (2) Craven and Cate, *The Army Air Forces,* II, 85.

bined Communications Board which set up a precedence list for the manufacture of all radar equipment and relegated Coast Artillery radar procurement to Categories III to IX inclusive, thereby delaying all Coast Artillery radar manufacture for many months. By this action the procurement of Radio Set SCR–296 was stopped and certain critical parts were diverted for the manufacture of radar equipment in categories I and II [doubtless aircraft radar] in spite of the fact that a contract had been let, manufacture was in progress and many of the SCR–296's were nearing completion. Similar action has delayed the initiation of procurement of Radio Sets SCR–584 and 545 several months.

General Moore urged Somervell to take steps "to correct the existing situation" and to jack up the precedence of these GL radars "to a point which will assure uninterrupted procurement in the immediate future." He regarded such sets as vital safeguards in the invasions which the military chiefs were contemplating. "Our harbor defenses," he wrote, "must have the necessary antiaircraft fire control apparatus to assure a safe haven for allied naval forces. Our antiaircraft units must be supplied with gun laying radars before they can enter combat with any reasonable prospect of success."

Somervell, no authority on electronics, sought information from the electronic section of his empire, the Signal Corps—information "upon which a reply may be drafted." Colton drafted the reply. So far, he showed, the delays at which Green and Moore chafed were not all the consequence of priority maladjustments at the production level. They were rather a consequence of a priority oversight at a lower, and earlier, stage in the development that resulted in insufficient machines to tool up production plants. The changes which the Antiaircraft Artillery Board had wanted made in the original XT–1, when it had tested the sets in March 1942, called for $10,000,000 in tools alone, before the raw materials were assigned and before production could even begin. Yet the Signal Corps had been favored with no such tool allotment. What it had gotten for its manufacturers it had obtained by diversion from other services. That had been true till very recently when the Signal Corps had been allowed a 4-percent tool allotment, still ridiculously small when one considered the vastly larger percentage electronics shared, on a cost basis, with the rest of the war production effort.[79]

The little matter of low priority for the pilot models was only one obstacle. There were many others: shortage of raw materials and critical components, such as tubes, for example, which consumed such rarities as tantalum, molybdenum, and tungsten and whose manufacture was most delicate and exacting. Then there were selsyns, tricky little electric motors and co-ordinating mechanisms which enabled the different parts of a large robot to keep in perfect step, its motions perfectly synchronized. The order for 584's was going to require some 60,000 selsyns immediately. Still another tricky component, rejoicing in the name amplidyne, consisted of electrical motors and gears which enabled heavy platforms bearing radar antennas and mounts to rotate, smoothly, precisely, whether fast or slow. The obstacles to production scheduling which all these complexities presented

[79] Ltr, Green to CG AGF, 8 Oct 42, sub: Radar Development, with 1st Ind, Gen Moore, Chief of Ground Rqmts Sec (writing for CG AGF) to CofS, 22 Oct 42; 2d Ind, Somervell to CSigO, 31 Oct 42; 3d Ind, Colton, Actg CSigO, to CG SOS, 24 Nov 42. SigC 413.44 Gen No. 3 (RB–1533).

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Metcalf summed up for General Somervell late in September 1942: [80]

> Delivery of these sets [2,750 SCR–584's and 273 SCR–545's, by General Electric and Western Electric respectively] was previously scheduled to be completed by the end of 1943. However, the production of Radio Set SCR–584, which comprises the bulk of this procurement, is contingent upon a great many uncertain factors, for example, the extension of plant facilities and provision of assembly of these sets and for production of the special semi-trailer and precision antenna elevating and tracking mechanism, the allocation of various critical raw materials and procurement of such critical component parts as tubes, selsyns, amplidynes, etc. Accordingly, on the basis of the best information now available, the Chief Signal Officer estimates that no more than about eleven hundred seventy-five (1175) Radio Sets SCR–584 can be safely counted upon for delivery by the end of 1943.

Thus, production of Signal Corps equipment such as this giant microwave gun-laying radar was big business indeed, in which many an agency participated. In one of the early procurement debates respecting the SCR–584 there sat representatives of the Signal Corps Radar Laboratory, the Navy, the War Production Board, the National Defense Research Committee, Westinghouse, General Electric, and Chrysler. Rives and Elder presided, while Dr. Bowles, Secretary Stimson's radar consultant, attended.[81] Eventually, the difficult mount design, with all the exacting requirements that daunted several manufacturers, was accepted by the Chrysler Corporation. General Electric and Westinghouse, each with a contract for 1,375 sets, began production, and by May 1943 the first production SCR–584 was to arrive at the Signal Corps Radar Laboratory.[82]

MEW, Microwave Early Warning Radar

As the gun layer SCR–584 was one brilliant application of microwave radar to ground military use, so was another, MEW, also a Radiation Laboratory ten-centimeter development. MEW never received an SCR number because it was typed after the Army-Navy nomenclature replaced the SCR designations, and so its official military title came to be AN/CPS–1 (C for air-transportable, P for radar, S for search). Its development began in 1942 as an outgrowth of microwave research at ten centimeters applied to detection of aircraft at very great distances. Named microwave early warning, it became abbreviated to MEW. Its range from the start excelled that of all other radars and vanquished forever any claim that long range might be the exclusive prerogative of long-wave sets. Moreover, older long-wave, long-range radars were notoriously affected by their site. They were not very accurate either, and they could be jammed easily by enemy transmitters operating on their relatively low frequencies. All these defects the MEW swept aside.

MEW introduced a new type of antenna and reflector. The majority of previous microwave sets had employed a dishlike

[80] (1) Ltr, CSigO to CG SOS, 25 Sep 42, sub: Rqmts for radio sets SCR–545 and SCR–584. (2) Ltr, CSigO to Dir of SCRL, 2 Oct 42, sub: Selsyns required for radio set SCR–584. A single SCR–584 required 16 selsyns, 8 motors, and 2 amplidynes. Ltr, Dir of SCRL to CSigO, 7 Sep 42, sub: Amplidynes and selsyns. SigC 413.44 SCR–584 XT–1 No. 3, Sep–Dec 42 (RB–1523).

[81] SCRL, 12 May 42, Summary of Conference on Procurement of Radio Set SCR–584 at OCSigO, 8 May 42. SigC 413.44 SCR–584 XT–1 No. 1, Dec 41–May 42 (RB–1386).

[82] Camp Evans Sig Lab Prog Rpt, May 43, proj. 1–584, p. 27.

antenna reflector called a parabola. MEW employed a reflector which resembled a cylinder or pipe cut in half lengthwise. Instead of a dipole antenna which radiated from the center or focus of the dish-type reflector, MEW employed a long pipe or wave guide running the length of the half-cylinder reflector. The wave guide conducted radiations from the transmitter's magnetron and sprayed them, through a number of slots in the guide pipe, onto the concave surface of the half-cylinder reflector, whence flashed forth a flattened beam. Some of the transmitter and receiver components were attached directly to the back of the large antenna shell, so that the set literally perched on its own antenna array. MEW had a tremendously high power output of 500 kilowatts at impulse peaks.[83]

It was the members of the so-called High Power Group (HPG) at the Radiation Laboratory who developed the MEW, and just before it the SCR–615. Late in November 1942, using a makeshift antenna and reflector atop the main building of the Massachusetts Institute of Technology, the HPG tested their prodigious MEW against a target (a PBY in some accounts, a B–18 in others) flying southeast from Cambridge, beyond the shore and out over the ocean, even beyond Nantucket Island. An excited group of scientists watched the oscilloscope and stuck pins on a wall map as the target's reflection came back from ever farther away. The pins marched on across the map, off its edge, and onto the wall as MEW continued to track the plane out to 177 miles.[84]

The Signal Corps had a representative at the Radiation Laboratory on that day, Wendell L. Rehm of the Radar Laboratory's general engineering section. On the next day, back at his laboratory desk at Camp Evans, Rehm addressed a memo to Maj. John J. Slattery. He called the results of the MEW test "quite amazing." The test airplane, which he called a B–18, was finally lost at 177 miles at an altitude of 16,500 feet. He added that radar scientists were already wondering how they could present all the targets which so powerful a radar could pick up—whether they might not have to use a whole battery of oscilloscopes since a single scope could not begin to display everything such a set could "see" in an area of land and sky approximately 400 miles in diameter. One of the scientists, Dr. Lawson, had cautioned him not to be "too optimistic" until further tests. Obviously, though, the Radiation Laboratory workers were agog and could well be optimistic.

It is worth recording, however, that not all Signal Corps officers and civilians were as enthusiastic. A cautious engineer from the Office of the Chief Signal Officer, Norman A. Abbott, attended a conference a few days later at the Radiation Laboratory and viewed the MEW itself with lusterless eye, principally because the set employed so huge an antenna and reflector and because it had no provision for determining target altitude, points sure to irk the Air Forces. Abbott reported that Army liaison men at the Radiation Laboratory thought it "just another long-range detector of which there were

[83] (1) Guerlac, Radar, pp. 645–49 (Sec. C, Ch. VII, pp. 42–46). (2) Memo for File, Capt D. E. Thomas, Electronics Br, 9 Dec 42 sub: MEW set under development of Radiation Lab, attached to OCSigO R&W Action 1, Capt Thomas to Maj McRae, 16 Jan 43. SigC 319.1 Rpts Gen No. 3 (RB–1965). (3) Craven and Cate, *The Army Air Forces*, I, 293–94.

[84] Guerlac, Radar, pp. 649–51 (Sec. C, Ch. VII, pp. 46–48).

several already in existence." [85] This cautious military estimate would soon yield to the enthusiasm of the scientists who knew how revolutionary this new departure in microwave radar was.

Thus, during 1942, United States Army microwave radar, developed from the pooled military and civilian efforts of the British and the Americans, began to prove its worth. In aircraft applications the proof came quickly. The ground application came more slowly, but the promise of SCR–582 and 584 and of the MEW was already clear by the year's end. These radars would establish the excellence of microwave sets on the ground, although not until 1944 would the 584 and the MEW participate in combat operations. Then their contributions would be scarcely less impressive than those of the airborne BTO radar in blind bombing or of the ASV in driving German submarines from the seas.

[85] (1) Incl Memo, Rehm for Slattery, 26 Nov 42, sub: Observations while at MIT Boston, Mass. MEW set as being developed by Radiation Lab, with Ltr, Dir of SCRL to CSigO, 4 Dec 42. (2) Memo, Abbott for File, 9 Dec 42, sub: Development of SCR–682, SCR–598 and MEW. SigC 413.44 AN/CPS–1 No. 1, Dec 42–Jun 43 (MEW) (RB–2034).

CHAPTER X

Accumulating Strength Over the World

(June–October 1942)

Bolstering the Army Airways Communications System

Increasingly as 1942 progressed, Signal Corps men were moving out over all the world to assist the global expansion of the Army Air Forces. Early in the 1940's the Air Corps had begun expanding its airways and extending its Army Airways Communications System stations far beyond the continental boundaries of the United States, gradually at first, to Hawaii and Panama and to the outlying bases leased from the British in 1940, then with terrific acceleration in 1942 to such distant lands as Africa, Australia, and Asia. United States Army airplanes were pioneering military airlines, air ferries they were called, to move planes, men, and equipment to combat areas. American bombers and fighters were engaging the enemy in the theaters of war. Toward both missions, air ferrying and air combat, the Signal Corps contributed heavily.

Assisting the Installation and Operation of Airways Stations

A major Air Forces undertaking early in 1942 was the build-up of the North Atlantic ferry route, via airfields in New England, Newfoundland, Labrador, Greenland, Iceland, and Scotland. The airfield control centers had to be joined in a dependable communications chain, by links of radio only. Some of the radio stations along the route dispatched flight messages and provided essential navigational aids. Others were meteorological stations, spotted in remote northern wastes, such as Baffin Island, far distant from the route, in order to collect and disseminate advance weather information, vitally needed if the control stations were to direct flights safely over the notoriously treacherous North Atlantic sky routes. Airways, especially in such remote and violently dangerous climates, demanded abundant and reliable facilities, facilities of two sorts: communicational and navigational. Communications called for dependable long-range radio to work with ground stations and with aircraft in flight. Navigational facilities included radio guide beams and blind-landing electronic aids.[1]

[1] The beams might be either the conventional A–N radio range or the pulsed signals of the newer, fantastically accurate loran, half-brother of radar. Loran concerned not the Air Forces alone but the Navy also, for it could aid the navigation of ships

All this spelled out work for the Signal Corps serving the AACS, operated by the Army Air Forces.

At first the work was not always efficiently or very effectively done. According to the Army regulations, it was the Signal Corps' job to install and maintain the equipment; it was Air Forces' job to provide the men, specifically units of the AACS, to operate the equipment. In actual operations, however, during the first months of the war, neither did the Signal Corps have the organization and facilities to meet completely its share of the joint obligation nor did the AAF have enough men in the AACS to man all its stations. Airway stations sprang up by the score, nonetheless, along routes which encompassed the globe. The AAF men often installed the equipment themselves as best they could, for want of skilled Signal Corps crews. Conversely, Signal Corps men often served on AACS jobs, plugging holes in the undermanned AACS until the Air Forces got more men, as often as not by raiding the Signal Corps for technicians to transfer directly into the AAF.

Although along the North Atlantic ferry route the airmen had put in much of their AACS equipment, the Signal Corps had established installations at Gander and Stephenville in Newfoundland, before the AACS took them over.[2] At Gander a Signal Corps detachment continued to handle all cryptographic work for the AACS until nearly a year after the airmen had taken control of the station from the 1001st Signal Service Company. It was March 1942 when the AACS acquired from the Signal Corps the station at Stephenville. Previously both there and at a station in St. John's Signal Corps men had handled all the AACS traffic.[3]

Not only did the Signal Corps thus operate some of the northern route stations for the AACS, but it sometimes operated them in the southern areas also. For example, two enlisted men from the 860th Signal Company had established in February 1942 a tiny communications station, RCZ, serving an Army airfield at San José, Costa Rica. Later, the station acquired two more men from the 860th; and, although commanded by Air Force officers, the four Signal Corps men continued to man the radio station and message center, operating one Hallicrafters

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at sea no less than that of airplanes in the skies. The Signal Corps and the Navy, therefore, co-operated in setting up loran (LRN) installations. For example, a joint party including Lt. H. E. Toner, Signal Corps, Lt. Comdr. L. M. Harding, U.S. Navy, and others traveled through Alaska in August, September, and October 1942, to determine LRN sites, conferring en route with Navy, Air Forces, and Signal Corps officers in the area (for example, with Col. Ira H. Treest, signal officer of the Western Defense Command, and with Colonel Andrews, commanding officer of the Alaska Communication System). Memo, Maj Banes, AC, Instl and Maint Sec, for Chief of Radio Div, 16 Oct 42, sub: Rpt on LRN siting trip, 18 Aug–12 Oct 42. AAG 413.4–R Com Equip.

In September 1942 an agreement was struck between the Signal Corps and the Navy regarding the procurement responsibility for loran equipment—the Navy procuring ground-station equipment, the Signal Corps the airborne components. Memo, Lt Col J. R. Cunningham, Chief of Radio Div AC, for Dir of Com, 18 Sep 42, sub: Loran—Army vs. Navy responsibility. AAG 413.4–P Com Equip.

[2] Hist Br Hq AACS AAF, The Army Airways Communications System, pp. 12, 142. (Hereafter cited as Hist of AACS.) AF Archives 2690–1.

[3] Historical Report, for the 6th AACS Wing, 7 Dec 41–31 Dec 43, pp. 2, 6, 10, and chronological introduction, pp. 1–2 under 1941, and pp. 3, 14 under 1942. AF Archives WG–AACS–6–HI, 7 Dec 41 (1825–32). (2) Terrett, *The Emergency*, p. 281.

receiver and two BC–191 transmitters under a second set of call letters, WSJC.[4]

Examples of this same sort of intertwined relationship, illustrating how Signal Corps men at first assisted the AACS, then were either replaced or absorbed, occurred abundantly along American airways in Central and South America. Here, as the Air Forces flung bastions around the Panama Canal and developed a southern route to Africa, Europe, and the Middle East, Signal Corps administrative stations and the AACS worked side by side, often pooling their facilities. At Albrook Field in the Canal Zone, the AACS moved Station WZA into the central radio building which the Signal Corps maintained there. In it the airmen installed and operated their radios and even utilized the Signal Corps personnel in the building to handle their message center and cryptographic work. The situation was duplicated in the AACS Stations WYRF and WYYT, the former at Guatemala City, the latter at Rio Hato, Panama. At Rio Hato, the AACS, unable to replace Signal Corps cryptographers with men of its own, first retained and then absorbed them.

In at least two Pacific outposts in the southern area, Signal Corps men assisted the AACS—on the Galápagos Islands at Station WYRZ and on the coast of Ecuador opposite these islands, at Salinas, Station WYSX. When the AACS arrived at Salinas it found personnel from the Signal Corps and from the 25th Bombardment Squadron already in the station handling communications, and for a while they all shared the same room. Here, too, the Signal Corps unit continued to do the cryptographic work until eventually it was transferred into the AACS. It was the same way on the Galápagos, where the AACS operated its Station WYRZ in the building which housed the Signal Corps administrative station, telephone and message centers, and cryptographic rooms. Cryptography, here as elsewhere the very last Signal Corps service to be taken over, was ultimately absorbed when the AACS assumed full control of the message center and cryptographic section.[5]

Similarly, Signal Corps units that went to the China-Burma-India theater found themselves doing a great deal of AACS work because much of the military activity in primitive and remote areas was by air. The Tenth Air Force there had to rely upon Signal Corps units to pinch-hit for AACS. Consider, for example, the one officer and 18 enlisted men of Team E, who set up and operated an important station for the Air Forces in India.[6] Arriving at Chakulia in Bihar Province, some 200 miles northwest of Calcutta, the team members at once converted their mobile 300-watt transmitter, conveyed in a K–18 truck, into a fixed station. Work assignments soared as an airfield took shape at Chakulia for the 2d and the 490th Bombardment Squadrons, which were attacking enemy shipping in the Indian Ocean. After putting in wire lines and telephones, the men found that administrative traffic, the usual Signal Corps chore,

[4] Not until 22 July 1943 would the 6th AACS Squadron take over this diminutive station, as WYSV. History of the 72d AACS Group, 11 Dec 40–Sep 44, p. 19. AF Archives SQ–A–COM–153–HI, 11 Dec 41 (1896–12).

[5] *Ibid.*, pp. 1–24. In Alaska, AACS stations at Elmendorf, Ladd Field, Umnak, and Cold Bay long depended upon Signal Corps cryptographers in the ground forces post signal sections. Third AACS Wing Historical Record Report, 1942, p. 28. AF Archives WG–AACS–3–HI, 1942 (1825–26).

[6] Team E was one of the first Signal Corps groups that had landed at Karachi, India, in March. See above, pp. 113–14. It subsequently became part of the 835th Signal Service Battalion.

was not their only responsibility. They had to handle strictly tactical Air Forces traffic too, definitely not the usual task for Signal Corps men.

> The field was ready when the first B–25 came over and signaled for a landing . . . . There was a telephone net to all the airfields in the area, a net built through British switchboards, over Indian wire, and a poor one because of that, but the best the country could offer. There was a radio net to carry the load when the whoop-and-holler telephone system failed completely.
>
> "We'll take care of administrative traffic," the 835th men remember saying, "but who'll handle your tactical traffic, the weather, and the air-ground?"
>
> "We'll do the air-ground," was the answer. "The rest is up to you."
>
> Thus, the 835th men were handed a job that was normally the full-time work of the AACS. Flight instructions . . . targets for today . . . rendezvous . . . bomb-loads . . . anticipated enemy action . . . weather . . . all this a steady stream of *dits and dahs* in the headphones of the radio operator. Result of mission, losses to enemy aircraft and anti-aircraft fire, enemy planes destroyed—all pounded out on the brass key of a manual circuit.

These Signal Corps men took much satisfaction in their hard assignment, for the bombers based at Chakulia were carrying out successful offensive raids on Japanese targets at a time when generally the initiative was in the enemy's hands. For eight months the men worked long hours (especially long because, lacking a cipher machine, they had to encipher messages the long arduous way, by hand on strip boards) until an AACS unit arrived to take over the tactical traffic. Even then, Team E continued to handle, in addition to administrative messages, all intrafield communications and weather reports. When the AACS was finally able to handle them and the station commander wanted to transfer these men of the 835th Signal Service Company into the Air Forces, Signal Corps tasks demanding experienced men in Bombay and Calcutta took precedence, rather exceptionally, over Air Forces desires, and the Signal Corps men departed to meet the demand.[7]

The story was the same at New Delhi where, in 1942, the Air Forces desperately needed radio operators, code clerks, and message center men. Another Signal Corps group of one officer and 18 men, Team H, could not itself do all the work and therefore set up a training program, assigning a detail of five enlisted men to establish a school. Their "first class consisted of 17 officers and 75 British enlisted personnel. These men were trained and placed on duty with the Army Airways Communications Service [*i. e.,* System] until American personnel could be shipped in to replace them." [8]

Similarly too at Jorhat, in Assam province, hard against the embattled Burma border, still another detachment from the 835th at first installed (with help from the 402d Signal Service Company) equipment for the Air Forces and then worked the traffic until an AACS unit put in its appearance.[9]

Thus, at individual airway stations AACS men and Signal Corps men worked together in 1942 forging the air chains which linked North America, to the east, with England; to the south, with Central and South America (thence with Africa, thence northwards with England again, and eastward with the Middle East and India);

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[7] Sgts John and Ward Hawkins, *History of the 835th Signal Service Battalion 1942–1946,* pp. 20–22. SigC Hist Sec File, A47–200, Drawer 15.

[8] Not only during 1942 but throughout 1943, the men of the 835th handled huge numbers of AACS messages in New Delhi. *Ibid.,* pp. 13, 30.

[9] *Ibid.,* p. 38.

to the northwest, with Alaska and the Aleutians; to the west, with Hawaii, and on and on, linking with south and southwest Pacific islands, with Australia, and with China, Burma, and India again. Truly a breathtaking sweep, from the United States to the ends of the earth.

Signal Corps Supply and Maintenance for the AACS

Under Army Regulations 95–200 and 105–20 the AACS was to control and operate all the station links serving these airway chains. The same regulations charged the Signal Corps with a double obligation: first, the development, procurement, storage, and issue of AACS material; and second, the installation and all major alterations of this equipment.

According to the Air Forces, the Signal Corps could not at first supply equipment fast enough, and the airmen often took steps to obtain radios from whatever sources they could discover, from amateur radio operators and from commercial airline stocks.[10] Yet in general the Signal Corps met its supply obligation for the AACS well enough so that it could rebut one of General Arnold's chronic complaints about the Signal Corps with the statement that "the Army Air Forces has made no complaint about the equipment furnished by the Signal Corps for the Army Airways Communications System. . . ." And if the AAF did get some of its equipment independently from radio amateur hams, the Signal Corps got much more, under a carefully developed plan, the Amateur Procurement Program, which brought in about 10,000 pieces of equipment purchased for some three million dollars. While some seventy tons of it went to the British to bolster their Libyan campaign, the bulk went into AACS stations—the Signal Corps Aircraft Radio Laboratory at Dayton, Ohio, converting scores of the radios it had acquired from hams into usable AACS sets.[11]

By the spring of 1942 the tempo of equipping the AACS had stepped up enormously. On 4 June Colonel Rives, Chief of the Radar and Aircraft Communications Branch in the Office of the Chief Signal Officer, said that he "was procuring . . . approximately $91,000,000 worth of radio equipment for use by Army Air Forces [and] Task Forces at airdromes and airways." [12] Additionally, the Signal Corps was accomplishing more than procurement alone to meet Air Forces blueprints. In fact, it had itself carried out some of the prelim-

[10] Hist of AACS, pp. 227–28.

[11] Incl Tab C, Army Airways Communications System, with 1st Ind, Somervell to CG AAF, 24 Nov 42, on Ltr, Arnold to CG SOS, 10 Nov 42, sub: Delayed proc of critical radio and related equip required by AAF. SigC (EO) 475, SigC Equip Gen. For reminiscences of the procurement of equipment from hams, who "parted with their beloved transmitters and receivers with tears in their eyes," see the recollections of Brig. Gen. Tom C. Rives, Ret., in "MARS Founder Heads Electronics Center," *MARS Bulletin,* III (March, 1952), 45–46.

[12] Memo for File, Rives, 4 Jun 42, sub: Conf on proc of equip for AAF, airways and airdromes, task forces, etc. SigC 413.44 Gen 1 (RB–1393).

An example of the demands which the AACS was making upon the Signal Corps is a request which the Commanding General, AAF, made on 25 May 1942. He asked for 1,550 fixed communication transmitters of seven widely different types; 900 navigational transmitters, that is, radio ranges, fan markers, and the like; 2,000 receivers; 1,500 90-foot antenna towers; and enough electric power generators of proper voltages, phase, and capacity to provide two sets at each station, plus 25-percent spares. Remote control equipment had also to accompany each transmitter so that the actual transmitter site might be several miles away from the operating and control rooms. Ltr, CG AAF to CSigO, 25 May 42, sub: Equip for AACS. SigC 413.44 Gen 1 (RB–1393).

inary work. In the absence of a comprehensive Air Forces plan toward providing AACS stations, the Signal Corps on its own had made provision for some 400 stations, in addition to about 50 which had been built or begun before Pearl Harbor. "On December 7, 1941, less than 50 stations were established in areas under the jurisdiction of the United States," General Somervell, head of SOS, informed General Arnold late in 1942, adding that preliminary work had just started on fewer than ten stations in newly acquired foreign bases. "The AAF provided no plan for the creation of new stations," Somervell asserted. "The Signal Corps," he emphasized, "proceeded to obtain equipment and on its own plan has equipped some two hundred stations outside the continental limits of the United States, in addition to about as many more within the United States." [13]

The supply of electronic equipment for the AACS was therefore relatively good, but not so the installing of it, not during 1942. Prior to Pearl Harbor the Signal Corps had properly installed the equipment it supplied both within the continental United States and in the foreign departments; it had also completed a number of installations for the AACS in the Caribbean area and in Bermuda.[14] Thereafter, amid the rush of wartime demands, the Signal Corps endeavored, whenever it could, to meet its installation responsibilities either by contracting with civilian engineers or by assigning Signal Corps officers, if any were available, to supervise the work. In general, though, after the meteoric expansion of air stations all over the world, Signal Corps, in its AACS activity under the Plant Division of the Office of the Chief Signal Officer, largely ceased to make arrangements for installing AACS equipment, finding that it could not readily contract with competent engineers to supervise the work where and when the AAF desired. Competent men were hard to come by anywhere, in the Army or out of it. Further, the Signal Corps simply lacked anything resembling an adequate world-wide organization specifically prepared to install AACS stations.

During 1942, therefore, Colonel Parker and his Plant Division in most cases merely procured the requested equipment and shipped it to the ports of embarkation. From there on, by a sort of informal understanding, the AAF took charge, moving and installing the stuff however it could, often with the aid of its own AACS operators. Often, too, the AAF made contracts with commercial companies, notably with Pan American Airways in South America and in Africa, to put in the radio aids. Indeed, the AAF was already doing so much of this installation work and the Signal Corps so little that General Olmstead in the early spring of 1942 transferred such AACS activity as remained to him, moving it from the Plant Division to the Radar Division under Colonel Rives. He did so at the Air Forces' request, on the assumption, Rives said, that "radar would be the sole contact with the Army Air Forces." [15] Although Army regulations were still explicit, the Signal Corps was yielding under the pressure of workday necessities.

[13] Incl Tab C, AACS, cited n. 11.

[14] Memo, Col Conrad for Col Meade, 17 Jul 42, sub: AACS. SigC 676.3 AACS (EO-2-P No. 26).

[15] (1) *Ibid.* (2) Memo for File, Col Rives, 31 Jul 42, sub: Conf on AACS, p. 2. SigC 676.3 AACS (EO-2-P No. 26). The AACS activity in the Radar Division constituted the Airways and Airdrome Section. Indeed, some Signal Corps men at this time regarded AACS as meaning "Airways and Airdromes Control System."

The AAF in fact hoped to confirm the temporary control which it now enjoyed over the engineering, installation, and maintenance of its AACS equipment by accomplishing a change in Army regulations. However, these ambitions were to be frustrated. The AACS was overreaching itself. Many of the installations put in overseas functioned poorly, for their personnel had not been trained for this sort of work. They were not engineers. AACS men were intended to be operators only; Army regulations so specified. As Colonel Conrad in the Executive Office of the Office of the Chief Signal Officer wrote on 17 July: "It has become evident that Air Force personnel are not achieving the maximum possible operational efficiency. This last is mainly due to poorly trained personnel, lack of experienced installation crews and some negligence on the operators' part." [16]

BOLERO, Mishaps in June; Impact on Signal Corps-AACS Relations

Troubles harassed the North Atlantic ferry route especially, the air link so essential to BOLERO, at stations where the difficulties arising from the inexperience and ignorance of the men were compounded by trials peculiar to the far north, such as poor electrical grounding in permanently frozen sandy or marshy terrain, and in particular the transmission fade-outs caused by the aurora borealis.[17]

The North Atlantic ferry route was double-tracked: one airway, for four-engined planes, proceeding directly from Gander Lake to Prestwick; and the other, for twin-engined aircraft, reaching Scotland by a series of shorter flights, by way of Labrador, Greenland, and Iceland. The AACS had either completed or was completing the majority of stations serving these routes when, early in the spring of 1942, AAF commanders, dismayed by AACS difficulties along the skyway, asked the Signal Corps for technical assistance. But Colonel Rives and the Airways and Airdromes Section of his Radar Division could spare no one to render the help the Air Forces desired. The Signal Corps, therefore, made a contract, the AAF consenting, with the Raymond Wilmotte Engineering Company of Washington, D. C., to lend aid. As Rives explained on 31 July, "trouble was first encountered in the northeast route and later in the Caribbean area. The Signal Corps was still doing very little of the installation work . . . . The Air Corps," Rives said, "asked for technical service and in view of the fact that Radar Division had no personnel to furnish such service, the services of the Raymond Wilmotte Engineering Company were employed to do the job on the northeast route." [18]

Things had gone badly. In February 1st Lt. Crocker Snow, commanding the North Atlantic Sector of the Air Corps Ferrying Command, had reported that communications northeast of Presque Isle, Maine, were a "mess." In March he had made an analysis of what he felt to be the main difficulties besetting the route: poor communications, a serious shortage of weather personnel and of weather facilities, poorly

[16] Memo cited n. 14.

[17] Hist of AACS, pp. 135–36, 141.

[18] Memo cited n. 15(2), p. 2. The trouble in the Caribbean evidently involved supply as well as installation. In consequence of an AAF complaint about AACS equipment shortages, especially in the Caribbean area, General Somervell asked Olmstead on 21 May to improve his methods of procuring, storing, and issuing and so to expedite shipment. Ltr, Somervell to CSigO, 21 May 42, sub: Status of shipment for various items of equip. SigC 413.44 Gen 1 (RB–1393).

performing radio and range stations, insufficient maintenance and operations personnel, inadequate airdrome facilities, and all but primitive messing and housing arrangements. Through April both personnel and radio navigational aids had remained inadequate. Then on 18 June, only a few days before the first BOLERO flight was scheduled, an inspection of the route indicated that delays in receipt of weather information and in its dissemination arose mainly because inexperienced communicators, and cryptographic and weather officers failed to coordinate their work well.[19] On 19 June the signal officer in the First Corps Area, Col. James H. Van Horn, reported that he had found the facilities at Goose Bay, Labrador, and the morale of the men equally bad.[20] Subsequently, General McClelland in Air Forces Headquarters summed up the BOLERO mess, saying "probably due to the exigencies of the situation at the time, the communications system, if it could be called a system, on the North Atlantic airway was not 'engineered' but was a loosely coordinated effort to get something ready in time for projected movements." [21]

Such halfway measures may suffice in many hectic wartime situations, but in airway communications they will not do. The late spring of 1942 meanwhile heard the voices of high ranking Air Forces officers swelling the chorus of complaints. In May General Arnold fumed at the communicational and meteorological inadequacies along the route. He was, in brief, "dissatisfied." General Spaatz, commanding the Eighth Air Force in England, had occasion for similar feelings after he had taken off early in June from the Presque Isle Army airfield on two attempts to fly to Goose Bay and had to turn back each time, not because of weather, though it was adverse, but because ground communications had been impossible. Static, he recorded, was bad, but equally bad operating procedure on the part of ground communicators had stymied communications. And without communications there could be no air ferrying. Spaatz urged that the best airlines communications expert in America be sent with authority to reorganize the communications links.[22]

But before anything either specific or general could be done, the first BOLERO flight ended in disaster. Eighteen B-17's took off from Presque Isle for Goose Bay on 23 June. All arrived safely. So far so good, but on the second leg of the flight three days later, only half arrived at their destination, Narsarssuak, Greenland, six having to turn back to Goose Bay while the remaining three crash-landed. Undoubtedly, communications failure contributed largely—as Tom Rives put it in a nutshell: ". . . when they cracked up the 3 B-24's [they were B-17's]—these ships cleared from Goose Bay to Greenland. After they had cleared the weather turned bad on them. There was a number of ships involved in the flight and they called and told them to go back. Part of the flight got

[19] History of the Air Transport Command, Ferrying Command Operations, 7 December 1941–30 June 1942, pp. 166ff. AF Archives, Maxwell Field.

[20] Memo, Van Horn for Col French, 19 Jun 42, sub: Reference rpt submitted to Van Horn by Lt Soney, SC. SigC 676.3 (CC CEB) Canadian Ferry Route.

[21] AAF R&R, McClelland to AFATC, 10 Oct 42, sub: Additional radio facilities, North Atlantic Wing. AAG 413.4–Q Com Equip.

[22] (1) Incl Tab D, paraphrase of radiogram 1739, London, Lt Col [Milton W.] Arnold to AGWAR, 28 May 42, with Memo, CSigO for Lt Gen Henry H. Arnold, 12 Sep 42, sub: Action to assume duties and responsibilities in connection with the AACS. SigC 676.3 AACS (EO–2–P No. 26). (2) Incl 1, Radio Msg, Spaatz to Arnold, 13 Jun 42, with Memo, Lt Col F. L. Smith for Dir of Com, 16 Jun 42. AAG 413.4–L Com Equip. (3) Craven and Cate, *The Army Air Forces*, I, 348.

the message and acknowledged. The rest didn't get the message. The operator on the ground thought that all had gotten it. Some cracked up." [23]

The first BOLERO flight precipitated a showdown on the question of who was responsible for AACS installation and maintenance. The matter came to a quick boil, both along the ferry route itself and in Washington headquarters. Along the route the airway stations fell under close scrutiny. In August Captain R. H. Freeman from Plant Division, accompanied by representatives from the Air Forces and from the Civil Aeronautics Administration, inspected AACS facilities at Presque Isle, Goose Bay, Sondrestromfjord, Narsarssuak, and Reykjavik. All the installations, Freeman wrote to Colonel Parker, showed obvious engineering defects. Antennas, both transmitting and receiving, had been put up without thought as to their directional characteristics. In some cases they presented the angle of minimum efficiency toward the distant stations with which they communed. The operators were crowded and used blaring loudspeakers which drowned one another out. In some cases, they worked in noisy aircraft hangars, where various electric motors injected strong interference into their communication circuits.[24]

At Washington headquarters a series of disputes beginning in July eventually led to the resuscitation of AACS installation activity in the Office of the Chief Signal Officer. Stoner, Meade, Conrad, and others speaking for the Signal Corps, and Marriner, DeArmond, and others for the Air Forces, agreed that at the moment neither was "properly equipped" to make quickly and efficiently all the installations of which the AACS had so desperate and immediate a need outside the continental United States. The conferees agreed that the Civil Aeronautics Administration was best supplied with the needed personnel qualified by long experience in the intricate ways of radio ranges, marker beacons, and the like. Installation crews composed of these men, together with some Signal Corps men, it was thought, could do the job. Direction of the work would be taken from the Radar Division and returned to its original place in the Plant Division.

Further conferences on 28 and 31 July sought to clarify just who would do what. Even within the Signal Corps it was not easy to separate intertwined equipment and functions—VHF radio, for instance, would remain a responsibility of the Radar Division, presumably because of its employment in the radar stations of the Aircraft Warning and Intercept Services.[25]

[23] (1) Memo cited n. 15(2), p. 7. (2) Samuel Milner, "Establishing the BOLERO Ferry Route," *Military Affairs,* XI:4 (Winter, 1947), 220. (3) Craven and Cate, *The Army Air Forces,* I, 644. (4) For an on-the-spot account, see Memo, Jansky, Operational Analyst, for Saville, 9 Jul 42, sub: Com along Labrador, Greenland, and Iceland route to England. AAG 413.4–M Com Equip. Cyril M. Jansky, Jr., a radio engineer returning from a tour of inspection in England for the AAF (Saville's Directorate of Air Defense), was accompanied by Dr. Everitt, prominent electronics engineer whom General Olmstead had sent on a European tour of inspection, in order, among other things, to investigate and make recommendations to correct engineering and operational defects of AACS stations.

[24] Incl Tab E, Memo, Freeman for Parker, 10 Sep 42, sub: Summary of inspec trip of northeast air ferry route, with Memo cited n. 22(1).

[25] (1) OCSigO R&W Action 1, Meade to Dirs of Army Com Sv and of Sig Supply Sv, 18 Jul 42, sub: Conf for formulating plan for instl of AACS stations; (2) Min of Conf, Maj Fell, OCSigO Planning, 28 Jul 42, sub: AACS and associated activities; (3) Min of Conf, 31 Jul 42 (bearing Stoner's concurrence, dated 2 Aug). SigC 676.3 AACS (EO–2–P No. 26).

All this the Deputy Chief Signal Officer, General Code, summed up for General Arnold on 5 August, informing him that the Airways and Fixed Radio Branch, set up on 29 July in the Plant Division, "will, upon notification of requirements to be furnished by the Commanding General, Army Air Forces, engineer all installations, taking into account the operational requirements of the Army Air Forces and will procure, store, issue, install the equipment, and arrange for all maintenance other than First Echelon, and will utilize to the fullest the facilities of the Civil Aeronautics Administration, signal officers of the various Service Commands, and such other agencies, civil or military, as are available."

At the same time responsibility for determining requirements was split between the two corps. The Commanding General, Army Air Forces, was made responsible for determining AACS requirements "for air-ground and flight dispatching circuits, weather circuits, and radio aids to navigation, specifically including marker beacon, direction finding and radio range equipment." The Chief Signal Officer was made responsible "for determining the need for administrative radio stations." [26]

Despite this agreement, the Army Air Forces remained dissatisfied. Hardly a month after the agreement, on 2 September, it developed, at a conference including Colonel Parker, head of Plant Division, and Col. Wallace G. Smith from the Air Forces, that the latter had in mind to submit a recommendation to the General Staff for transfer of responsibility for AACS installation and maintenance to the Air Forces. Meanwhile, pending a decision, the AAF said it would try its utmost to make the existing arrangement suffice and toward this end agreed to assign at once two liaison officers to Plant Division in order to coordinate matters pertaining to airways communications. Yet these liaison officers failed to appear promptly and a few days later Parker summed up his views of the situation in bald terms: [27]

> . . . It would appear that no great effort is being made by the Air Corps to comply with the understanding reached in the above mentioned conference, and it is my belief that this action is being purposely delayed in order to provide time for them to present their case to the General Staff. I am, furthermore, of the opinion that we . . . should take steps at the earliest practicable date to prepare reasons why such a move would not be desirable and that such advance action as is necessary and practicable be taken to acquaint the General Staff with the fact that the Signal Corps, if given the cooperation of the Air Corps, can do the job in a satisfactory manner.

Thus some airmen did not accept either the requirements laid down by Army regulations or the Signal Corps' efforts to comply with them. This intolerable situation soon exploded, sparked as usual by the Air Forces. On 12 September, Colonel Smith, speaking for Marriner, director of communications in AAF headquarters, told Colonel Meade: "We feel that we should be charged with all engineering, installation and maintenance of Army Airways and associated administrative and supply radio channels and are taking steps to prepare a

[26] Incl Tab A, Ltr, Code to CG AAF, 5 Aug 42, sub: Procedure in establishing AACS related radio facilities, with Memo, CSigO for Arnold, cited n. 22(1).

[27] (1) OCSigO R&W Action 1, Parker to Dir of Army Com Sv and Dir of Planning, 7 Sep 42. SigC 322.08 PEA 1, Jul 40–Dec 42. (2) Memo for Rcd, Maj Fell, 2 Sep 42, sub: Conf on method of providing AACS Com Facilities. SigC 676.3 AACS (EO–2–P No. 26).

Staff Memorandum recommending we be charged with these duties and the Signal Corps relieved of them." [28]

General Olmstead at once began to prepare a brief of the whole matter, pointing out that the Signal Corps had "in good faith" set up a supply and installation system, had already surveyed the North Atlantic ferry route to eliminate deficiencies there, had already turned over four major engineering jobs to the Civil Aeronautics Administration, and had contracted with a civilian agency to survey antenna installations with a view to improving the arrays. He intended to ask General Arnold "to stop all this petty bickering and let us both get on with the necessary work of providing these installations in accordance with the previous informally approved plan." [29] He never channeled his protest to Arnold, however, since an amicable settlement was reached without it. For the next two years the Signal Corps retained control.

Beginning late in September, the Plant Division entered upon an extensive program of reorganization and expansion under its chief, Colonel Parker. Still under General Stoner and the Army Communications Service, it became the Plant Engineering Agency (PEA) and moved to separate quarters in Philadelphia. Its Signal Airways Branch (SAB) and Signal Airways Service (SAS), when provided with installation crews serving in the four sectors into which the Air Forces divided the world, would grapple with the huge work load to come. Some notion of what AACS requirements entailed may be obtained by considering that radio communications, administrative and flight messages, constituted only one part of the whole. The airways and air stations had to be supplied with a huge net of hundreds of weather reporting stations bristling with meteorological equipment. The installation of the stations, their continued supply and maintenance, and the supply of balloons, radar, and theodolite tracking equipment, anemometers, barometers, ceiling lights, and so on and on *ad infinitum,* not to mention wire and radio nets—all constituted another part of the load on the SAS and the SAB.

Then there was the matter of sites: in Tibet, on the Greenland icecap, in the Sahara Desert, in the jungles of interior Brazil, some in places so remote that they could be supplied only by parachute drop. The problem presented by meteorological stations was but another elaboration of the Signal Corps' responsibility to supply, install, and maintain AACS equipment. Still another was the matter of navigation stations which the Air Forces' world-wide airways must have, especially over the oceans. There were locator stations employing directional finders. There were radar and radio beacon stations, loran stations, blind-landing aids at airfields, all entailing more and more equipment, often, too, in the most remote areas of the globe.[30]

Build-up for the Air Forces in the Northeast

Engineering assistance and technical aid toward the installation of all the varieties of AACS equipment—communicational, navigational, meteorological—were not the

[28] Incl Tab C, with Memo, CSigO to CG AAF cited n. 22(1).

[29] Memo cited n. 22(1) and Incl. Tab E. See also papers in SigC 400.192 Production Control (Delayed Procurement of Equipment Requested by AAF) 1942. Deputy CSigO file.

[30] (1) Capt Lloyd P. Dodds, History of the Plant Engineering Agency, 1941–1946 (1946), *passim* (*e. g.*, p. 346). (2) Capt Sidney L. Jackson, Radnese "100": Chapter II of International Radio Cir-

only requests touching military airways which the Army Air Forces made of the Signal Corps during 1942. From the welter of demands which BOLERO laid upon the AACS, one in particular bore down upon the Signal Corps, the demand that the Corps handle administrative traffic along the ferry route to England. Mounting radio traffic along the North Atlantic airways in the spring of 1942 quickly overtaxed the Army Airways Communications System. The AAF wished to be relieved of administrative messages altogether in order to concentrate on tactical messages, such as those pertaining to weather and to aircraft flights. Early in June, therefore, Colonel Marriner asked that the Signal Corps establish and operate administrative circuits for the Air Forces between Presque Isle, Goose Bay, and Narsarssuak, "as soon as possible in view of the present acute situation." [31]

Within a month of Marriner's request, General Stoner was reporting rapid progress under Colonel Van Horn at Presque Isle and Goose Bay. Transmitters of three kilowatts' output were already on hand at each location. As Stoner expected, Goose Bay went on the air by mid-July, working in one direction with an ACAN station at Narsarssuak, WVDB, and in the opposite direction with WVHP at Presque Isle, WVO in Boston, and WVP on Governors Island in New York Harbor.[32]

Colonel Marriner soon followed his first request for administrative stations with a second. It was a larger order than the first and asked that the Signal Corps "provide administrative channels [for the Army Air Forces] at The Pas, Churchill, Southampton Island, CRYSTAL 2, CRYSTAL 1, and BLUIE EAST 2." [33] The spots named by Colonel Marriner lay far to the north athwart Canada, Hudson Bay, and Greenland. They were sites of airfields and AACS stations under development according to plan CRIMSON. This plan the AAF Ferrying Command had evolved to bolster BOLERO and to provide an inland route through northern Canada in order to reduce the extent of overwater flying to the United Kingdom.[34]

cuits (1944), SigC historical monograph E–2b, p. 2. SigC Hist Sec File. (3) See below, p. 437. As for remote installation sites, take for example the priority list which the AAF handed the Signal Corps in October 1942 respecting radio range stations, desired in the following order: Natal, Belem, Accra, Point Noire, Ascension, Aden, Karachi. Ltr, Div Com AAF to CSigO, 14 Oct 42, sub: AACS–26 priority of installation of SRA range. SigC 676.3 India AACS 1, 1942.

Simultaneously in the Pacific radio ranges reached out along a string of islands: Christmas, Canton, Bora-Bora, Samoa, Fiji, New Caledonia, and New Zealand, under the guidance of six engineers from the CAA, who began work late in 1942. Air Force historians emphasize the help the AACS installations in the South and Southwest Pacific received from Signal Corps men, backed by Colonel Powell, signal officer in Hawaii, by Col Francis L. Ankenbrandt in the South Pacific Area (USAFISPA); and by General Akin on MacArthur's staff. 7th AACS Wing Hist Record, Oct 42–15 May 44, pp. 5–6. AF Archives WG–AACS–7–HI, Oct 42–15 May 44 (2433–146). 7th AACS Squadron Hist Data, 1 Jan 41–15 May 44, p. 7. AF Archives SQ–A–COM–7–HI, 1 Jan 41–15 May 44 (2140–137), USAF Archives, Maxwell Field.

[31] (1) Ltr, Marriner to SCigO, 3 Jun 42, sub: Establishment of adm radio circuit. SigC 676.3 (CC CEB) Canadian Ferry Route. (2) Craven and Cate, *The Army Air Forces*, I, 342–49.

[32] (1) Memo, Stoner for Code, 6 Jul 42, sub: Status of present and proposed adm radio channels for AAF Ferrying Command; (2) Ltr, Van Horn to CG SOS SPSLP, 30 Sep 42, sub: Adm radio station, Pedagogue. SigC 676.3 (CC CEB), Canadian Ferry Route.

[33] Memo, 1st Lt Raymond B. Jewett, SC, for Maj Mitchell, 16 Jul 42, sub: Army adm circuits, for AAF Ferrying Command, northern Canada. SigC 676.3 (CC CEB), Canadian Ferry Route.

[34] Hist of AACS, pp. 153–54. BLUIE EAST 2 was Angmagssalik (or Cape Dan) on the east coast of Greenland on a line between Iceland and Sondrestromfjord, or BLUIE WEST 8, where the Signal Corps was setting up administrative station WVHN

Undertaking at once to install administrative radio stations at these six sites, the Signal Corps first drew up plans for the project. This administrative net was to extend from the northern United States to The Pas, thence northeast to Churchill, on across Hudson Bay to Southampton Island, thence east to the head of Frobisher Bay, across Davis Strait to Sondrestromfjord on the western side of Greenland, and finally across the icecap to Angmagssalik on Greenland's east coast.[35] The administrative radio at the head of Frobisher Bay, it was further planned, would establish a channel to Fort Chimo, Labrador, where the Signal Corps would set up administrative station WVMD, CHAPLET, alongside the existing AACS station CRYSTAL 1, WYTL. CHAPLET in turn would be linked with Signal Corps stations already operating at Goose Bay and at Narsarssuak. While a new Signal Service Company, the 841st, was being activated at Fort Meade, Maryland, to man the projected stations,[36] the Plant Division hastily assembled equipment such as 300-watt transmitters BC-365 and BC-447. It planned to lease equipment in Chicago and in nearby St. John, Indiana, in order to anchor one corner of the net in the Chicago ACAN station WVT. By late October numbers of the CRIMSON stations were at work; at least two were already in the hands of operators from the 841st Signal Service Company.[37]

As the year drew to a close, then, the Signal Corps was operating, on a temporary basis at least, all of the administrative stations which the AAF had requested in order to assist its AACS along the North Atlantic airways. Since they soon lost their usefulness, some of the stations never received permanent fixed equipment. Radioteletype systems which the Signal Corps would install in AACS stations during 1943 eventually enabled the airmen to handle heavier traffic loads without assistance. And although four-engined planes continued to fly along the sea route to Scotland, the inland airways soon fell into disuse, both because of climatic exigencies and because the reduction of the submarine menace made it more advisable to carry small planes aboard

on Greenland's western shore. CRYSTALS 1 and 2, located respectively at Fort Chimo in northern Labrador and on upper Frobisher Bay in Baffin Island, lay on each flank of the Atlantic entrance to Hudson Bay. Southampton Island (the station site was called Coral Harbor) lies at the northern end of Hudson Bay. Midway down the west side of the bay shore is the outpost of Churchill, Manitoba. The town marks the northern terminus of a railroad which runs 500 miles southwest to The Pas, in southern Manitoba, just north of Lake Winnipeg.

[35] *Signal Corps Radio*

Site	*Call Sign*	*Code Name*
The Pas	WVMB	
Churchill	WVMA	APPELLATION
Southampton Island	WVMC	SUSPICION
Upper Frobisher Bay	WVMW	BOOKIE
Sondrestromfjord	WVHN	BLUIE WEST 8
Angmagssalik	WVHM	BLUIE EAST 2

An AACS station was already located at upper Frobisher Bay. It was CRYSTAL 2, operating under the call letters WYTM. Whereas the four-letter call of Signal Corps administrative radio stations was prefaced by WV, AACS station calls generally began with WY.

[36] OCSigO R&W Action 2, Maj Watters, Theater Br WPD, to Traffic Div, 11 Aug 42. SigC 676.3 (CC CEB) Canadian Ferry Route.

[37] (1) OCSigO R&W Action 1, Maj Watters to Traffic Div, 16 Jul 42, and Action 5, Col French, Traffic Div, to WPD and Plant, 1 Aug 42, sub: Adm stations for North Atlantic ferry route; (2) OCSigO R&W, Col Guest, CL Br, to WPD, 23 Jul 42, with attached "Freq and Call Sign Assignments"; (3) OCSigO R&W, Watters to Plant Br, 26 Oct 42, sub: CRIMSON radio com; (4) Ltr, French to CG First Sv Comd, 29 Oct 42, sub: Routing of adm traffic to northeastern bases. SigC 676.3 (CC CEB), Canadian Ferry Route. (5) See also papers in SigC 320.3 Northeast Canada Pers.

ships rather than to attempt to ferry them by air. The CRIMSON project was then abandoned altogether.

Radars for Aircraft Warning

Another demand which the Signal Corps was meeting for the Air Forces involved radars for aircraft warning. By mid-1942 numerous Signal Corps ground radars were standing vigil at scores of sites from Iceland to India. A tabulation made in July showed that the five corps areas which guarded the American coasts had over 250 radars in service: 2 SCR–271's, 70 SCR–270's, and 194 SCR–268's. The Ninth Corps Area, facing the Pacific, enjoyed the lion's share, having 31 SCR–270's and 127 SCR–268's. The remaining sets were scattered along the eastern coast in the First, Second, Third, and Fourth Corps Areas.[38]

Now, as theaters of war were opening up increasingly in the Pacific and were on the point of opening up in Africa also, the Signal Corps had to procure, install, and maintain more and more radars, both for increased defense of the homeland and for protection of American positions abroad. Already, many scores of American 268's, 270's, 271's, and 516's were serving the Army in an amazing variety of locations: to the eastward—in Iceland, Greenland, Newfoundland, Bermuda, Panama, Puerto Rico, Trinidad, Ascension Island, and Liberia; to the westward—in Alaska, Ecuador, Galápagos Islands, Hawaii, Christmas Island, Canton Island, the Fijis, Aitutaki, Tongareva, Tongatabu, Bora Bora, New Caledonia, Australia, and India. Most numerous were the mobile 270's and 268's, the latter especially, 76 of which were in use by task forces at "locations unknown," 69 of them out of San Francisco, 7 out of New Orleans. So Lt. Col. James R. Rearden, charged with the Installation and Maintenance Branch in the Office of the Chief Signal Officer, informed Colonel Rives, Chief of the Radar Division, on 14 July.[39]

The mobility of the American sets was becoming an important factor as 1942 wore on and as Allied plans contemplated offensive movements. While British radars held the first place in the estimation of officers in the Air Forces Headquarters at the outset, the fact that the SCR–270 was relatively more mobile became a telling point. By the end of May the Signal Corps had been informed that "most of the SCR–270's now being procured will be used to equip Task Forces." [40]

As invasion deadlines approached, quite a rush developed for 270's, and for the mobile short-range SCR–268's also. The AAF was using all Signal Corps' production of SCR–270 and 271, together with many SCR–268's intended originally for use by the Coast Artillery Corps. For example, in July Signal Corps' Installation and Maintenance Branch sought to provide the Air Forces, "for use in BOLERO," with 48 SCR–268's, together with a quantity of spare parts sufficient for one year's operation.[41]

[38] Incl 1, Distribution of Ground Radar Sets in Continental U. S., with OCSigO R&W Action 1 (SPSMA 1854), Lt Col James R. Rearden, O/C I&M Br SPSMA–6, to O/C Radar Div, 14 Jul 42, sub: Ground radar maint. SigC 413.44 Radar Installation 3, Apr–Sep 42 (RB–1537).

[39] (1) Incl 2, Quantity of SCR–268, 270, 270–B, 271, 271–A, 516, and others overseas at locations as indicated, with OCSigO R&W Action 1 (SPSMA 1854) cited n. 38. (2) Ltr, CG AAF to CSigO, 24 Aug 42, sub: Installation priorities, steel antennas. AAG 413.4–P Com Equip.

[40] Rpt of Conf on SCR–270 and SCR–271, 25 May 42. SigC 413.44 SCR–270–271 12–H, May 42 (RB–1131).

[41] Incl, Weekly Prog Rpt I&M Br, 9–15 Jul, Item 2c, with OCSigO R&W Action 1, Rearden to Radar Div, 16 Jul 42, sub: Info and status rpt unit, Radar Div (SPSMA 1875). SigC 319.1 Rpts Gen, May 38–Aug 42 (RB–781).

At about the same time the AAF asked for a large number of the fixed 271's. The AAF had on order 357 SCR–270's when, in early July, it expressed a desire that only 20 percent of them be delivered as mobile sets; the rest the AAF now wanted converted to fixed SCR–271's, possibly because the manufacturer, Westinghouse, along with some 90 subcontractors the country over, was ahead of the production schedule (the 271 was easier to produce than the 270). Accordingly, the Signal Corps Radar Laboratory prepared to have 286 of the mobile sets converted into fixed SCR–271's, 196 of them equipped with 100-foot antenna towers, the rest with 50-foot arrays. Of these fixed radars, the Air Forces indicated that 215 would be erected outside the United States.[42]

The Navy, too, put in requests for these Signal Corps radars. By August, it was pressing vigorously for 270's, having a high priority for 28 sets to serve task forces scheduled to sail in September. These, added to 52 already on order for the Navy plus another 42 for the marines, totaled 122 mobile radars. Besides, the Navy had an order in for 16 fixed SCR–271's also.[43] For some time previously, the Navy had been using an SCR–270 on Midway Island and the marines a 270 and a 271 on Samoa.[44]

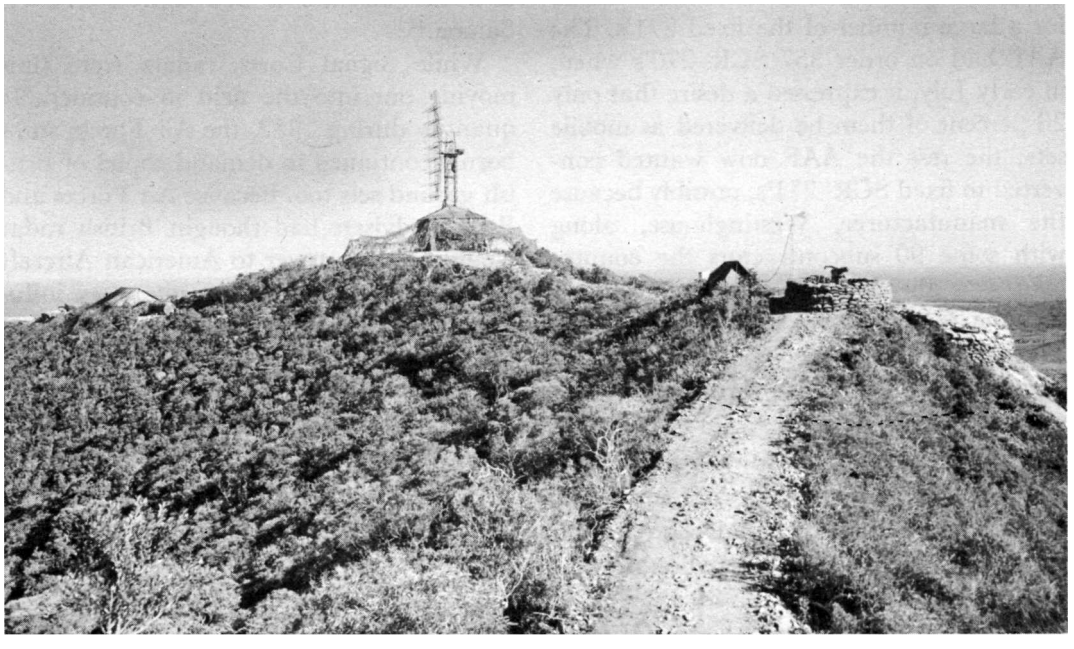
While Signal Corps radars were thus moving out into the field in considerable quantity during 1942, the Air Forces stubbornly continued to demand copies of British ground sets too. Because Air Forces and British advisers had thought British radar would be the answer to American Aircraft Warning Service requirements, they influenced the War Department's thinking that the American sets would eventually yield to the supposedly superior CH, CHL, GCI/CHL and so on. Canadian factories were to produce the GCI/CHL as SCR–588. This radar did not become abundant, however, while Signal Corps' SCR–270 and SCR–271 became increasingly available and moreover were not inferior. Yet the AAF staff, retaining its predilection, continued through the year demanding such cumbersome long-wave sets as Saville and Watson-Watt had urged upon them in January and February.[45] In April Colonel Marriner, speaking for the AAF, had listed its expected ground radar needs. Every type he named

[42] (1) Ltr, Capt A. L. Vieweger, O/C Prod Engineering, to CSigO, 23 Jul 42, sub: Radio sets SCR–271–D. SigC 413.44 SCR–270–271 12–H, Jun–Jul 42 (RB–1132). (2) Rpt of Conf cited n. 40.

[43] (1) Ltr, CG AAF to CSigO, 20 Aug 42, sub: Priority list for SCR–270–( ) and SCR–271–( ) for August; (2) 3d Ind, CG AAF to CSigO, 1 Sep 42, on Ltr CSigO to CG AAF, 30 May 42, sub: Unexpended funds for equip for AWS. SigC 413.44 SCR–270–271 12–H, Aug–Sep 42 (RB–1133). The Navy had already received 29 SCR–270's and 271's by July's end. 1st Ind, Marriner to CSigO, 7 Aug 42, on Ltr, CSigO to Dir of Com AAF, sub: Improvement for SCR–270–(271). AAG 413.4–N Com Equip.

[44] (1) Incl Ltr, CO U.S. Naval Air Station, Midway Island, to Comdt Navy Yard, Pearl Harbor, 9 Apr 42, sub: Radar, with 1st Ind, CSigO to Dir of SCRL, 2 Jun 42 (basic missing). SigC 413.44 SCR–270–271 12–H, Aug–Sep 42 (RB–1133). (2) Incl Ltr, CO U.S. Marine Corps, 2d Defense Bn, to Comdt U.S. Marine Corps, 20 May 42, sub: Fld Info on AW equip, with Ltr, CSigO to CG AAF, 31 Jul 42, sub: Navy Rpt on radar performance. AAG 413.4–B Radar Equip, 1942.

[45] See above, pp. 93–102, *passim*, CH's, Chain Home sets, were the first British search radars whose two- and three-hundred foot towers formed a chain of defense around the English homeland. Incidentally, the wave lengths of the British CH, MRU, and TRU were long indeed, so long as to be comparable to the wave lengths of high frequency radio. For CH, they were 15 meters long, 20.4 megacycles; for TRU, 7 meters long, 43.75 megacycles. Memo, Maj Fell for record, 30 Oct 42, sub: CH Stations. SigC 413.44 British Equip 6, May–Nov 42 (RB–1527).



AIRCRAFT WARNING RADARS. *The fixed SCR-271 on Ile des Pins in the Southwest Pacific (above) and the mobile SCR-268 in Greenland (below).*

was British, CH, MRU, CHL (both fixed and transportable versions), GCI, fixed and transportable; and finally, portable sets which the British designated LW, light warning. For four of them, the CH, the MRU, and the TRU (identical except for mobility), and the portable LW, the only source was England itself. "The procurement of one hundred MRU sets," Marriner had emphasized, "is a matter of the highest urgency." [46]

By August Col. Clay Hoppough, on Signal Corps detail with the Army Air Forces, was asking for 60 LW's for the BOLERO project. "It is the understanding of the Commanding General, Army Air Forces," he wrote, "that orders have been placed for 200 British LW (lightweight portable) sets. There is a requirement for 60 of these sets for the BOLERO project." He wanted also 9 MRU sets, 6 TRU's, 3 CHL's, and 19 GCI's, specifically for BOLERO. "Steps should be taken," he urged, "to procure these sets in sufficient time to utilize them for the BOLERO project." Simultaneously, he repeated the request for a dozen huge CH stations for home defense, which Saville had sought so urgently early in the year.[47] Some of these British sets arrived in the United States in due course, a TRU, for example, evidently the first on 29 August, and a very meager scattering of others during the last months of 1942.[48]

Meanwhile, pressure for British ground radar for the Army Air Forces began to peter out. The radars could not be had in quantity, whereas Signal Corps sets were becoming increasingly abundant. For instance, by July when Colonel Rearden tabulated the several hundred 268's, 270's, and 516's which were in service, he could list only nine British sets: three in Iceland (one ACH and two CD/CHL's) and six in Panama (four SCR–588–A's, Canadian copy of the CHL, and two SCR–588–B's, copies of GCI/CHL's).[49] Besides, they were old types, already outmoded. But before passing from the American scene,[50] these British radars, which had given the Signal Corps many a headache, lent a parting shove to an Air Forces movement which relieved the Signal Corps from its obligation to install and maintain Aircraft Warning Service ground radars.

Installation and maintenance of the Corps' many radars all over the world, chiefly for the AAF and its Aircraft Warning Service, placed upon the Signal Corps a need for an organization and for facilities which had not existed at the beginning of

[46] (1) Ltr, Marriner to CSigO, 21 Apr 42, sub: Procurement of ground radar equip for U. S. SigC 413.44 British Equip 5, Jan–Apr 42 (RB–1155). (2) Col Metcalf, 21 May 42, Weekly Prog Rpt of Radar Div, May 14–20. Weekly Achievement Rpts, 27 Apr–8 Jun 42. SigC Central Files.

[47] Ltr, Marriner (signed by Hoppough) to CSigO, 11 Aug 42, sub: Proc of British radar equip. SigC 413.44 British Equip 6, May–Nov 42 (RB–1527).

[48] (1) Memo, Lt Col John F. R. Seitz, Exec International Div, SOS, Washington, for CSigO, 2 Sep 42, sub: RDF equip requested for transfer from U. K. to U. S.; (2) Memo, SCRL for Lt Col Paul E. Watson, 10 Sep 42, sub: TRU program; (3) Ltr, CG AAF to CSigO, 27 Nov 42, sub: CH radar program. (4) An MRU arrived on 5 October. Ltr, G. W. Hignett to Col J. M. Piner, 9 Oct 42. (5) An LW was ready to leave U. K. in October. Memo, Seitz for CSigO, 15 Oct 42, sub: RDF equip. File cited n. 47. (6) Two CH sets arrived in New York on 2 November. Ltr, Hignett to Saville, 2 Nov 42. AAG 413.44–B Radio.

[49] Incl 2 with OCSigO R&W Action 1 (SPSMA 1854) cited n. 38.

[50] The AAF canceled its CH program altogether in the spring of 1943. (1) Ltrs, CG AAF to CG's First and Fourth Air Forces, 25 Jan, 22 Jun 43, sub: Instl of transportable radar units (TRU) in Western and Eastern Defense Comds. AAG 413.44-N Radar. (2) Ltr, Colton to Dir SigC Ground Sig Sv, 12 Apr 43, sub: British CH-TRU-MRU equip. SigC 413.44 Brit equip 9, Apr–May 43 (RB-1913).

1942. It soon became a galling problem which the Signal Corps tried to solve by various means. Early in the year the responsibility of training men to site and install the sets had been specifically charged to the Signal Corps Radar Laboratory at Camp Evans. By May, Maj. Paul E. Watson, executive officer at the laboratory, had outlined plans for an Installation and Maintenance School at the camp.[51] For a while the school turned out radar crews, not many but enough, it seems, to keep up at first with the current needs. Colonel Rearden, after visiting the laboratory in July, reported that "temporarily the production of radar maintenance men has exceeded the production of the apparatus." [52]

Crews had gone out, or were going, to widely scattered places. Of the 204 civilian radar installers who were already overseas, 64 had received special training. Twelve of them were in Alaska, 21 in Puerto Rico, 69 in Panama, 89 in Hawaii, 5 in Trinidad, 5 on Ascension Island, and 3 in Australia.[53] For the time being, the Signal Corps planned to make much wider use of civilians for the maintenance of radars since it did not have enough trained men in uniform. Thus General Olmstead contemplated sending civilian maintenance men to Ascension Island, Australia, Bermuda, Canton Island, Christmas Island, Curaçao, Fiji Islands, Galápagos Islands, Iceland, India, Mexico, Newfoundland, New Caledonia, New Hebrides, Samoa, Society Islands, Tongatabu, and Trinidad.[54]

These arrangements, however, neither satisfied nor sufficed. As the war moved into the second half of the year with prospects of ever more overseas installation of radar, especially of such portable types as the British LW which could be used in tactical operations during invasions, there arose the same problem that had plagued the installation of Army Airways Communications System equipment: who would install the sets promptly when and where the Air Forces wanted them? The existing arrangement by which the Signal Corps provided a few civilian crews was unsatisfactory under war conditions overseas. The Air Forces wanted military crews, subject to military restraint and compulsion, to put in the equipment in unpleasant, if not dangerous, sites abroad, jobs which civilians were prone to decline, or quit.[55] And whereas during these summer months of 1942, the AACS installation problem was being solved in Signal Corps' favor, in radar the responsibility for installation and maintenance went to the Air Forces.

The problem of responsibility touching radar installation came to a head in arguments over the anticipated British CH sets, whose installation would pose great difficulty. This already obsolescent radar required several towers, each several hundred

[51] (1) OCSigO R&W Action 1, Maj Watson to Col Rives, 15 May 42, sub: Siting of radar equip. SigC 413.44 SCR-270-271 12-H, May 42 (RB-1131). (2) Memo, Watson for Dir of SCRL, 4 May 42, sub: Proposed Instl and Maint School at SCRL. SigC 413.44 Radar Installation 3, Apr-Sep 42 (RB-1537).

[52] OCSigO R&W Action 1 (SPSMA 1854) cited n. 38.

[53] (1) Ltr, CSigO to Dir of SCRL, 8 Jul 42, sub: Instl crew. SigC 413.44 Radar Installation 3, Apr-Sep 42 (RB-1537). (2) Incl 3, Capt G. L. Claybourn, Rpt on Civ Pers Assigned to Foreign Stations, 14 Jul 42, with OCSigO R&W Action 1 (SPSMA 1854) cited n. 38.

[54] Memo, CSigO for ACofS, Opns Div, through CG SOS, 24 Jul 42, sub: Civ radar maint crews, overseas locations. SigC (EO) 413.44 Radar Equip Gen, 1942-44.

[55] The Signal Corps experienced the same trouble with civilian employees. See Ltr, Col Ankenbrandt, SigO South Pacific Area, to Col Lanahan, OCSigO, 2 Feb 43, p 5. SigC Opns Br 111, Col Ankenbrandt's Rpts.

feet high. As early as June General Somervell had considered transferring the responsibility to the Air Service Command, which would have the right to use Signal Corps personnel during an undefined period while ostensible control would still be required of the Chief Signal Officer.[56] Now in September General Code, the Deputy Chief Signal Officer, wanted to know if the Air Service Command wished to take over the job of putting up the CH's—a long-term task which would consume a year or more, Code thought—or did General Arnold desire that the Signal Corps do it? [57]

Twelve CH's had been ordered by the Signal Corps for the Air Forces. Ten were planned for the vicinity of large coastal cities like New York. Two would go to Panama. The thorny problem of installation now became unavoidable, especially regarding TRU's, planned for overseas positions. For this work the Signal Corps had no military organization, although it had the knowledge, while the AAF lacked even the latter. On 25 September the problems were debated during a conference between members of the Signal Corps, the Air Forces, and the Royal Air Force. The Signal Corps had found it difficult to get men for overseas installations. When Major Fletcher, from the Air Forces' Directorate of Air Defense, brought up the intent to use "in overseas positions" the British TRU's, Maj. Charles F. Fell of Olmstead's Directorate of Planning remarked that the responsibility for putting them up would fall to the theater commander. But whom would the commander have on hand to do the work? He would have to look to the Signal Corps. And Fell added, "We have no organization to supply military people." As for the civilian crews that the Signal Corps Radar Laboratory had been training, Fell remarked, "Colonel Corput [director of the laboratory] gets the people to the place [overseas] and they quit on him." [58] When the first CH was reported on its way to American shores in October, another group in conference decided that this first set should go to the Signal Corps Radar Laboratory where installation crews would receive training, both civilian crews for stateside installation and military crews (Air Forces supplying the soldiers) for the installations in Panama.[59]

Meanwhile, General Arnold substantiated the policy to which Somervell had consented in June toward giving complete responsibility to the AAF for erecting and maintaining its ground AWS radars. "The Air Service Command," Arnold now wrote, "is in the process of taking over the responsibilities for the installation and maintenance of ground radar equipment used by components of the Army Air Forces. . . . They will continue to assume this function as rapidly as they are able to do so." Code replied that the Signal Corps would assist by training the first CH crews and would furnish instructions and operational and maintenance manuals. Thereafter, the AAF would take over the installation, mainte-

[56] Ltr, CG SOS to All Corps Area Comdrs and CGs of Defense Comds, 2 Jun 42, sub: Maint and instals of radar equip. SigC 413.44 Radar 2, Jul–Dec 42.

[57] Ltr, Code to CG AAF, 2 Sep 42, sub: Instl of ground radar equip. SigC 413.44 British Equip 6, May–Nov 42 (RB–1527).

[58] Summary of TRU, CH Conf at OCSigO, 25 Sep 42, attached to Ltr, Corput to CSigO, 5 Oct 42, sub: Transmittal of summary on TRU, CH Conf; also min of conf, pp. 3–5. File cited n. 57.

[59] (1) Memo, Capt James E. Keely, O/C Ground Radar Sec-2, for Cols Metcalf and Winter, 11 Nov 42, sub: Conf, 26 Oct 42; (2) 2d Ind, CSigO to CG Fld Svs ASC, 30 Nov 42, on Ltr, Maj G. Selwyn, SigC, to CSigO, 5 Nov 42, sub: Electrical calculators CH (RDF). SigC 413.44 British Equip 6, May–Nov 42 (RB–1527).

nance, and operation of its ground radars.[60]

Thus ground radars for the Air Forces, radars which the Signal Corps had developed and in the use of which it had pioneered, were moving out of Signal Corps' hands. The operation of the equipment, explored and defined by the Signal Corps during its organization of the prewar Aircraft Warning System, along with the related tasks of installing and maintaining the sets, passed wholly to the using arm before the first year of World War II was out. The organization and control of the aircraft warning units, wherein the Signal Corps also had pioneered, had already, hard on Pearl Harbor, passed to the Air Corps. Now, toward the end of 1942, only Signal Corps' basic responsibilities for radar develment and procurement would remain with the parent organization.[61] Radars on the ground as well as in aircraft had become essential to Air Forces' mission, and the Signal Corps was supplying the sets in increasing numbers.

Defense to Offense in the West

Whereas in mid-1942 the invasion of North Africa became topmost in Army's planning and toward it the Signal Corps would amass men and equipment, the Pacific arena remained uppermost in the mind of the American public. There, far to the west, America's military men had first to plan a holding action against the Japanese. This meant creating and strengthening bases not only in the South Pacific but also in Australia, China, Burma, and India. By mid-year 150,000 Army troops had been established in the South and Southwest Pacific areas.[62] The defensive turned into a limited offensive in July after General Marshall and Admiral King signed the Joint Directive for Offensive Operations in the Southwest Pacific Area agreed on by the United States Chiefs of Staff." [63] On 7 August the marines landed on Guadalcanal and were followed before the year's end by Army troops.

Hawaii

Honolulu was the center of Pacific operations. As American forces spread out over the Pacific, the radio tentacles of WTJ, ACAN station at Fort Shafter, multiplied. True, the Japanese had lopped off the Philippine stations in May 1942, but new circuits quickly reached out along the route to Australia during the spring and summer.[64] Shafter's most heavily used circuits, toward Melbourne in one direction and, in the other, to San Francisco's WVY and to Washington's WAR, were now high speed, using Boehme equipment but still requiring much laborious hand-typing into the

[60] 1st Ind, CG ASF to CSigO, 16 Sep 42, and 2d Ind, CSigO to CG AAF, 28 Sep 42, on Ltr, Code to CG AAF, 22 Sep 42, sub: Instl of ground radar equip. File cited n. 59.

[61] And only for two more years at that, at the end of which they too would be taken over by the increasingly powerful Army Air Forces.

[62] *Biennial Report of the Chief of Staff, 1941–43,* p. 15.

[63] John Miller, jr., *Guadalcanal, The First Offensive,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1949), pp. 16–17.

The circumstances of the Pacific war increased Army and Navy co-operation, especially in communications. On 23 September the Traffic Division in Office of the Chief Signal Officer reported the first use, in all communications with the South Pacific, of JANP, Joint Army Navy Procedure. The Signal Corps message centers in San Francisco and Honolulu were co-ordinated with WAR in this initial application of JANP toward standardizing and speeding the flow of military messages. Weekly Digest-Traffic Div, Prog, 23 Sep 42, Item 1 A 3, signed by Lt Col Clinton B. Allsopp. SigC 319.1 Drawer 483, AC 133, Weekly Digest of Prog and Problems, Rpts from Divs 7–30–42—12–30–42.

[64] See above, pp. 109–10.

SECTION OF THE RADIO ROOM, FORT SHAFTER, HONOLULU

Boehme perforated strips and out of them. The other circuits remained entirely manual, transmission being accomplished solely by hand-tapped keys. Traffic loads in busy WTJ had been running about a half a million words a month at the outset of the war and were now far exceeding that, so that doubtless Colonel Powell, Signal Officer at Fort Shafter, and his harassed radio operators of the 9th Service Company relished their first introduction to automatic equipment in October, when an installation crew from WAR put in IBM radiotype. The very first tests on the direct WTJ–WAR channel Colonel French in WAR described on 28 October as "very favorable." [65]

Signal Corps activities under Colonel Powell waxed varied and tremendous. ACAN radio and WTJ were but one part of his responsibility. There were numerous wire nets in the islands, for example, no less than 45,000 circuit miles of fire control cable alone by the war's end.[66] His supply and depot responsibilities—storing, issuing, maintaining, repairing—grew heavier with each Army division dispatched to the Pacific, beginning with the 27th, which had arrived in Hawaii in March 1942. The Hawaiian signal office, moreover, provided all the fixed-station equipment of the Army

[65] (1) See above, p. 222. (2) Weekly Digest Traffic Br, Prog, 28 Oct 42, Item 1 A 11. File cited n. 63.

[66] History of Signal Section, appended to History of Subsection G–2, HUSAFMIDPAC, United States Army Forces, Middle Pacific and Predecessor Commands, Vol. I, Sec. IV, Wire, p. 1. OCMH.

Command and Administrative Network for the Pacific area.[67]

In July Army signal intelligence activity in Hawaii received a badly needed boost with the arrival of the 101st Signal Company, Radio Intelligence (RI). Previously, the activity had been woefully weak. There had been a monitoring station on the islands since 1935. At the outbreak of the war it was Station Five, operated by a detachment from the 2d Signal Company, under operational control of the Chief Signal Officer in Washington, but administered and supervised by Colonel Powell. It remained puny in size and ability, lacking even direction finders to determine the direction whence came the signals it monitored. During the first months of the war the Army depended upon the Federal Communications Commission to provide direction-finding facilities, to maintain, in general, the signal security of the Hawaiian Islands, and to guard against subversive radio activity. The main job of Station Five was to intercept and study Japanese Army radio traffic. To build up this activity the Secretary of War had informed the Commanding General, Hawaiian Department, on 31 March 1942, that he was sending the 101st Signal Company, Radio Intelligence, which would carry out its mission under the Signal Corps' Intelligence Service in Washington.[68]

Southwest Pacific Installations for ACAN

In Australia the defensive attitude of the gloomy early months of 1942 had given way to a spirit of offense. Fears for northern Australia diminished by mid-year as the enemy's push south now began to yield to the Allies' counterefforts. The north shore of New Guinea and the Solomons became the front line, and in June General MacArthur moved his headquarters north, from Melbourne to Brisbane. The ACAN station moved too, followed in September by the USASOS headquarters which switched, not to Brisbane, but to Sydney.

So it was that by mid-1942 Station WVJJ at Brisbane was becoming the nerve center of the Southwest Pacific ACAN system, replacing WTJJ at Melbourne. The circuits from Sydney, Townsville, Darwin, Nouméa, and Honolulu were now relocated to terminate at Brisbane. Great expansion ensued, as American and Australian forces, reacting to their earlier defeats, began to consolidate their strength and make their first victorious advances. New equipment was flowing in. WVJJ transmitters multiplied and their power increased to 10 and then to 40 kilowatts.

Following the progress of the armies, the web of fixed Army communications, ACAN stations, extended further northward. A new channel, direct from Brisbane to San Francisco, was accompanied by ramifications of the Southwest Pacific local networks; for instance, a significant one to the north went to work in September between Brisbane and Port Moresby, New Guinea (WVLQ).[69] The Port Moresby radio, significant advance though it was, still fell pitifully short of reaching the few survivors of Bataan and Corregidor, now holding out as guerrillas and suffering relentless pursuit. As of mid-October, the latest radio contact by Mac-

[67] (1) *Ibid.*, pp. 5, 12. (2) Dr. Donald O. Wagner, Army Command and Administrative Network, 1941–1945: Pt. I, The Pacific, SigC historical monograph E–6, p. 11. SigC Hist Sec File.

[68] (1) Hist of Sig Sec, Sec. VIII, Signal Intelligence, pp. 1–3, cited n. 66. (2) Ltr, TAG to CG Hawaiian Dept, 31 Mar 42, sub: Intercept directive. AG 311.23 (3–30–42) NC–B.

[69] Wagner, Army Command and Administrative Network 1941–45, Pt. I, p. 25, and chart dated 16 Feb 43.

Arthur's headquarters in Brisbane with the 14th Infantry, Philippine Army, had been made on 7 August. At that time the guerrilla force explained that imminent danger from the Japanese was compelling it to close down its radio transmitter.[70] But the so-called "guerrilla network" in the captive Philippines continued to operate, sporadically. Portable radio sets—in the hands of fugitive Americans, Filipinos, and others, some of whom were smuggled in by submarine—continued to transmit reports on Japanese activities, assisting Allied operations and the subsequent recapture of the islands in 1944.[71]

Late in 1942 Signal Corps units in Australia such as the 436th and 440th Signal Construction Battalions began constructing considerable landline wire links through northeastern Australia, especially, in the vicinity of Townsville. They also constructed an alternate landline for part of the telephone system connecting the Brisbane installations with those at Melbourne and Sydney as well as at Townsville. This system ran close to the coast. An alternate line inland seemed desirable in case of enemy action along the coast, and this they built also. Besides building new lines, they made use of existing Australian facilities, which they found they had to alter not a little. All this long-line telephone work they accomplished under the eye of the Australian Postmaster General, who insisted upon placing his own supervisors over Signal Corps construction jobs. Communication procedures, equipment, and construction methods differed considerably between Australia and the United States. "The so-called supervisors," one of the Australian officials admitted, "learned how open wire-lines should be built." [72]

Southwest Pacific Communications for USASOS

The Army Command and Administrative Nets constituted only a part of the stations and circuits which it was Signal Corps' duty to provide. Other nets had to be set up for the supply services. Supply of armies is so vast an undertaking that it requires its own separate communication systems of wire and radio nets to handle the endless bookkeeping details which otherwise would harry administrative and operational communicators. In some minor areas of activity, one single communication set-up may serve all functions. But generally the Signal Corps finds it necessary to establish separate stations and separate nets for the supply service of the Army. A good example of Signal Corps' effort toward communications for the supply function overseas is afforded by the Australian nets beginning in mid-1942.

In July 1942 Col. Calvert H. Arnold became the Signal Officer of the United States Army Services of Supply in the Southwest Pacific Area (USASOS SWPA).[73] Shouldering his large burden at first at Melbourne, Arnold presently moved to Sydney,

[70] Msg, MacArthur [to WD] (06651) No. C–716, 15 Oct 42. Msg Log File, Staff Com Center.

[71] Wagner, Army Command and Administrative Network 1941–45, Pt. I, p. 48.

[72] (1) *Ibid.*, p. 26. (2) Ltr, Col John C. Grable, Exec OCSigO USASOS SWPA, to Col Parker, Plant Div, 10 Dec 42; (3) Maj J. W. Lea, SC, Proposed Application of Telephone and Telegraph Carrier Systems, 12 Sep 42. SigC (AC) 331.1 Inspec Trip to S and SWPA, Maj A. E. Wharton, 1942.

[73] His Signal Section at SOS headquarters embraced divisions for Administration, Cryptography, Personnel, Procurement and Fiscal, Planning, Radio, Wire, Supply, together with the Message Center serving the SOS headquarters. Hist of USASOS and AFWESPAC, Ch. XXIX, Signal Corps, Jul 12–Mar 43, p. 1. OCMH.

opening the SOS headquarters radio station there on 6 September. A week later the new Sydney radio opened channels to Melbourne, to Brisbane, and, five days later, to Townsville, Honolulu, and Darwin, and then on 28 September, to Nouméa.[74]

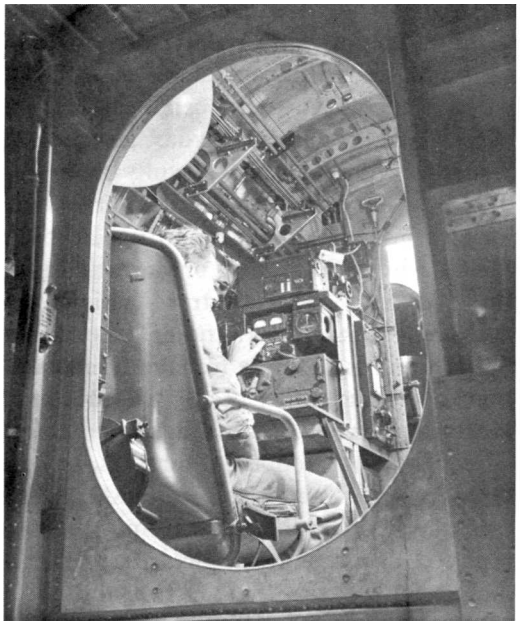
The Services of Supply maintained base section headquarters at Brisbane and at Townsville. It maintained an advanced base section in Port Moresby. A large 10-kilowatt radio served the Brisbane base section. Beginning operation in mid-July, it provided channels to Melbourne, Sydney, Townsville, Darwin, Nouméa, Honolulu, and San Francisco. Another channel opened in mid-September bringing in Port Moresby.[75]

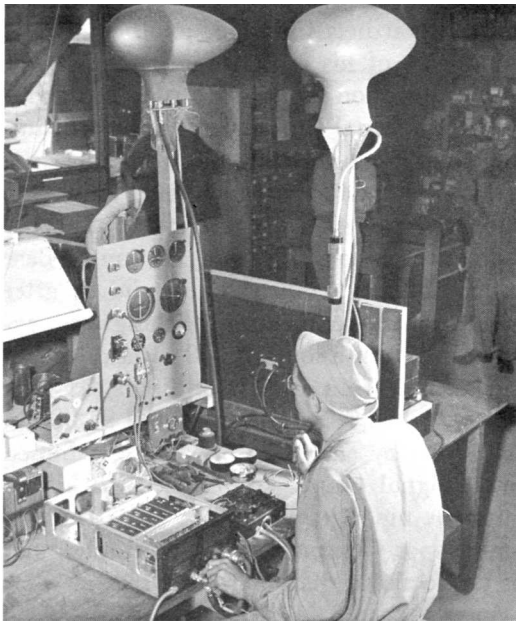
From the major stations in the base sections, local networks fanned out liberally and Arnold had to provide fixed radio equipment for all of them (not very fixed either, since they shifted frequently as the tactical situation changed and the men moved on). During the late summer and autumn of 1942 there were radio nets operating around the clock along truck convoy routes, as for example along the route through the Australian interior from Townsville to Darwin, with stations at Night Camps No. 1 and No. 2, at Helen Springs, Birdum, and Adelaide River. There were low-power radio sets at Cairns and Mount Isa in the Townsville base section net. In the same base section area, two low-power radio stations perched on Cape York jutting north into the Coral Sea looking toward New Guinea, in order to relay messages to and from the Allies who were now locked in the Papua Campaign.

Another radio net which Arnold and his men operated for the SOS Base Section No. 2 at Townsville opened for business on 6 October and took in northward-reaching stations at Cairns, Cooktown, Portland Roads, and Horne Island, all in Australia, together with Merauke, westward along the south coast of New Guinea. While some channels closed down, their purpose having been served after the tactical picture changed (for example, the Merauke and Horne Island stations closed on 5 November), other new ones opened: Townsville–Darwin on 10 November, Townsville–Port Moresby on 12 November, Townsville–Portland Roads on 25 November.

In Port Moresby itself, the signal office of the U.S. advanced base set up for business in August 1942, establishing links at once to Townsville and Brisbane with such radios as could be had at first. In fact, Arnold's men began setting up communications at Moresby before any American combat troops arrived. Col. John C. Grable, Arnold's executive signal officer, wrote to Colonel Parker in Plant Division exclaiming that "we, as an SOS, are being required to do considerable work in combat zones and of a type that corresponds more to combat work than SOS functions."[76] Subsequent radio links took form as fast as Signal Corps men could acquire the equipment, in particular two additional channels to Townsville established in November as the Papua Campaign intensified and the flow of messages increased. Local nets spread out from Moresby as the offensive moved on against the Japanese. For example, before the year's end a low-powered net serving SOS needs linked Port Moresby with Milne Bay at the tip of New Guinea and with Oro Bay on the north shore, near the bitter battleground of Buna.[77]

[74] *Ibid.*, pp. 21, 54.
[75] *Ibid.*, p. 29.
[76] Ltr, Grable to Parker, 10 Dec 42, cited n. 72(2).
[77] Hist of USASOS and AFWESPAC, Ch. XXIX.





INSTALLATION AND MAINTENANCE OF SIGNAL EQUIPMENT *included such assignments as installing radio equipment in aircraft (left, above), repairing radio compasses (right, above) in Australia, and the operation of general repair shops (below) in New Guinea.*

Meanwhile, as Arnold provided communication nets for SOS, another equally vital part of his responsibilities, supply of communication equipment, rapidly magnified. His Signal Corps men multiplied supply depots and dumps throughout the Southwest Pacific base sections of SOS. Site after site seethed with activity. In the Brisbane area alone, the signal section of Base Depot No. 3 acquired one building after another, not to mention parking lots, expanding from about 15,000 square feet indoors and from 20,000 outdoors, as of 1 June, to 158,000 under roof and 95,000 in the open by early 1943. All this, jammed with Signal Corps equipment, was looked after by ninety civilians and the 202d Signal Depot Company, less two storage and issue sections that were serving at Port Moresby.[78]

In Sydney and Melbourne the 201st Signal Depot Company had its hands equally busied in the signal sections of the depots there (the Melbourne depot gradually merged with the one at Sydney). At Townsville, 22,400 square feet of covered storage space and "an almost unlimited amount" in the tropical open had been acquired. There was no refrigeration for dry batteries and unroofed storage had its disadvantages. Near Port Moresby, in the advanced base section of SOS, the storage and issue detachment from the 202d Signal Depot Company established a dump in October. Frame and canvas shelters increased the warehouse space there, for certainly open storage was useless to attempt in New Guinea jungle heat and humidity. The men at Milne Bay used grass huts to supplement storage space. Thus Sydney, Brisbane, Townsville, Port Moresby, Milne Bay were the main line of Signal Corps supply.[79]

[78] *Ibid.*, pp. 65–66.
[79] *Ibid.*, pp. 67–71.

An important responsibility of Arnold's supply function was repair and maintenance. Badly handicapped by the lack of proper test equipment, especially in the very high frequency ranges of radar, a scant 200 Signal Corps repairmen serving under the SOS headquarters "provided repair services for all combat units of the Fifth Air Force, for all Aircraft Warning organizations, for the 32d and 41st Infantry Divisions, for the Netherlands East Indies Intelligence Section and for remote fixed radio installations operating under the Signal Section of Headquarters USASOS." Scattered everywhere in small sections at airfields, in base depots, in forward combat areas, and in trucks moving with combat troops, the men repaired everything electrical, from radars such as SCR–286's, 270's, 521's, and 535's, to motion-picture projectors. At times they even constructed equipment. For example, the signal repairmen in the Melbourne Depot built fifteen special portable radio sets which intelligence units of the Netherlands Indies forces put to use. Colonel Grable reported at the year's end that USASOS had purchased about seven million dollars' worth of radio equipment in Australia, designing it and getting it built in local factories. He added, "This is the only way that radio communication has been maintained, because the supply of equipment from the States came no-where near meeting the requirements." [80]

[80] (1) *Ibid.*, pp. 72–78. (2) Memo, Grable for Radio Sec, Plant Br, OCSigO, 10 Dec 42. SigC (AC) 331.1 Inspection Trip to S and SWPA, Maj Wharton, 1942.

In the period late 1942 to early 1943 Arnold's repairmen were the 142 constituting the 176th Signal Repair Company, together with 32 from the 201st Signal Depot Company, 14 from the 832d Signal Service Company, and a number from the 202d Signal Depot Company. The 176th maintained seven sections serving the Fifth Air Force at

Port Moresby and New Guinea

One of the most important terminals of the Brisbane net late in 1942 was Port Moresby. In that area America's initial assistance to the fighting Australians was in the air. Consequently, the first complete signal company to arrive from the United States was an aviation company—the 415th Signal Company, Aviation. The unit, originally intended for service in the Philippines, arrived from the States in Brisbane on 15 July. For two weeks its 136 men staged at Townsville in northern Australia, then sailed for Port Moresby. Their mission was to maintain communications for Headquarters, Advanced Echelon, Fifth Air Force. They quickly set up a message center in the Papuan Hotel at the port and began at once to relieve Australian communicators.

By 25 August the 415th was handling all administrative traffic for the Allied Air Forces headquarters. But teletype lines to the five Allied airstrips, lines stretching out along 20 miles of road from the town, were not so quickly laid or readily maintained. Air raids from the Japanese fields on the north side of the island, grass fires, and rampaging trucks continually severed the wire. The linesmen, on the alert twenty-four hours of the day, literally slept with their boots on. Moreover, as the base of military operations continued to shift from Australia to New Guinea, the traffic load upon the 415th steadily increased, accentuating a personnel shortage which became acute, thanks to tropical illnesses. Fevers and bowel and skin disorders chronically incapacitated 10 percent of the company's men.

In mid-October 1942 four men of the 415th, who were ferried by airplane over the mountain backbone of New Guinea, along with elements of the 32d Infantry Division, established at Wainegela Mission the first American radio station on the northern coast of New Guinea, somewhat downshore from Japanese-held Buna. Using an SCR–188, these men provided weather reports and communication facilities for the aircraft shuttle between Port Moresby, Milne Bay, and the Buna area. On 30 November they moved again, to Dobodura, within ten miles of the enemy lines, close enough to experience frequent night raids. Additional communication equipment and more men from the 415th were flown to the Dobodura airstrip in December to provide for the increasing flow of air transports which brought supplies and reinforcements to the Buna campaign.[81]

Holding Action in CBI

Far beyond the nets of Signal Corps wire and radio in the South and Southwest Pacific, other Signal Corps radios had been belaboring the ether since April, when the ACAN station, WVNA, Karachi, India, had first gone on the air. The Signal Corps communication nets in the China-Burma-India theater, General Stilwell's command, served chiefly two principal organizations comprising that theater: The Tenth Air Force and the Theater Supply Services, SOS, United States Army Forces, CBI.

The Tenth Air Force, in turn, fathered six offspring (1) its Air Service Command (not to be confused with the main Air Service Command at Wright Field, Ohio);

Port Moresby, Townsville, Carbutt Field (near Townsville), Charter Towers, Brisbane, Amberly Field (near Brisbane), and Tocumwal. Hist cited n. 73.

[81] History of the 415th Signal Company Aviation, Fifth Air Force. AF Archives SIG–415–HI, 1 Dec 42 (5527–1).

(2) the 10th Communication Region of the AACS; (3) the India Air Task Force; (4) the China Air Task Force; (5) the Karachi Tactical Area; and (6) the Chabua Tactical Area. In the early autumn of 1942 representatives of each of these units came together in order to draw up a theater signal plan, detailing the duties of each signal officer and specifying the extent and operation of all nets. Aside from general supervision and co-ordination, the principal duties of the theater signal officer, Maj. George L. Townsend, were allocation of call signs and blocks of frequencies, with clearance by the Indian and Chinese governments, and technical control of the aircraft warning system. The actual planning and co-ordination of the AWS, however, was the function of the signal officer of the Tenth Air Force, Col. S. S. Lamb, who was also responsible for maintaining channels between his headquarters and those of the four subordinate tactical forces. The local Air Service Command had its own administrative net, and so did the theater Services of Supply. The 10th Region of the AACS, officially relieved of administrative traffic, devoted itself solely to its part in service and tactical aviation.

The United States Army Forces, CBI signal plan, seeking to assure military communications in these remote areas of the world, expressly encouraged a resort to naval, commercial, or Allied Air Forces facilities "when available and suitable." In his headquarters at Chungking, at theater field headquarters, and at signal branch offices in New Delhi and Ramgarh, General Stilwell had such communication facilities in use as could be supplied. Little enough they seemed, for the major items in use at Chungking included, for example, only one telephone switchboard (BD–72) and 13 phones (EE–8); only one teleprinter and three telegraph sets; three typewriters, except that one had been lent to the Navy; an assortment of receivers and generators, transformers and power units; and a 300-watt continuous wave transmitter (BC–447), supplemented by another, of 40 watts, borrowed from the Navy. On duty with this equipment were 6 officers and 16 enlisted men, rather than the required 14 officers, 49 enlisted men.

Brig. Gen. Claire L. Chennault's air force had two radio nets: one administrative, one tactical. The first served the Air Service Command, the second the China and India Air Task Forces and the Karachi and Chabua Tactical Areas. To the Air Service Command net went men and officers of the 861st Signal Service Company, the 43d Signal Company Service Group, the 83d Signal Company Service Group, the 235th Signal Operations Company, and detachments of certain Air Corps units (the 51st Fighter Control Squadron and the 7th Bombardment Group).[82]

After the Signal Corps' first large transmitter in India, at Karachi, had begun operation in April 1942, satellite stations rapidly sprang up. During the summer New Delhi in Central India became the net control station, serving the whole area, one far-reaching circuit excepted: New Delhi-Karachi-Washington. Three local networks radiated from New Delhi, one using a 300-watt Federal Transmitter, reached to Karachi on the west; another using a BC–447 of similar power, reached both south and north, respectively to Bangalore and to Allahabad; the third, using a 300-watt Federal, reached to Chabua, Calcutta, and Ramgarh, all lying eastward toward China. At Karachi there were two nets: the origi-

[82] Consolidated Signal Plan, USAF CBI (29 Sep–7 Oct 42). SigC CC 676, CBI Signal Plan.

nal long circuit to Washington on a 10-kilowatt BC–339 and 340, and a net embracing New Delhi, Asmara in East Africa, and Chungking in China, all using 300-watt transmitters. Chabua in eastern India had two nets, one to New Delhi and one to Kunming and to Chungking, using 300-watt sets also. Chungking's return circuits to Chabua and Karachi used a 300-watt transmitter borrowed from the Navy. There were numerous lesser Signal Corps radio channels, too, operating in those faraway lands: Ramgarh to New Delhi, Bangalore to New Delhi, Allahabad to New Delhi, Calcutta to New Delhi, Kunming in China to Chabua in India. In China there were two local nets which belonged originally to the American Volunteer Group: one from Chungking to Linchow, Lingling, Kweilin, Chinkaiang, and Hengling; the other from Kunming to Yunnanyi and Changhi.[83]

American forces in CBI relied at first almost entirely on radio, and naturally so, both because of the distances involved and because the native wire networks were rather ineffective. Early in 1942, however, the Indian Government Department of Posts and Telegraph provided local telephone communications for United States Army use through civilian switchboards at New Delhi, Karachi, and Calcutta. In June negotiations began for the installation of a switchboard at New Delhi by the Army and the Indian Government for exclusive military purposes. Meanwhile, the Army experienced difficulty in getting the use of teleprinter circuits for longer distances even on a part-time basis. The reason given was that the facilities were already overloaded by British military traffic. Wire lines were eventually provided, however, by new Army construction on a "project" basis or by exploiting the organizational equipment of certain units for local communications.[84]

Strengthening Eastern Outposts

All this varied and romantically remote Signal Corps effort in the Pacific and the Orient, however, was but a sideshow, a decidedly subordinate arena of activity. American military planners were looking eastward over the Atlantic to the defeat of Germany first. The enemy in the Pacific would have to wait.

Iceland

In Iceland on the northern route to Europe the Signal Corps by mid-1942 had supplied the equipment needed to complete the radio stations serving ACAN. Yet adequate and reliable quantities of electrical power for the big transmitters remained a problem until late in September when the Signal Corps mended matters by sending a large 35-kilowatt generator for the main transmitter and eight lesser ones (four of 7½-kilowatts and four of 5-kilowatts) to

[83] Wagner, Army Command and Administrative Network, 1941–45, Pt. II, China–Burma–India, pp. 70–71. Signal Corps teams that moved out from Karachi during the second half of 1942 were Team 1, in July, to Ramgarh, Bihar Province; Team 5, in July, to Kunming, China; Team E, in October, to Chakulia. Hawkins, *History of the 835th Signal Service Battalion, 1942–1946,* pp. 8, 20, 23.

[84] Wagner, Army Command and Administrative Network 1941–45, Pt. II, pp. 77–78.

Air Forces wire nets by 24 November 1942 included a teletype circuit between New Delhi and Agra, and other lines between Jorhat and Kinjikhoa; Tinsukia, Dinjan, and Barhapjan; Chakulia and Ramgarh; Chakulia and Calcutta; Chungking and Peishiyi. An SOS wire net diagram of this same date shows circuits from New Delhi to Lahore to Karachi; from New Delhi to Bombay and to Bangalore; from New Delhi to Calcutta and to Chakulia; from Calcutta to Tinsukia. The CBI Signal Corps story to mid-1943 is continued below, pp. 460–67.

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serve the smaller ACAN radios which communicated with Greenland, Iceland, and with each other within the local Iceland net. There was no standby for the big 10-kilowatt transmitter on the Washington-Iceland circuit. But there was the peacetime Icelandic radio station at Vatnesendi, and this the Signal Corps sought to lease. Negotiations initiated through the State Department led to a contract early in November, whereupon Radio Vatnesendi not only became a valuable standby facility in case of emergency but also began at once to carry traffic, assisting the now heavily loaded ACAN circuits routed through Iceland.[85]

Beginning in July 1942 the 26th Signal Construction Battalion put in many miles of open lines, put up an aerial cable catenary crossing over the Olfusa River at Selfos, and strung aerial cable between Utskalahammar and Castle Hill. When the Signal Corps proposed assigning this battalion to General Eisenhower to serve in North Africa, Eisenhower refused, answering that its work in Iceland was too vital to be interrupted. He cited as especially important its work toward completing facilities for the airdrome at Keflavik and toward strengthening the aircraft warning system on the island.[86] The wire project, called "Latitude 65," continued to occupy Signal Corps men on Iceland; for example, the 54th Signal Battalion put in many miles of tape-armored subterranean cable and aerial cable, too, under the severest kind of weather and over most difficult lava rock and muskeg terrain. The project would never be completely finished,[87] for the defensive character of the war which had drawn America into Iceland and which had made the island's defense seem important at first, was now changing to the offensive. An offensive which, if it no longer contemplated BOLERO and the immediate invasion of Europe, did envision TORCH and war upon the Axis in Africa.

Panama to Trinidad

Iceland was but America's left hand extended to England. The right arm reached down around the Caribbean and out toward Africa. The South Atlantic route paralleled the northern in importance. Along the way Panama had its own tremendous significance, of course, because of the Canal. By June 1942 Army's uttermost efforts to bolster its defenses were showing results. Even the Signal Corps received some encouragement, despite the dark report which Watson-Watt had leveled in March against American radar and aircraft warning measures. Brig. Gen. Harry C. Ingles, former Signal Officer in Panama and now chief of staff for the commanding general, had told Colonel Rives, Chief of the Radar Division in the Office of the Chief Signal Officer, that "in spite of Mr. Watson-Watt's damning report, which was a most casual survey as he was here only three days, our Aircraft Warning Service is not so bad and is improving rapidly." Ingles added, "There are two basic faults which we knew long before we ever heard of Mr. Watson-Watt, namely: defective siting of some sets and totally untrained personnel." [88]

[85] 1st Lt Charles R. Novick, A Story of Signal Communications in Iceland, SigC historical monograph E–4a, pp. 13–14. SigC Hist Sec File.

[86] (1) Capt Frederick Reinstein, Signal Corps Fixed Communications in the European and Africa-Middle Eastern Theaters (1945), SigC historical monograph E–7, p. 11. SigC Hist Sec File. (2) OPD to CG ETO (05648) Nos. R–2073, 17 Oct 42, and 4014, 24 Oct 42. Msg Log File, Staff Com Center.

[87] Reinstein, Signal Corps Fixed Communications in the European and Africa-Middle Eastern Theaters, pp. 10–11.

[88] (1) Ltr, Ingles to Rives, 19 May 42. SigC 676.3 AWS Panama, 3 (RB–2162). (2) See above, pp. 100–101.

Warmly encouraging was a personal note to the Chief Signal Officer from Lt. Gen. Frank M. Andrews, commanding in the Panama and Caribbean areas, who wrote to "Dear Dawson" on 9 June:

> Reference your letter of June 5th, Dr. Bowles arrived here Sunday and has already started to work. I am sure, from my talk with him yesterday morning, that he is going to be very helpful.
>
> How is everything coming with you? We are still pestering you about personnel and equipment, but I know that you are doing all you can for us. The truth of the matter is that we have got a pretty elaborate and expensive radar set-up down here which is of very little use to us until we can complete the picture. For example, even when we do get a good plot of an incoming airplane we cannot make a satisfactory interception because we cannot accurately track our own pursuit and cannot reliably communicate with it. Everybody is interested, however, and is working hard. Equipment is coming in and the situation is improving.

General Olmstead replied gratefully to this, one of the relatively few good things anyone had to say of the Signal Corps and its labors in the early days of World War II. "It is a pleasure," he replied on 16 June, "to know that someone in the field appreciates the enormous job that remains for the people here to do." He summarized the equipment situation, relative to identifying friendly airplanes and communicating with their pilots. "IFF equipment," he wrote, "should be available on the aircraft in the Canal Zone at a very early date. The VHF ground equipment will be shipped to Panama for installation within the next sixty days. The Radio Set SCR–522, which is the airborne portion of the VHF equipment, is being installed on airplanes at the present time. . . . When the equipment is operating," Olmstead concluded, "you should be able to track our own pursuit, communicate with them and to make satisfactory interceptions under normal operating conditions." [89]

The new VHF radio facilities (100–156 megacycles) were already in place in some of the Caribbean ground stations; for instance, transmitters and receivers SCR–562 and 563 at Henry Barracks on Puerto Rico, also VHF direction finders, SCR–565 and 566, at Cerrote, Corozal, Fajardo, and Maunabo, all on Puerto Rico, and also on St. Thomas and St. Croix in the Virgin Islands.[90] Even so, it would be early 1943 in the Caribbean, as elsewhere, before VHF intercept facilities would become completely integrated and implemented with SCR–522 and IFF on every aircraft co-operating with ground VHF and GCI radar.

Upon completion of long-range high frequency radio (2–20 megacycles) installations both for ACAN and for AACS, business was now booming. ACAN work loads in the Caribbean Command headquarters waxed mightily, the load on the Quarry Heights-Washington channel (WVL–WAR) multiplied fifteen times over during 1942—from 362,000 words a month to 5,388,725.[91] By the autumn of 1942 the welter of air communications serving the myriad fields and flight activities along the South Atlantic ferry route began to shape into an organized pattern. For service from field to field, the 325th and the 327th Signal Companies, Aviation, were responsible; for communications from plane to plane

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[89] (1) Ltr, Andrews to Olmstead, 9 Jun 42; (2) Ltr, CSigO to Andrews, 16 Jun 42. SigC 413.44 Radar Equip 1, Oct 41–Sep 43 (RB–1386).

[90] Maj John H. Baker, Communications and Radar in the Area of the Caribbean Defense Command 1940–1948 (1948), p. 109. OCMH.

[91] *Ibid.*, p. 107.

and from plane to field, the airmen were responsible.

By now the accumulation of installations and equipment was becoming impressive. Along the South American coast, for example at Curaçao, Hato Field possessed a BC–410 working point-to-point communications, also a BC–460 serving this purpose too, plus air-ground. Much more equipment was on order: radios and a radio range, both for Hato Field and for nearby Camp Suffisant, Curaçao, and for Dakota Field on the adjacent island of Aruba. Out in the Lesser Antilles island chain, Beane Field on St. Lucia now rejoiced in two BC–401's for air-ground and for point-to-point service, also in a radio range B–446. Whether one flew along the coast or via the Antilles chain, the routes converged on Trinidad. There, a number of AACS stations now flourished. Waller Field had a BC–329 for airdrome control, a BC–401 for air-ground, a B–446 radio range. Fort Read had a BC–401 in operation and three more on order. Port of Spain had a BC–401 serving the XXVI Fighter Command net control station, and Edinburgh Field had two BC–329's on order, one to provide airdrome control for each of its landing strips. Next, farther along the ferry route toward Natal and Africa, came Atkinson Field, with a BC–401 for air-ground, a BC–642 for point-to-point, a B–446 radio range. Farther on was Zandery Field, Surinam, as yet unequipped but awaiting two BC–401's and a B–446.[92]

Radar stations now multiplied too. By the end of July, while three SCR–270's were scheduled to go to Aruba and Curaçao, four were already operating in the Puerto Rico area, as well as three 271's, one each at Santa Ana, El Yunque, and St. Thomas, and a 270 at Borinquen. No less than nine 271's were to be delivered between August and October in the Trinidad sector, which included St. Lucia, British Guiana, and Aruba-Curaçao. Already fourteen SCR–268's were on Trinidad for the use of the Coast Artillery. Improvement in radar operation, siting, and calibration was steady as the crews grew in experience and as the Signal Corps learned more about siting problems. On 2 August General Andrews complained that the inadequate supply of test equipment and spare parts still stood near the top of his troubles with the AWS. Even while the supply was improving, the increasing number of radars operating day and night imposed a demand that continued to outrun the supply.[93]

While manpower became less and less a problem, the tropical environment remained hostile to electronic equipment and to its operators alike. A field sanitary inspector looking over AWS radar stations in September found conditions ideal for dis-

[92] *Ibid.*, pp. 118–20.

[93] *Ibid.*, p. 150. A technical report from the crew of the SCR–270 on Crown Mountain, St. Thomas, dated 15 September 1942, gives an idea of the normal attention required by a big radar over a period of time:

"At the very first running of this equipment, in December, 1941, one element burned out, [was] cleaned, rewound, and burned out again. A filament transformer proved insufficiently insulated and began arcing to ground. The pulse was stopped for an hour on one occasion when a condenser shorted. As a result of insufficient lubrication and faulty alignment, the gear in the equipment for changing direction failed, throwing the set off service for a day. Roller bearings burned out. A day was lost when the bearings in one of the motors failed. High leakage of current burned out several line fuses on the rectifier, a situation cleared by filing off some sharp edges and thoroughly cleaning everything; the result was a clearer picture in the oscilloscope. Resistors burned out; another condenser shorted; the circulating fan motor burned a coil. . . ." *Ibid.*, p. 154.

ease and fever. Drainage through the puttylike, waterproof soil was impossible. Round about were lagoons full of algae and croaking frogs, the larger pools rejoicing also in crocodiles and caymans. The Signal Corpsmen at the radars worked amid the raucous chorus of frogs, the bark of crocodiles amid heat and disease, the heat could be lethal enough to knock a man out and yet the night so cool that though wrapped in a wool blanket and shrouded by a mosquito netting canopy, one would shiver all night through.[94]

Panama became a testing ground for new and newer radar, especially for such microwave sets as the SCR–615, which began to get into the field in 1942. Dr. Bowles, of the Massachusetts Institute of Technology and Secretary of the Microwave Committee of the National Defense Research Committee, having been recently appointed the expert consultant for radar to the Secretary of War, stimulated developments both at home and on excursions into the field.[95] At Stimson's request Bowles and Ralph Bown of the Bell Laboratories, the latter also a member of the Microwave Committee, inspected Panama in June. They urged microwave ASV in place of the long-wave equipment ASV–II, or SCR–521, then in use by patrol bombers. In particular, they urged microwave radars for the Aircraft Warning Service in order to provide low coverage against aircraft, something which the long-wave radars in Panama, both the SCR–270 and 271 and the British CHL (SCR–588), could not adequately provide. In consequence of Bowles' trip and recommendations, two more scientists from the Radiation Laboratory, Dr. DuBridge and L. C. Marshall, also visited the Canal soon after and worked out plans to send two SCR–582's and an SCR–615 to the Canal Zone, these being the first Signal Corps microwave radars put to use on the ground.[96]

Trinidad to Africa and to the Middle East

America's right arm, with Signal Corps nerves and sense centers, punched right through a succession of bases from the West Indies and Trinidad, on along the coast of Brazil, British Guiana, Surinam, to Natal, at the eastern tip of Brazil, on across the South Atlantic to Africa, by way of the lone volcanic isle of Ascension in mid-ocean, a counterpart to Iceland in the North Atlantic. The small advance party of soldiers of the Composite Task Force 8012, who had been at work on the isle since early spring of 1942, were completing initial installations and running low on their rations when the *Steel Engineer* arrived on 10 July, followed on 14 August by the *James Parker,* bringing enough men to complete the Army garrison. Aboard the *Steel Engineer* came two SCR–271's, minus their towers and operating buildings. Even so, the 692d Signal Aircraft Warning Company improvised and got both radars installed and operating before the end of September. The African invasion, drawing imminent, now gave tremendous importance to the Natal-Ascension-Accra ferry route. The AACS radio station, WYUC—serving Wideawake Field—its radio beacon and homing facilities, and its radiotelephone circuits, all labored hugely as the weeks brought TORCH nearer. November, the month of the inva-

[94] *Ibid.,* p. 156.

[95] Dr. Henry E. Guerlac, Hist Div OSRD, Radar, 1945, pp. 991 ff (Sec E, Ch. I, 9 ff).

[96] (1) *Ibid.,* pp. 994–95 (Sec C, Ch. I, pp. 12–13). (2) See above, pp. 260–61.

sion, would bring a sevenfold increase over September in the number of shuttling aircraft which would pause on Ascension Island.[97]

In Africa itself the airway routes divided: northward to the Azores and the United Kingdom; eastward to Egypt, the Middle East, and India. The AACS, with the aid of the Signal Corps, had, by October 1942, set up Army airway stations at Roberts Field in Liberia, at Accra on the Gold Coast, at Lagos and Maiduguri in Nigeria, at Fort Lamy in French Equatorial Africa, at El Fasher and at Khartoum in the Anglo-Egyptian Sudan, at Cairo in Egypt, at Gura (near Asmara) in Eritrea, and at Aden in Arabia. As of October nearly all the equipment installed was commercial (much of it had been taken over from previous Pan American Airway stations in Africa). But more and more Signal Corps equipment was arriving. For example, a quantity which the Signal Corps shipped in October for these stations included: 4 each BC–400's and 446's, 9 BC–460's, 10 each BC–329's, SCR–556's and SCR–551's, 1 each BC–339 and BC–340.[98]

These were AACS stations, equipped by the Signal Corps but operated by the Air Forces. Important ACAN stations were going up in Africa too, essential links in the round-the-world equatorial belt of U. S. Army communications. Before mid-year Signal Corps planners had decided upon the equipment, the frequencies, and call signs for an administrative net along the African ferry route to relieve the heavily loaded Pan American and AACS stations.[99] Outstanding among the new ACAN stations would be the ones at Accra and Asmara, on the west and east coasts of Africa, respectively. A 10-kilowatt transmitter had just arrived at Accra, General Olmstead learned early in October, and members of the 830th Signal Service Company hoped to have it ready for service by November.[100]

Among the Signal Corps men who helped to put up the ACAN station at Asmara, Eritrea, was Team Seven, 1 officer and 20 enlisted men from among the early comers to India. By July they had flown in from Karachi and set about their labors. The antenna towers were already there, thanks to the Italians (Radio Marina), and they were high—"reaching somewhere near the sun in the daytime and the moon at night." Lacking the planned 40-kilowatt transmitter, the men put to temporary use a 300-watt set.[101] Within a few weeks, as ACAN Station WVNT, they began working Karachi, some 2,000 miles to the east, and then Accra, also about 2,000

[97] (1) Memo, Gen Handy, ACofS USA, for CG AAF, 4 Jul 42, sub: Radar equip priorities; (2) Ltr, TAG to CG USAF in Ascension Island, 13 Oct 42, sub: Instl of VHF in Ascension Island, with 9 Incls. OPD 413.68 Ascension Island. (3) Hist Div WDSS, History of U. S. Army Forces, South Atlantic, p. 258. OCMH. (4) See above, p. 108.

[98] Carbon copies entitled AACS Equipment at 13th, 18th and 19th Communications Regions, 25 May 43, unsigned and otherwise unidentified. SigC 676.3 AACS.

[99] (1) OCSigO R&W Action 1, Col Lanahan, Asst Dir of Planning, to WPD, 23 Jun 42, sub: Sig com plan for a SOS African ferry route; (2) Memo, CSigO for Opns Div SOS, 24 Aug 42, sub: Addition of one 1-kilowatt team to 830th Sig Sv Co. SigC (EO) 4–5 Tables of Equip for the 830th Sig Sv Co.

[100] Ltr, Lt Col Brooke Sawyer, Sig Officer Hq USAF Central Africa, to CSigO, 5 Oct 42, sub: Pers and equip, 830th Sig Sv Co, inclosed with OCSigO R&W Action 1, Maj J. E. Watters, War Plans Br, to Maj Bagnall, Plant Div, 14 Oct 42, same sub. SigC (EO) 4–5, No. 2 Tables of Equip for 830th Sig Sv Co.

[101] (1) Hawkins, *History of the 835th Signal Service Battalion, 1942–1946*, p. 14. (2) Consolidated Signal Plan, USAF CBI (29 Sep–7 Oct 42), p. 25. SigC (CC) 676, CBI Signal Plan.

ANTENNA TOWERS OF RADIO MARINA, ASMARA

miles away but to the west, across the breadth of Africa. More men were needed and in September Company C of the 850th Signal Service Battalion sailed from New York bound for Asmara by way of Suez. Already two smaller groups of the 850th had arrived in Asmara, a section of 1 officer and 13 men on 5 August, followed by a second section of 1 officer and 7 men on 14 September.

Team Seven was thus relieved, only to receive at once an exotic assignment to Cairo where the men lived luxuriously in the patio palace of an oriental prince while they installed an ACAN station in the Egyptian capital. With the one-kilowatt transmitter which the Plant Division had just sent over, Team Seven succeeded by the end of October in establishing a direct circuit, Cairo to Washington, WVNV–WAR. By this time, too, the men of the 830th in Accra were making good their intent; the direct Accra-Washington radio channel was shaping up and on 9 November it went into operation, WVNI–WAR, using high speed Boehme.[102] Whereas before, the signals of Karachi could get through to Washington, and vice versa, only at certain favorable hours of operation

[102] (1) Hawkins, *History of the 835th Signal Service Battalion, 1942–1946,* p. 14. (2) Weekly Digests—Traffic Division, Prog, Col French, 2 Sep 42, Item 1 A 6; 4 Nov 42, Items 1 A 5 and 7; 11 Nov 42, Item 1 A 3. SigC 319.1 AC 133, Drawer 483, Weekly Digest of Prog and Problems, Rpts from Divs, 7–30–42—12–30–42. (3) Incl 2, Hist Data 3176th Sig Sv Co (formerly Co C 850th Sig Sv Bn) Asmara, Ch. I, pp. 1–2. OCMH.

(the radio beams passing over the troublesome polar regions), now communications over the long distance, halfway around the world, became dependable at all hours, passing through the favorable equatorial regions by way of the stations at Accra and Asmara, which served as relay points.

Meanwhile, members of the 833d Signal Service Company were at work in the Persian Gulf Command, or the Iran-Iraq Service Command, activated 24 June 1942. Two sections of the company arrived in the command area in July. By 1 August they completed installing a radio station at Basra, Iraq, and another at Andimeshk, Iran. The former served as the net control station, working Andimeshk on schedule and serving as a relay point for traffic destined for Karachi, for Cairo, and for Asmara.[103]

England: Signal Corps' Efforts Looking Toward TORCH

Beyond the Atlantic, in England itself, the Signal Corps had begun its overseas effort during the defensive period even before Pearl Harbor, when it sent special observers, followed by officers of the Electronics Training Group. The effort had steadily expanded during the first half of 1942 with the arrival of Signal Corps units serving the United States Army Forces in the British Isles (USAFBI), and with the establishment of a signal center at 20 Grosvenor Square. In July the Signal Corps men installed their first large transmitter just shipped in from America, a powerful 40-kilowatt multichannel radio. By mid-July it began regular operation directly with WAR,[104] providing several telegraph channels and one voice or telephoto channel, operating from an American Telephone and Telegraph Company terminal in New York to a General Post Office facility in England. The big heavy-duty transmitter was essential. In the event of its failure, the Signal Corps received access to a State Department wire line, leased in June. It was a direct Western Union teleprinter duplex submarine cable circuit between Washington and the Embassy in London. The Washington Message Center made use of it, as and when State Department business permitted, by means of an extension patched on in response to bell code signals. Delays were not uncommon. Even so, the circuit proved an invaluable facility, especially since it provided an emergency channel for the highest priority traffic.[105]

By mid-1942, as General Eisenhower took charge of the European Theater of Operations, United States Army (ETOUSA), which replaced USAFBI, American Army signal centers were multiplying. One served the new Headquarters, Service of Supplies, ETOUSA, at Cheltenham. Brig. Gen. William S. Rumbough, newly appointed as Chief Signal Officer, ETO, commanded both the Signal Section, ETOUSA, and the Signal Service, SOS, ETOUSA. At Cheltenham the SOS signal center began with seven American officers, six

[103] Capt Sidney L. Jackson, Communications in the Persian Gulf Command: Chapter IV of the Theater Fixed Networks (1944), SigC historical monograph E–1d, pp. 5–6. SigC Hist Sec File. For the continuation of the Caribbean-Middle East activity of the Signal Corps to mid-1943, see below, pp. 447ff.

[104] (1) Memo, Gen Stoner for Exec Control Div, 22 Jul 42, sub: Prog Rpt, 16–22 Jul 42, Rpt 46, Item 1 a. SigC (AC) 319.1 Weekly Prog Rpts, Army Com Br, Dec 41–Jul 42. (2) See above pp. 106, 223.

[105] Reinstein, Signal Corps Fixed Communications in the European and Africa-Middle Eastern Theaters, pp. 18–19.

American enlisted men, and numbers of British civilian and military men working at a huge 17-position British switchboard. Another new signal center in London itself was one serving the central base section headquarters, which began life modestly with a handful of men working the relatively limited wire facilities provided by a 4-position British switchboard. Still other smaller signal centers began operation in the United Kingdom during the last half of the year serving lesser SOS headquarters, as in Northern Ireland and at the Western, the Eastern, and the Southern Base Sections.[106]

When in August the Allied Force Headquarters (AFHQ) for the invasion of North Africa began to take form and was lodged in Norfolk House, in London, its communications were kept closely tied to the signal center at 20 Grosvenor Square by means of two special simplex teleprinter circuits linking the code rooms in the two buildings. From early summer until November the signal center was involved in special preparations for TORCH, creating or augmenting communication links with far-flung strategic points—Iceland at one extreme, Algiers at the other. The vicinity of Grosvenor Square itself, however, was too exposed, too vulnerable to the dangers of bombing, to remain the communications center. In the summer of 1942, therefore, the Americans asked the British to supply a safer building, not too distant from the original headquarters. Offered and accepted was the Selfridge Annex at Duke and Somerset Streets, a sizable steel and concrete structure blessed with deep basements running 45 feet down. It was mid-December, though, before the Signal Corps men could accomplish the move. Meanwhile, work began on a second, auxiliary bombproof signal center on Goodge Street to be completed in early 1943. Plans for TORCH were in full swing by the end of August. The telephone switchboard at the signal center of the Central Base Section expanded to ten positions. And still more switchboards went in, with more trunk lines, more cross-connections, more of all the things that speed communication signals. The American signal center in London was now handling telephone calls alone to the number of 16,000 a day, and its teletypewriters, a dozen Creed printers of British manufacture, pounded out over half a million words during August.[107]

Thus the American build-up in England steadily intensified during the summer, preparing for the invasion of Africa and for the bombing of Germany. For if the Conti-

[106] (1) ETO Hist Div, Administrative and Logistical History of the European Theater of Operations, Pt. I, The Predecessor Commands: SPOBS and USAFBI, pp. 207–11, 221. OCMH. (2) Reinstein, Signal Corps Fixed Communications in the European and Africa-Middle Eastern Theaters, pp. 28–30. (3) History of Signal Center Hq ETOUSA, Feb 42–Jan 44. SigC 314.7 History of Signal Center Hq ETOUSA Feb 42–Jan 42, Kansas City Records Center.

[107] (1) History of Signal Center, Hq ETOUSA, Feb 42–Jan 44, cited n. 106(3). (2) Historical Record, Construction of the Duke Street Signal Center. Adm 578 DRB AGO. (3) Historical Record, Construction of the Signal Center Operational Hq [Goodge Street]. Adm 580 DRB AGO. (4) Brig Gen Francis H. Lanahan, Jr., "Build-up for Battle," *Signals*, I:1 (September–October, 1946), 17–21.

According to Lanahan, equipment used at the London center for recording and relaying messages from a commercial terminal on the Embankment was "ancient" and broke down under the heavy traffic from North Africa on the day of the invasion. The frantic attentions of two expert mechanics failed to restore it, and on this occasion technology yielded to officer couriers who rushed back and forth between the Embankment and 20 Grosvenor Square carrying copies of communiqués from Algiers. The next great invasion, into Normandy in 1944, required signal communications on a scale twenty-five times as great as those demanded in 1942 for TORCH.

nent could not be invaded immediately it could be bombed. In this the British needed all possible American help, which General Spaatz, commander of the Eighth Air Force, was now readying. Just as Eighth Air Force planes began participating in air raids, General Olmstead arrived in the United Kingdom to look over his installations. He talked with Spaatz, who said he expected to lose a good deal of equipment in his tactical operations. He emphasized to Olmstead that he expected to get sufficient quantities of communication material, an abundant unending flow of it, to keep full the communication stores of the Eighth Air Force, despite the steady drain of combat losses. Olmstead promised to do his best and informed General Arnold on 1 August, "I have advised my supply agencies that they are not to take any action to decrease the amount of communication equipment to be shipped to England below General Spaatz' requisitions unless I personally have approved such cut." [108] On 4 July 1942 the Eighth Air Force committed its first bombers, when six American craft joined an RAF attack on targets in Holland.[109]

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[108] Memo, Olmstead for CG AAF, 1 Aug 42, sub: Com material which will probably be requested for Gen Spaatz. SigC (EO) 475 SigC Equip Gen.

[109] Craven and Cate, *The Army Air Forces,* I, 658.

CHAPTER XI

Preparing for the First Major Test

(June–November 1942)

The months between June and November 1942 constituted a period of intensive and fruitful effort for the Signal Corps in all aspects of its many-sided activities. While communication facilities were being extended in every direction overseas, the headquarters organization in Washington pressed ahead with equal vigor and determination. Along with all the other segments of the Army, the Signal Corps was engaged in developing its organization and in building its strength for the period just ahead, when the defensive role would be abandoned and the first major offensive would be launched. The gathering of effort showed most clearly in three major fields: planning, procurement, and training.

Training

Training especially in mid-1942 was sharpened by the knowledge that it was directed toward a specific goal—preparing men for the first offensive action overseas scheduled for late 1942.[1] The shape, the scope, and even the objective of the offensive were matters that had to wait upon basic tactical decisions on a higher level. But so long as the details remained in doubt, the constant shifting of plans for the types of units and numbers of men required caused corresponding uncertainty in the training programs.

Even though by midyear there was still no firm commitment for troop requirements, one thing seemed clear—the final figures would probably call for specialists in numbers that would strain Signal Corps facilities to the utmost to provide. By this time previous plans for getting men, and in particular the efforts of Colonel King, Chief of the Military Personnel Branch, were beginning to pay off. By midyear Signal Corps strength stood at about 7,694 officers, 121,727 enlisted men, and 54,000 civilians. Nearly 29,000 of the enlisted men were in training.[2] More men were pouring in, not all of them able to absorb all of their training, but most of them able to acquire enough to become valuable. Some trainees were illiterate and obviously could not be trained in electronic skills, at least not until they learned to read and write. The Signal Corps had to assimilate its share of the Army's intake of these men. By September they were becoming a burden when the War Department limited them, in the case of the Signal Corps, to three and a third

[1] See Chapters II and VII, above, for Signal Corps manpower problems and training activities earlier in 1942.

[2] (1) Statistics, draft MS in OCMH. (2) CSigO, Annual Report, 1942, p. 4, and 1943, p. 30?

percent of reception training center housing capacity.[3]

Sources of Signal Corps Manpower

Some Signal Corps plans for getting men succeeded; others turned out badly. An example of the latter was Colonel King's plan to obtain some 2,000 additional officers and 6,800 specialists for installing and maintaining radars through the Army Specialist Corps. The first requisition was submitted in June, but three months later, only 10 officers had been appointed, and only 40 specialists.[4] The program suffered from administrative confusion, no one being sure whether the men were military or civilian appointees, since they were subject both to Civil Service classification and to military commissioning procedures. Part of the trouble lay with the appointees themselves. Of the few who received commissions before the Army Specialist Corps went into discard, some were poor officer material. In October the Army Specialist Corps was discontinued altogether.[5]

But other considerable reservoirs of manpower, of competent civilians both men and women, were becoming available. Some, after training, would serve the Signal Corps in civilian status. Others would don uniforms. As Waacs, for example, women would take over many a Signal Corps man's job, releasing him for field duty. Colonel King, who remembered how effective women telephone units had been in France in World War I, advocated their use again. By October the Signal Corps had completed its first surveys and had determined that there were at least 2,000 jobs in the Corps that could be taken over by Waacs.[6] As for civilian employment, the summer of 1942 saw the high tide. Late in August field employees numbered somewhat over 66,000, with nearly 5,000 more in the Office of the Chief Signal Officer in Washington.[7]

The small but valuable reservoir of officer manpower provided by the Affiliated Plan yielded a peak number of officers from the telephone companies in July. In August the Signal Corps obtained permission to call in an additional 100 such officers, even

[3] (1) SOS Memo S615-3-42, 10 Sep 42; (2) Memo, Div of Mil Pers SOS for TAG, 15 Dec 42, sub: Excess illiterates at SOS RTCs. SPGAE/327 Gen (12-15-42)-40. SigC 353 RTC Gen 1, Jan-Aug 43.

[4] (1) Memo, Actg CSigO for CG SOS, 6 Oct 42; (2) OCSigO R&W Action 1, Maj W. K. St. Clair for King, 3 Aug 42, and Action 2, King for Auxiliary Br, 3 Aug 42, sub: Army Specialist Corps. SigC 210.1 Army Specialist Corps.

[5] (1) *Logistics in World War II, Final Report of the Army Service Forces, 1 July 1947* (Washington, 1947), pp. 107, 111. (2) Tabs V and VI to Tab D, Incl to Memo, King for Deputy CSigO, 23 Oct 42, sub: Pers rqmts. SigC 320.22 Enlisted Strength, MT-25. (3) Memo, Lt Col W. A. Rooks for Col Willis, 30 Nov 42, sub: Inspec, instruction and emergency repair crews. SigC 353 Gen, Sep-Dec 42. (4) CSigO, Annual Report, 1943, p. 291.

[6] (1) CSigO, Annual Report, 1943, p. 310. (2) Memo, Gen Milliken for Exec Control Br, 29 May 42, sub: Weekly prog rpt, p. 5. Weekly Achievement Rpts, 27 Apr 42-8 Jun 42, SigC Central Files. For a general discussion of the WAAC and the WAC in the Signal Corps, see Mattie E. Treadwell, *The Women's Army Corps*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1954).

[7] CSigO, Annual Report, 1943, pp. 394-95. On 1 September the nine service commands were organized, and 30,000 civilians in the Signal service at large lost their identity as Signal Corps employees, leaving approximately 36,000 civilian employees in the field, according to Signal Corps records.

The draft manuscript, Statistics, lists a total of 51,503 civilian employees for the Signal Corps as of 30 June 1942, and 49,637 as of 30 September 1942. It is believed that the exclusion of certain categories of employees in the statistical summaries used and the inclusion of other categories in the Signal Corps figures account for the discrepancies. For an explanation of statistical data used, see Statistics, pp. 40-42. OCMH.

though they had not been included in the 1942 Troop Basis. It called them to active duty in the company officers' course at Fort Monmouth, on the understanding that their attendance would not interfere with the training of other officers required either for units which the 1942 Troop Basis had set up or for other units which had to be activated within the year, though outside the troop basis.[8] Some of the affiliated officers, though technically very competent, were such poor students at the Signal Corps School that school officials wondered if they could qualify for commissions, until it was pointed out that these officers had been affiliated for special construction work wherein they had developed ability from long experience on the job. A man who had engaged in construction work, the Signal Corps reasoned, could not be expected or required to possess the same education as an engineer. Such men, like pigeoneers, could not be measured with the usual schoolmaster's yardstick.[9]

Negroes constituted another source of manpower which the Signal Corps began to tap. The Signal Corps Troop Basis for 1942 included Negro units for the first time since World War I, and the first such unit to be activated was the 275th Signal Construction Company. Sent to Panama to build a pole line, it found itself unwelcome to the Panamanian Government and was returned to the United States after completing its task.[10] Negroes in foreign theaters posed problems. Australia wanted none of them. They were not acceptable in China. In Africa itself the economic status of the United States Negro bred discontent among the native blacks. There were of course problems in the United States, too: segregation in some states, and strong local prejudices in some areas, notably in the vicinity of Camp Crowder, Missouri, where the Negro construction units trained. At Fort Monmouth the situation was quite different. The few Negro officer candidates who were in school there studied and lived among the white trainees and there was no race problem.[11] Negro troops were needed, regardless of the social problems they raised, and the troop program for Negro units provided for the activation of the 93d and 92d Division Signal Companies in May and October 1942, respectively, together with six more Negro construction companies to be activated by August.[12]

The largest and most valuable group of trainees for the Signal Corps, generally destined for service in uniform, was provided

[8] (1) Ltr, Col Lattin to Dir of Tng SOS, 7 Aug 42, sub: Tng of affiliated SigC officers. SigC SPSMT-352 SCS Ft. Monmouth. (2) 1st Ind, Gen Huebner, Dir of Tng SOS, to CSigO, n. d., with basic. SigC SPTRS 352.11 SC (8-7-42).

[9] OCSigO R&W Action 2, Lt Col Duncan Hodges, Mil Pers Br, to Mil Tng Div, 30 Jan 43, sub: Affiliated officers. SigC 381 Affiliated Units 1, 1943.

[10] (1) Msgs, Andrews, Quarry Heights, to TAG, No. 621, 8 Dec 41, and No. 761, 20 Dec 41; (2) Memo, Eisenhower for WD Classified Msg Center, 27 Apr 42. OPD 370.5 (4-16-42) (3-4-42). (3) Memo, Maj Gen Thomas T. Handy, ACofS OPD, for CG SOS and CG AGF, 26 Dec 42, sub: Movement of 275th Signal Construction Co. AG 370.5 10-8-41(1) Troop Movements to the Panama Canal Dept (Mercury).

[11] (1) OCSigO R&W Action 1, Maj James S. Vaughan for King, 6 Oct 42, sub: Conf on assignment of Negro officers to units in 1943. SigC MP, Confs, May-Nov 42. (2) Memo, Marshall for Gen Bryden, 28 Oct 42, sub: OCS. AG 352(1) Sec. 1 OCS. (3) Interv, SigC Hist Sec with King, 11 Oct 49. SigC Hist Sec File. For a general discussion of the Negro in the U.S. Army, refer to Ulysses G. Lee, The Employment of Negro Troops, a forthcoming volume in this series.

[12] Ltr, Chief of War Plans Div to All Brs, OCSigO, 24 Jan 42, sub: Troop unit basis for mob and tng, 1942. SigC 381 Gen.

by the Enlisted Reserve Corps and the associated training program. The majority of students under this plan were already halfway into the Army as reservists, the Army paying their expenses while they attended civilian preservice schools in civilian dress. On 1 July 1942 more than 19,000 were enrolled in preservice training, as mechanic learners, junior repairman trainees, junior craftsman trainees, assistant technician trainees (preradar), and so on, at some 250 vocational schools and colleges the country over. By September's end some 30,000 were on the rolls.[13] Not all of them became reservists. Some remained civilians and took civilian posts in the Signal Corps or in industry producing for the Signal Corps. But by October so many of them were being called to active duty from a reserve status that they were jamming the Signal Corps replacement training centers. Added to the men from other sources, they became more than the large RTC's at Monmouth, Crowder, and Kohler could absorb. For awhile, late in the year, there was a backlog of ERC men awaiting induction while the RTC's struggled with the overload. Early in December the ERC program came to an end, with a presidential order closing the door to further enlistment of men between the ages of 18 and 38. Those on the ERC rolls were permitted to finish. The Signal Corps estimated that well over 50,000 technicians had come to it through this productive program. The great majority were radio and radar technicians. Only about 3,000 were radio operators—that is, old style Morse code men—and 1,000 were telephone repairmen.[14]

Growth of Training Facilities

The rapid growth of Signal Corps training facilities was barely keeping pace with the increased flow of trainees. Congestion and crowding at the replacement training centers were chronic. The capacity of the two centers at Fort Monmouth and Camp Crowder stood at about 20,000 men. A third replacement training center at Camp Kohler, near Sacramento, would take care of an additional 5,000 trainees, but it had been authorized only as a temporary expedient. Under such circumstances, overcrowding was inevitable.[15]

By autumn movement out of the congested Fort Monmouth area eased the situation there somewhat. While Camp Edison and Camp Wood took part of the overflow, aircraft warning training moved out entirely to Camp Murphy, and in August all aircraft warning training at Monmouth ceased. Camp Wood still had the look of a muddy lumber camp when it opened officially on 14 July 1942. By autumn a full complement of barracks, mess halls, school buildings, and all the other necessary appurtenances of a full-fledged camp had appeared on the 275-acre tract. In October the headquarters of the replacement train-

[13] (1) CSigO, Annual Report, 1943, pp. 398–400. (2) Marvin L. Ingram, The Civilian Training Program of the Signal Corps in World War II: I, Pre-Service Training on the Vocational Level (1945), SigC historical monograph C–3, pp. 64–66. SigC Hist Sec File.

[14] (1) OCSigO R&W Action 1, Civ Tng Br to Control Div, 6 Nov 42, with Memo, Incl, Activities of the Civilian Training Program, Signal Corps. SigC ET–310. (2) Ingram, The Civilian Training Program of the Signal Corps in World War II, I, p. 68, and II, Pre-Service Training on the College Level (1945), SigC historical monograph C–3a, pp. 61–64.

[15] Capt Frederick Reinstein, Study of Signal Corps Replacement and Filler Training 1941–1944 (1945), SigC historical monograph C–9, p. 77. SigC Hist Sec File.

ing center also moved from Monmouth to Wood. Pigeoneering departed in August, going to Camp Crowder, and in October the Cryptographic Division moved to a rural site, secret and safe, in the foothills of the Blue Ridge near Warrenton, Virginia. There remained at Monmouth proper only the Signal Corps School, with its enlisted, officer, officer candidate, and training literature departments. Yet for every specialized subject no longer taught at Monmouth, a new one appeared. For example, there were the new VHF techniques which vitally concerned air-ground communications and radio relay, soon to play a significant role in North Africa. In August Signal Corps instructors at Fort Monmouth began teaching VHF courses to classes that crammed the rooms, with enrollment continually larger than authorized.[16]

Meanwhile, the Signal Corps had been unable to meet the target date of 1 August for opening its third replacement training center at Camp Kohler, California. Activated a month later, on 1 September, this center became an exempt installation under the command of Brig. Gen. Stephen H. Sherrill, the post remaining under the jurisdiction of the Ninth Service Command. Cadres of officers and enlisted men came from Fort Monmouth and Camp Crowder. The first 481 recruits arrived on 19 September; basic training began two days later. By the first of October there were 3,000 trainees, more than 50 percent above the capacity originally authorized. Having acquired Camp Kohler, the Signal Corps had no wish to give up the site at the end of the year, with the needs for trained signalmen steadily mounting. As matters stood, the only hope of retaining Kohler in 1943 lay in converting it into a unit training center. Therefore plans for such a center, with a capacity of 5,700, went forward concurrently with plans for Kohler's use as the third of the replacement centers.[17]

The first unit training center had been established at Crowder in August. Crowder was growing fast. By September some 2,100 officers and men were developing teamwork in the unit training center, while more than 13,000 men were being trained in the RTC and another 6,000 specialists in the school.[18] To administer and supervise this growing complex of virtually separate training activities, the Services of Supply on 17 September approved the organization of a new headquarters, the Central Signal Corps Training Center, thereby establishing a pattern which was soon followed at Monmouth, where the Eastern Signal Corps Training Center was established on 9 October.[19]

While the facilities for mass training of Signal Corps soldiers spread out in every direction, the highly specialized radar training at Camp Murphy, Florida, likewise flourished. Colonel Mitchell and his staff of instructors overhauled the courses, adding new ones from time to time during the late summer and early autumn. As elsewhere throughout the Signal Corps' school activity late in 1942, emphasis was shifting from the training of individual specialists to group, or unit, training of electronic teams.

[16] (1) CSigO, Annual Report, 1943, pp. 11, 346. (2) Ltr, King to Dir of Cryptographic Div ESCS, Vint Hill Farms Station, Warrenton, Va., 3 Nov 42, sub: Cryptographic School. SigC MP 352 Schools 1942.

[17] (1) Reinstein, Study of Signal Corps Replacement and Filler Training 1941–44, pp. 118–19. (2) Memo, Col William C. Bennett, Jr., Tng Div SOS, for Dir of Tng, 14 Nov 42, with 1st Ind, Huebner to CSigO, 17 Nov 42. SigC SPSMT 353 Walerga.

[18] (1) CSigO, Annual Report, 1943, pp. 375–86. (2) Organization Chart, Camp Crowder, 1 Sep 42. SigC SPSMP 4.

[19] Reinstein, Study of Signal Corps Replacement and Filler Training 1941–44, pp. 29, 77–78.

Thus at Murphy a team-training department opened before the year's end, instructing as co-ordinated teams all the various specialists who operate a radar station. Radar maintenance men, engine maintenance men, rigger-electricians all had to learn how to work together, and also had to learn such things as camouflage, chemical warfare defense, first aid, laying field wire, pitching tents. They had to be specialists to perform their highly technical duties. But they had to be soldiers, too, able to live, fight, and survive in the field.[20] Radar men very often would serve under extraordinary conditions in every sort of climate and in every sort of situation. Their assignments placed them in positions of great individual responsibility and trust. "When you're over there fighting and want to catch some sleep, you know someone is watching over you and you'll be warned if enemy bombers start zooming in." That was how a sergeant in an aircraft warning unit put it—a unit which survived a savage Japanese attack in Milne Bay, then landed at Oro Bay near Buna and pushed fifteen miles through the jungle to set up the radar sets which helped to provide information concerning the Japanese convoy later sunk in the Bismarck Sea.[21]

Meanwhile, in the Indio-Needles area of California and Arizona, where the Army Ground Forces' Desert Training Center had been established, such signal troops as could be spared were receiving desert training under simulated theater conditions—training which would be invaluable in the campaign in North Africa. From the beginning, the role of the Signal Corps in that training project was a difficult one. The plans of Maj. Gen. George S. Patton, Jr., for the Desert Training Center had called for a repair shop for signal equipment, a post signal officer, a signal property officer, and a service company detachment to operate post signal activities, in addition to the signal units with troops. With overseas needs for Signal Corps men remaining unfilled, it is understandable that he got less than he asked for. Signal Corps troops were in exceedingly short supply in the Desert Training Center. The local telephone company provided communications service for the area to a point, and beyond that, the much-under-strength 60th Signal Company of the IX Corps carried on.

The exercises also rapidly consumed signal equipment, likewise in short supply. Although the Signal Corps men involved were too few to provide any appreciable reservoir of men experienced in desert training, General Van Deusen, Commandant, Eastern Signal Corps Training Center, Fort Monmouth, was gratified to note that the commanders of the major units engaged in the training displayed a fuller appreciation of the necessity for proper radio training than had been evidenced in the past.[22]

Where motorized and armored units deployed at distances of 50 miles and more in the soft, smothering sand, commanders and staff officers came to depend more and more upon radio voice communication. Indeed, some Signal Corps observers at the maneuvers in the desert training area in October reported that the Armored Force was relying too much on radio communication, and overlooking the value of visual and messenger communication in many situations. A pigeon detachment had been assigned to the Desert Training Center to determine

[20] CSigO, Annual Report, 1943, pp. 328–32.

[21] T/Sgt George W. Cates, Historical Rpt of Aircraft Warning Unit Training Center, App., Aircraft Warning Does the Job, p. 18. SigC Hist Sec File.

[22] Ltr, CG ESCTC to CSigO, 16 Oct 42, sub: Rpt of duty as observer, Desert Training Force. SigC EC 354.2 Maneuvers 1942.

whether communication by that means would be practicable in warfare in North Africa.[23]

Gradually support was building up for the Signal Corps point of view that the complexity and extreme importance of communications demanded men of superior qualifications for communications training. It was a point of view which, in the later years of the war when the value of electronics in warfare had won wide recognition, brought a high percentage of AGCT Class I and Class II men to the Signal Corps.[24] In late 1942, however, other services, particularly the Navy, the Marine Corps, and the Army Air Forces, were still skimming the cream of the manpower available. For example, General Somervell in September 1942 vigorously protested a War Department directive which aimed at channeling into the Air Forces for a number of months 50,000 of the men who scored 100 or better in both the Army General Classification Test and the Mechanical Aptitude Test. Somervell argued that the ruling handicapped the procurement and development of combat leaders for all the Services of Supply.[25]

All things considered, the Signal Corps was now doing rather well in the business of supplying and training soldier specialists, though the Army's demands continued to keep somewhat ahead of output. By mid-October, the several RTC's had turned out 25,000 specialists and had assigned them to units.[26] The combined capacity at Monmouth, Crowder, and Kohler stood at 46,970, and would soon exceed 50,000. The Signal Corps enlisted strength stood at about 143,000. Military Personnel Branch estimated that the Signal Corps would be able to supply about 80 percent of the numbers needed to meet such requirements as had been stated on paper for the period ending 31 December 1942. The Army Air Forces requirements could not be known for certain until the War Department General Staff released an approved troop basis for air units. So far it had released none, either for the current year or for 1943, but the AAF estimated informally that its requirements would total 118,000 by the end of the year. At the end of October, Colonel King lamented, "I still don't know what the requirements are, if any." [27]

The lack of firm requirements made planning very difficult. Even when approved troop basis figures were available, experience showed that the specialists actually needed usually ran about 15 percent above the paper requirements. Also, when requirements became known, too often the

[23] A History of the 280th Signal Pigeon Company, 1941–1944, Ch. VII. SigC Hist Sec File.

[24] In 1943 the percentage of Class I and Class II men received at Signal Corps RTC's was 58 percent, highest for any branch of the service, but in the period March–August 1942, it was only 39.2 percent, behind Finance, Chemical Warfare Service, AAF, and Ordnance. Palmer, Wiley, and Keast, *The Procurement and Training of Ground Combat Troops*, pp. 17–18.

[25] (1) Tab III, Tab D, Incl to Memo, Chief of Mil Pers Br for Deputy CSigO, 23 Oct 42, sub: Pers rqmts. SigC 320.22 Enlisted Strength Oct 42, MT–25. (2) Palmer, Wiley, and Keast, *The Procurement and Training of Ground Combat Troops*, pp. 24–25.

[26] (1) Weekly Prog Rpt, Opns Br, 22 Oct 42, 1942 History of Operations Branch. (2) Tab C to Memo, Chief of Mil Pers Br for Deputy CSigO, 23 Oct 42, sub: Pers rqmts. SigC 320.22 Enlisted Strength Oct 42, MT–25.

[27] (1) Memo, cited n. 26(2). (2) Info for SOS Staff Conf, 27 Oct 42. SigC SPSTP 6. (3) OCSigO R&W Action 14, Chief of Mil Pers Br to Sig Supply Sv, 31 Oct 42, sub: Spec tng for SigC specs. SigC 353 Gen Sep–Dec 42, MT–41. (4) Memo, Chief of Mil Pers Br OCSigO for Prog and Statistics Br, 22 Oct 42, sub: Weekly digest of prog and problems, 15–21 Oct 42. Digest of Prog, 23 Sep–21 Oct 42. SigC Central Files.

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requests for the men followed at once, no account being taken of the time needed to train specialists. The Signal Corps met the Army's needs by such ruses as supplying partly trained men, pulling them out of classes two weeks short of graduation. The General Staff had authorized King to do this, on the sound theory that partially trained men are better than men with no training at all. Yet the courses had already been shortened to the limits of efficiency, and further curtailment thrust men into service before they were ready for it. Such wastage, no doubt inevitable in the turmoil of war, was to hamper the efficiency of Signal Corps units in the oncoming offensive.

Problems of Procurement

Of three big fields of Signal Corps activity—training, procurement, and planning—it was procurement which lagged in late 1942. Partly this was the result of the fact that the Army did not control the civilian economy in the same direct and telling way that it controlled the assimilation of men into service, or the channeling of research into directed areas. Partly, production fell behind because of the sheer weight and complexity of the manifold problems involved in converting industry to all-out war effort. The Signal Corps felt the pressure, albeit many times removed, from numerous powerful federal wartime production and manpower agencies.

Most of all, production lagged because it had to wait upon basic tactical decisions. Tables of equipment and tables of basic allowances determined what kinds of items would be needed by the Army, and in what amounts. Until the number of men to be outfitted was agreed upon, and the areas in which the men were to serve were decided, calculations of equipment needs were largely guesswork. Even then, the normal period of time between the date that a production contract was let and the date that equipment could be expected to come off the production line varied enormously, according to the type of items required. Three months might suffice for a very simple piece of equipment, assuming that the factory was tooled up, with all the materials at hand, and a trained labor force ready. A radio set might take a year, a radar set several years, assuming that all development was complete. But what if there were not enough factories, or materials, or laborers? And what if changing tactical decisions forced design changes in equipment in order to incorporate newly discovered research ideas? All these things greatly affected the progress of Signal Corps procurement.

Even admitting that the problems of production could not be expected to yield to solution quickly, the Signal Corps productive efforts still had to be rated as less than satisfactory in the late summer months of 1942. "The Signal Corps is further behind in meeting its objectives than the other services," so General Colton wrote to the officers in charge of all branches of his Signal Supply Service on 21 August. The day before, the harried head of Signal Supply had attended a meeting in the Procurement Branch, Services of Supply, presided over by Maj. Gen. William H. Harrison. If production statistics and objectives were to coincide, then Signal Corps deliveries for the remaining months of the year would have to double and triple the July rate: "two and one-half to two and three-quarters times," Colton said, as he asked his officers to report upon prospective future deliveries.[28]

[28] Memo, Colton for O/Cs All Brs of Sig Supply Sv, 21 Aug 42. SigC 319.1 Rpts, Gen 2, Sep–Nov 42 (RB–1541).

Increasing Complexity of the Supply Organization

The pattern of supply had grown more intricate. While its responsibilities increased, the Signal Corps had less freedom of direct action under the Services of Supply, which acted at a supervisory level. The situation was much like that within the Signal Corps, wherein the Chief Signal Officer had interposed several echelons between himself and his operating divisions. Throughout the summer, General Olmstead had continued to reorganize his office. As new functions came into being or old ones assumed less or greater importance, he created new organizational units, killed old ones, or shuffled them around, seeking always to achieve a stronger and more complete decentralization.[29] Each shift within the Office of the Chief Signal Officer brought a corresponding change in the field organization, in swift chronological succession.

At the end of the summer in 1942 the Supply Service under General Colton at last clearly reflected what Colton's dual responsibilities had been for months; his two divisions were now labeled simply "Materiel" and "Research and Development." [30] The personnel of the Materiel Division branches—Scheduling, Facilities and Materials, Storage and Issue—brought the total manpower of this half of Colton's realm to 207 officers and 2,856 civilians, more than one half of all the civilians in the Office of the Chief Signal Officer.[31]

In the field, meanwhile, Signal Corps agencies multiplied, with every month bringing at least one decentralization of functions. In October 1942 the Storage and Issue Branch of the Office of the Chief Signal Officer moved to Philadelphia and became the Storage and Issue Agency, with only a liaison branch remaining in the Pentagon. In the same month the Signal Corps Inspection Agency set up housekeeping at Dayton. In November a new procurement district started operating at Monmouth, handling procurement functions formerly carried out by the Signal Corps General Development Laboratories at Fort Monmouth and the Signal Corps Radar Laboratory at Belmar, New Jersey. December brought the creation of a new superagency, the Signal Corps Ground Signal Service, which would supervise the activities of the supply and development agencies in the Fort Monmouth area much as the Signal Corps Aircraft Signal Service supervised those in the Dayton area.[32]

Dayton was the center of Signal Corps procurement for the Army Air Forces, which now used more radio and radar equipment than all the rest of the Army put together.[33] The activities of the Wright Field Signal Corps Procurement District and the Dayton Signal Depot were associated, the depot having had its genesis in the storage and issue section of the procurement district. The two agencies could hardly be said to be housed in the same building, for by October 1942 their offices and warehouses were scattered about the city in twenty-one

[29] Dr. Courtney R. Hall, Development of the Office of the Chief Signal Officer (1944), SigC historical monograph D–1, p. 152. SigC Hist Sec File.

[30] (1) See above, pp. 58–62. (2) Signal Corps Administrative Log, 1939–1945, OCSigO Orgn. Charts No. 18, 30 Sep 42, No. 19, 14 Dec 42. SigC Hist Sec File.

[31] CSigO, Annual Report 1943, p. 395.

[32] *Ibid.*, pp. 55ff.

[33] André E. Gerard, The Story of Supply in the Signal Corps in World War II, Pt. II, Procurement (1945), SigC historical monograph B–1b, p. 13. SigC Hist Sec File.

buildings, mostly former garage and automobile salesroom buildings.[34]

In the earlier part of the summer there had been a desperate shortage of officers, with only fifty assigned to both agencies, and the depot alone needing that many.[35] Personnel matters had improved by early fall. The volume of work was growing steadily. The Meteorological Division activities alone were expected to increase 100 percent within a few months. When the meteorological equipment was moved to Dayton from Philadelphia in midsummer 1942 officers tried to fit it into the 30,000 square feet in the Ripley Building, but had to ask for an additional 6,500 square feet of floor space in the Shroyer Building, a block farther up North Main Street. By November, with employees working as long as sixteen hours a day seven days a week on two shifts, supply functions were in good shape.

The Signal Corps inspection service had been operating in a twilight zone of responsibility all summer, awaiting the results of the inspection study being made by General Olmstead's trouble shooter, George L. Schnable. His fact-finding tour completed, Schnable had presented a plan which divided the country into zones, each office reporting to a central control agency, which would take over all inspection previously handled by the Philadelphia Signal Corps Procurement District and its field offices and by the various laboratories. In September the plan was approved. By October the necessary shifting of personnel and functions had been accomplished, and the new Signal Corps Inspection Agency was installed in its quarters at Dayton. Col. Lester J. Harris, formerly in charge of the now deactivated San Francisco Signal Corps Procurement District, headed the new activity. Five inspection zone offices, at Newark, Philadelphia, Dayton, Chicago, and San Francisco, reported to the agency, and there was a liaison headquarters section in the Office of the Chief Signal Officer.[36]

The Spare Parts Problem

Meanwhile, the decision to invade North Africa late in 1942 brought new urgency to a problem which had harassed the Signal Corps since the moment war began. This was the matter of providing enough spare parts, particularly radar parts. The basic reason for the existence of this problem lay in the initial lack of industrial capacity to cope with the tremendous volume of production demanded by global war. It was aggravated both by the concentration upon end item production to the neglect of spare parts and by the lack of a unified control in any Signal Corps agency.[37] The responsibility for spare parts cut across the areas of development, planning, requirements, procurement, production, storage and issue, and distribution. At one time or another, numerous Signal Corps agencies in all those

[34] History of the Dayton Signal Supply Agency, Chronology. SigC 314.7 History of the Procurement District, USAF Mat Comd Central Files, Wright-Patterson Air Forces Base, Dayton, Ohio. In August 1943 the association was legalized as the Dayton Signal Corps Procurement District and Depot. *Ibid.*

[35] Ltr, Lt Col John M. Rae, IGD, to Inspector Gen, 20 Jul 42, sub: Annual inspec of Wright Fld SigC Proc Dist. SigC EO 333.1, Inspecs at Wright Field, 1942.

[36] (1) History of the Signal Corps Inspection Agency, 5 October 1942 to 2 September 1945, pp. 10–21. SigC Hist Sec File. (2) Ltr, Dir of SigC Supply Sv, to CG Phila SC Proc Dist *et al.*, 4 Sep 42, sub: Establishing of the SigC Inspec Agency. SigC 400.163 Inspec 6, Sep 42. (3) Memo, Col George I. Back, Exec Officer Sig Supply Sv, for Control Div OCSigO, 6 Nov 42. Digest of Prog, 28 Oct 42–18 Nov 42. SigC Central Files.

[37] Gerard, Story of Supply in the Signal Corps, Pt. II, p. 58.

fields busied themselves with the matter.[38] The Services of Supply was also much concerned about spare parts, not only for Signal Corps items of equipment, but also for equipment of all the technical services.

Spare parts possessed a dual function, being used both for maintenance and for repair. Usually, the laboratory which was responsible for development of an item of equipment made up parts lists and calculated the amount of spare parts necessary for a year's supply. The contracting officers were supposed to include that amount in the initial contract. These two points were basic. Obviously, without knowing what parts went into a set, it was impossible to buy spare parts for it. The laboratories, understaffed and overworked, were very slow about getting the lists compiled. As late as May 1942 the maintenance requirements for some items were based on 1939 lists.[39] As late as October the Research and Development Division of the Office of the Chief Signal Officer was pointing out to the Signal Corps Radar Laboratory that the most complete radar parts list which it had furnished until then was in fact far from complete. Issued in March for the SCR–270 and 271, it omitted 33 capacitors, 7 resistors, and 3 coils that were actually used. The laboratory promised quick action, but as a matter of fact did not finish the first complete parts list for the SCR–270 and 271 until March 1943. Other vital lists did not appear until May and June.[40] Furthermore, until field experience furnished better answers, the computation of spare parts required for maintenance and repair was largely guesswork.

On the procurement side, contracting officers could not be expected to order spare parts if they had no idea what to buy, or in what amounts. Although by autumn all new contracts contained clauses providing for concurrent delivery of spare parts and end items, delivery still could not be assured. Unfortunately, spare parts were nearly always components of end items on the contract, and the pressure to get out quantities of end items was heavy and unremitting. Rather than interfere with production lines, manufacturers often asked for, and got, waivers on the required spare parts groups. The result was that increasing amounts of equipment did go out into the field, but, lacking spare parts, soon became immobilized. The question was whether it was better to equip initially as many troops as possible with the items listed in the tables of basic allowances, and let them use their equipment as long as possible without enough maintenance, or to equip fewer troops, but give them adequate numbers of spare parts to prolong the working life of the equipment. It was not a matter for the Signal Corps to decide, since the official Army policy, enunciated by the War Department early in 1941, required the immediate issue of equipment without waiting for spare parts. The problem was aggravated by the fact that troop activations were hasty, unorganized, and unpredictable. Provisional units sprang into being, and depots were stripped of supplies to equip them.[41]

[38] (1) *Ibid.*, p. 26. (2) Wallace Clark Rpt 25, 15 Mar 43. SigC 413.44 Spare Parts 5, Jun–Jul 43.

[39] Memo, K. C. Dolliner to Col Heath, 16 May 42. SigC 413.44 Spare Parts 1, 1941–May 1942.

[40] (1) Ltr, Exec Officer R&D Div OCSigO to Dir of SCRL, 26 Oct 42, sub: Complete parts lists for ground radar equip, and 5th Ind, O/C Applied Engr SCRL to CSigO, 4 Mar 43. SigC 413.44 Spare Parts 3, Sep–Nov 42. (2) Ltr, O/C Equip Coord Br to CSigO, 4 Jun 43, sub: Parts lists. SigC 413.44 SCR–270–12H No. 18 (RB–2013).

[41] Gerard, Story of Supply in the Signal Corps, Pt. II, pp. 28–29.

Radar spares were especially critical. When war came there existed no radar industry as such. Radar was a completely new field; there were no experience tables on which to base life expectancy and maintenance requirement lists. Even the designs were not fixed. Each day brought new tactical applications, fresh demands from the using services. And as the potentialities of the wonder weapon began to be revealed in the trial of battle, the clamor for more and more sets of new and improved design quite drowned out the pleas for spare parts to maintain the sets already in the field. Spare parts for the SCR–268, 270, and 271 comprised three separate classes: first, complete component sets; second, depot spare parts, which were certain individual items thought to be most needed, and listed on spare parts lists; and finally, spare parts furnished with each operating set. The basis of issue for spare parts, one set for every twenty-five radars, had been established for peacetime operation, which contemplated not more than six hours of operation per day. On a wartime basis, demanding at least eighteen hours of operation each day, one spare parts set for each five operating units would be needed.[42]

When war began, the Signal Corps had on hand in its depots only 12 spare SCR–268 sets, and 23 SCR–270 and 271's, together with 18 depot spare parts for the 268, and one each for the 270 and 271.[43] During the first frantic weeks of war, the Storage and Issue Division distributed the 268's and two of the 270's as spares to the points of highest priority: to Hawaii, Panama, Puerto Rico, the various interceptor commands, and other danger points. While these priority shipments were being made, floods of direct requisitions from using organizations poured in. The Signal Corps sent whatever it could, but usually it did not have all of the items required to make up a complete depot spare parts set, almost certainly not in the quantities designated. At once Storage and Issue initiated a $5,200,000 purchase request to provide spare parts for 500 SCR–268's for one year. During the next month it wrote up three more requests totaling $7,398,000 for spare parts for the SCR–270, and for massive quantities of tubes for both radars. But three months later, at the end of March 1942, purchasing officers had not yet been able to place all of the orders; no substantial deliveries could be expected at least until May, and "the situation in regard to depot spare parts [was] critical." [44]

The search for radar parts turned next to the corps areas, merely to be frustrated. Only the First Corps Area at Boston had any complete parts sets, six for the SCR–268 and four for the 270. The others reported none at all, or groups in varying degrees of incompleteness.[45] But most of the parts needed were of commercial design; perhaps the corps area signal officers could find them on local radio dealers' shelves. Throughout the summer, the corps areas, or as they were now being called, the service commands, bought on the open market such repair parts as they could find. The results were disappointing, but not unex-

[42] OCSigO R&W Action 1, J. C. Davenport to Maj Maude, 24 Dec 41, sub: Spare Parts for SCR–268, SCR–270, and SCR–271. SigC 156 Spare Parts (RB–946).

[43] Memo, Col Meade for CSigO, 15 Dec 41, sub: Immediate detector maint problem. File cited n. 42.

[44] OCSigO R&W Action 3, S&I Div to Maint Div, 25 Mar 42, sub: Spare parts for SCR–268, 270, and 271 sets. SigC 413.44 Spare Parts 1, 1941–May 1942.

[45] Msg, CSigO to Sig Officers All Corps Areas, 1 May 42, and replies. SigC 413.44 Spare Parts 1, 1941–May 1942.

pectedly so, since several parts sought could not be identified from the parts lists, and at least one part was of special design and could be secured only through a depot.

Any expedient which might yield results in the frantic search for radar parts was tried at least once. When General Electric's $1,000,000 contract for aircraft transmitters was canceled, the company shipped several carloads of fabricated and unfabricated parts to the Lexington Signal Depot. The Office of the Chief Signal Officer sent down two experts to sort out the material, select as much of it as was suitable for radar parts, and ship the rest out to repair shops.[46] Other experts searched the Philadelphia Signal Corps Depot general stock to see what portion of it could be used for radar parts, but found very little.[47]

The most rewarding effort resulted from formation of mobile procurement crews, three-man teams from the Signal Corps Radar Laboratory. They toured the eastern seaboard searching out radio equipment stores and buying up quantities of resistors and potentiometers, capacitors, transformers, tubes, switches, solder, and miscellaneous equipment. By July these roving teams had obtained practically all of the most critical items for the maintenance of 1,000 SCR–268's, 500 SCR–270's, and 100 SCR–271's.[48] For spare parts items not available on store shelves, the mobile crews had sought out small manufacturers, who could not make the complicated radars but who could make parts.[49] By the end of October the emergency mobile procurement program had brought in $1,614,891 worth of parts.[50] By then Westinghouse and other large concerns were shipping quantities of radar spares on the first large spare parts orders.

Yet the stock situation at the Lexington Signal Depot remained "very bad"; the Maintenance Branch felt that "hoarding had been going on," and sent a man to make a spot check at some of the repair shops in the service commands to find out.[51] The "considerable gap between the quantity of material shipped from the laboratories and depots and that received by the overseas bases" prompted Colonel Rives, chief of the Radar Division in the Office of the Chief Signal Officer, to send a three-man crew to the west coast to inspect service commands, ports of embarkation, and the headquarters of the Alaska Communication System to try to find out what was wrong with the distribution system of radar maintenance and spare parts.[52]

[46] (1) Memo, O. B. Anderson for Maj Reardon, 21 May 42; (2) OCSigO R&W Action 1, Capt H. L. Halterman to Maj Watson, Maint. Br, 20 May 42, sub: Spare parts. SigC 413.44 Spare Parts 1, 1941–May 1942.

[47] OCSigO R&W Action 1, Instl and Maint Div to Radar Div, 15 Jun 42, sub: Availability of spare parts at Philadelphia Sig Depot bearing other than radar numbers which might be used as substitutions for like parts in radar equip. SigC 413.44 Spare Parts 2, Jun–Aug 42.

[48] Memo, [O/C Mobile Crews] for Col Reardon, 3 Jul 42, sub: Summary of activities of emergency spare parts proc crews. SigC 230 Gen.

[49] OCSigO R&W Action 1, Lt J. C. Hansen to Reardon, 3 Jul 42, sub: Critical parts for SCR–268, 270, and 271 not obtainable on the open market. SigC 413.44 Spare Parts 2, Jun–Aug 42.

[50] Incl 2, Exhibit B, Summary of Completed and Outstanding Contracts Emergency Mobile Procurement as of October 15, 1942, and Ltr, O/C Mobile Proc to CSigO, 2 Nov 42, sub: Proc of spare parts SCR–268, 270, 271. SigC 413.44 Spare Parts 3, Sep–Nov 42.

[51] OCSigO R&W Action 1, Maj Arthur Soper to O/C, 12 Aug 42, sub: Ground radar maint. SigC 413.44 Spare Parts 2, Jun–Aug 42.

[52] Ltr, Chief of Radar Div OCSigO to Port Comdr Seattle POE, O/C Alaska Com System, and CG Ninth Sv Comd, 5 Oct 42, sub: Distr study of radar spare parts for shipment to overseas bases. SigC 413.44 Spare Parts 2, Jun–Aug 42.

Thus throughout the year the Signal Corps hacked away energetically at the spare parts problem. But the effort was scattered, a bit here and a bit there, so that the problem was dented but not reduced to manageable size. The basic difficulties underlying it remained. Not all of them were within the Signal Corps' power to solve, but the Corps would be blamed for them nonetheless. There would be many a complaint from North Africa because of the lack of spare parts for signal equipment.[53]

Spreading Procurement to Small Business

Of the many policy matters affecting Signal Corps production in the latter half of 1942, not the least was the question of spreading the work to smaller business concerns. The Signal Corps, both by choice and by necessity, had placed its supply problems largely in the hands of the five giants of the industry. But there was a persistent feeling of uneasiness among Signal Corps supply officers that the concentration of awards among the very large companies might result in overburdening them to such an extent that they could not deliver the material on time.

It was true that the large companies were supposed to subcontract 30 or 40 percent of their orders to smaller firms, teaching them the necessary techniques and assisting them in getting into production. But subcontracting was a controversial subject in 1942. To the Big Five, it was an obviously necessary technique not entirely new, since most of them habitually subcontracted for parts and subassemblies and in some cases for complete units under sublicensing agreements. Nevertheless, they doubted the wisdom of the Signal Corps plan to subcontract a fixed percentage of *all* contracts, and the president of Western Electric had suggested that there were technical reasons why subcontracting had to be handled with care. Not all contracting officers were in accord with the idea of subcontracting, either. They were under tremendous pressure to get out equipment and to get it out fast, and subcontracting meant trusting untried, possibly less skilled, sources. Yet the War Department policy was to broaden the base of procurement. Though obviously unable to apply a rule of thumb, Signal Corps procurement officers in general tried conscientiously to develop secondary sources of supply and to enforce the subcontracting provisions.

Early in February 1942 the Control Division had warned supply officers that even if all prime contracts with the nine largest firms supplying Signal Corps equipment were 30 percent subcontracted, Bendix would still need five years to complete its undelivered load, General Electric almost one and a half years, and Westinghouse two and a half years.[54] In August an officer from Colton's Aircraft Radar Branch wrote that overloading of the big companies had contributed to delay in deliveries because these plants could not work simultaneously on all their orders full blast. "Work on one order," he wrote, "is at a standstill because a 'higher priority' has been temporarily assigned to another order." This shifting of priorities in overloaded factories delayed less favored, yet badly needed, products. He wanted more insistence that the big com-

[53] For further discussion of the spare parts problem, see below, pp. 525ff.

[54] (1) Prog Annex No. 8, 16 Feb 42; (2) Supplement to Annex No. 8, 16 Feb 42; (3) Supplement to Annex No. 9, 2 Mar 42. SigC EO 319.1 Prog Annexes, 16 Feb–16 Mar 42.

panies subcontract to the smaller, less busy, factories.[55]

Of the loaded concerns Western Electric was the largest, in terms of the Signal Corps contracts it held at midyear. Its share was $932,000,000 of the four-billion-dollar Signal Corps outlay. Nearest runner-up was General Electric, with $386,000,000 on contract, followed by Bendix ($325,000,000), Westinghouse ($263,000,000), and RCA, only $84,000,000. Of the remaining 248 manufacturers holding Signal Corps contracts aggregating over $100,000, only three had contracted for more than $50,000,000: War Supplies Limited, $62,000,000; Philco, $60,000,000; Galvin, $55,000,000. Seven held contracts aggregating above $10,000,000: General Cable, $29,000,000; Belmont Radio, $22,000,000; Crosley, Fairchild Aviation, and Zenith, each $18,000,000; Farnsworth and Graybar, each $11,000,000. Graybar, moreover, was but a subsidiary of Western Electric.[56]

If added pressure were needed, it was supplied by Congressional action in the summer of 1942 with the passage of Public Law 603, which granted the War Production Board power to establish a Small War Plants Corporation to certify manufacturers capable of producing specific items of munitions, and the power to make contracts with any government agency through subcontracts with the certified business concerns.[57] General Somervell, chief of the Services of Supply, and General Harrison, his Director of Procurement, instructed all supply officers to utilize small war plants to the greatest extent possible, and General Colton instructed all branches of the Signal Supply Service to see that "when these plants are ready to take orders, they are given orders promptly." [58]

For hearings before the Senate Small Business Committee, the Signal Corps thumbed through its procurement records seeking the latest subcontracting figures. They showed that on 1 September 1942 the Signal Corps had 25,521 prime contracts with a dollar value of $3,098,329,568, and 500,000 subcontracts with a dollar value of $1,120,000,000, or 36 percent of the total. Small war plants (that is, plants employing 500 or less people), held 17,009 of the prime contracts, representing $464,749,435, or 15 percent of the total, and also held 156,000 of the subcontracts, with a dollar value of $235,500,000, or 7.6 percent.[59]

There were persuasive reasons why Signal Corps contracts with large firms would always predominate, and these reasons General Colton pointed out in a 25-page memorandum. The Signal Corps procurement

[55] (1) Memo, Colton for O/Cs All Brs of Sig Supply Sv, 21 Aug 42; (2) OCSigO R&W Action 1, Capt G. J. Rohrich, Air Radio Br SPSAR-1, to Exec Officer Radar Div, 1 Sep 42, sub: Comment on memo from Hq SOS. SigC 319.1 Rpts Gen 2, Sep-Nov 1942 (RB-1541).

[56] Semimonthly Rpt of Firms Aggregating Contracts over $100,000 as of 1 Jul 42. SigC (CH) 160 Semimonthly Rpts Oct 41-Jul 42.

[57] PL 603, 77th Cong, 11 Jun 42.

[58] (1) Incl 3, Ltr, Harrison to Chief of Tech Svs, 15 Sep 42, sub: Additional work for smaller war plants, with OCSigO R&W Action 1, O/C Facilities and Mat Br to Colton, 6 Oct 42, sub: Small war plants program; (2) AG Memo, SPX 004 (10-1-42) SPPDW-MP for Chief of Supply Svs, 1 Oct 42, sub: Additional work for small war plants; (3) Memo, Somervell for Chief of Supply Svs, 29 Oct 42, sub: Procedure on relationship with Small War Plants Div War Production Board; (4) App. A to Memo, Small War Plants Div Liaison Officer to Dir of Sig Supply Sv, 5 Dec 42, sub: Steps SigC has taken to comply with directives issued by SOS relative to small war plants. SigC RP 095 Small War Plants.

[59] Memo, Colton, Actg CSigO, for Chief of Small War Plants Br SOS, 6 Oct 42, sub: Senate Small Business Committee Hearings. SigC RP 095 Small War Plants.

problem was specialized. Almost entirely it concerned the electronics industry, because radio and radar equipment accounted for 93 percent of the total dollar value of Signal Corps procurement; wire and wire communication equipment less than 6 percent; and miscellaneous equipment such as photographic and meteorological items less than 1 percent. The radio industry was primarily an assembly industry, with prime contractors contributing engineering, design, and development talent. They placed orders for small parts with suppliers who in turn subcontracted with other suppliers, so that several layers of subcontracting resulted. In the case of one radio set, the different subcontracts in all levels reached into the thousands. Colton cited reasons why Signal Corps contracts were concentrated among only a few of the largest manufacturers: the inherent complexity and technical detail of much of the equipment; the necessity for hoarding machine tools, which had resulted in repeat orders to firms already producing equipment, rather than tooling up smaller concerns; the policy of purchasing complete sets whenever possible to simplify the storage and issue problem and to economize on signal personnel; and the necessity for keeping maintenance and repair parts interchangeable, which once again resulted in repeat orders from the same manufacturer.[60]

Actually the Signal Corps had already done much to help small business. When the limitation orders of early 1942 had brought about "distressed" labor conditions in some areas, the Signal Corps had placed orders such as the one with Kingston Products Corporation of Kokomo, Indiana, which was subcontracting sea-air rescue equipment SCR–578 for Bendix.[61] It had contracted with small plant pools, such as the ninety companies comprising the Omaha Industries, Inc., which had two contracts for wire throwers RL–37, and the Peninsular War Products pool of eight companies, which had a contract for telephone poles. It had spread the work on field telephone set EE–8 through a number of telephone manufacturing companies in order to keep their production lines up, even though one or two of them alone could have handled the entire requirement for EE–8's. The Signal Corps policy allowed a higher price to be paid small concerns for the same items that larger companies furnished at less cost. The Signal Corps had also transferred simple items from large manufacturers to smaller ones in order to make way for more complicated items, as in the case of headsets HS–30 transferred from Sonotone and Western Electric to the William J. Murdock Company, Kellogg Switchboard, North Electric Manufacturing Company, and others.[62]

During the late summer, the Signal Corps stepped up its efforts to subcontract, but without much effect. The total dollar share remained the same in terms of percentages. A report at the end of November showed that there were then 586,000 subcontracts in effect, averaging in value $2,240, for a total of $1,312,640,000. The number of prime contracts declined, to 24,251. The total value of all contracts was then $3,643,354,-

[60] *Ibid.*

[61] (1) Certification OPM to SW, 7 Oct 41, sub: Unemployment at Evansville, Ind., because of shortage of material; (2) Memo, Dir of Army Contract Div OUSW for CSigO, 10 Feb 42, sub: Suspension of certificates of four distressed communities and one industry; (3) Memo, Dir of Prod SOS for CSigO, 26 Oct 42, sub: Placement of contracts in distressed areas. SigC 323.37 (FM) Distressed Areas. Industrial Mobilization Div SigC Proc Dist, Philadelphia.

[62] Memo cited n. 59.

837.45,[63] which would account for about 36 percent of dollar value in subcontracts. Since the Signal Corps' figures in October had showed that ten firms each having contracts totaling over $50,000,000 held more than 75 percent of all Signal Corps contracts, it must be assumed that some of the larger firms were subcontracting among themselves, and that the percentage of subcontracts held by small firms had not increased materially.[64]

Plant Capacity, Material Shortages, and Patent Licensing

Unfortunately, as far as the Signal Corps was concerned, the Small War Plants Corporation brought in new facilities in the very field of simple equipment where excess capacity already existed in established, qualified facilities.[65] By the last quarter of 1942, plant expansions sponsored by the Signal Corps during 1941 and the earlier months of 1942 were coming into useful production. By October, 45 of the 64 Signal Corps plant expansions financed by Defense Plant Corporation and production expediting funds were in partial production. By the end of the calendar year, it was estimated, 52 would be in partial and 28 in full production. The list included plants producing capacitors, quartz crystal assemblies, radar components, radio antenna trailer assemblies, tubes of all kinds, testing equipment, insulators, field wire, assault wire, cable assemblies, dynamotors, motors, generators, lithium hydride, glass working lathes, powdered iron carbonyl, and tantalum oxide and metal. Plants were scattered over fourteen states from Redwood City, California, and Portland, Oregon, on the west coast to Salem, Massachusetts, on the east coast, and from Shreveport, Louisiana, north to Hamtramck, Michigan.[66]

Industrial capacity, however, hinged on many factors, and merely building factories was not a complete answer. Machine tools,[67] raw materials, and shortages of skilled labor, plus an ever-changing tactical situation, had to be calculated. Moreover each industry had its particular bottlenecks. Ever since the middle of 1942 the Signal Corps had been authorized to place advance orders, even up to 1944 requirements, to keep production lines going.[68] The Signal Corps lost some facilities to other using services because it could not supply enough

[63] (1) OCSigO R&W Action 1, O/C Proc Br to Spec Assignment Group Proc Br, 28 Nov 42, sub: SigC prime and subcontractors; (2) Incl to Action 2, (Spec Assignment Group Proc Br) to O/C Proc Br, Memo, 28 Nov 42, sub: Contracts. SigC (CH) 160 Semimonthly Rpt of firms aggregating contracts over $100,000, Oct 41–Jul 42.

[64] Not until May 1943 did the tabulations indicate that the items which could be manufactured by small plants were being contracted to them. In that month such business placed with small firms totaled 64 percent and by June it had risen to 81 percent. Incl to Memo, OCSigO Field Activities Br to Control Div, 20 Nov 43, sub: Weekly summary of prod accomplishments and difficulties. SigC RP 095 Small War Plants.

[65] Memo, Maj D. C. Graves for O/C Facilities Br OCSigO, 10 Apr 43, sub: Reasonable stabilization of prod schedules. SigC FM 400.192 Prod Lines—Continuation, Cessation, Maint, 1942–43.

[66] WD Monthly Prog Rpt, Sec 4–C, Const Industrial Facilities, 31 Oct 42, pp. 60–63. ASF Files, DRB AGO.

[67] In machine tools for example, Signal Corps production had at first been ignored, while producers of aircraft and munitions got the lion's share. The height of the machine tool shortage passed in September 1942; thereafter Signal Corps needs received more attention and its machine tool allotments improved. André E. Gerard, The Story of Supply in the Signal Corps in World War II, Pt. III, Production (1945), SigC historical monograph B–1c, pp. 31–34. SigC Hist Sec File.

[68] Memo, Dir of Proc and Distr Sv Div SOS for CSigO, 1 May 42, sub: Placement of advance orders. SigC FM 400.192 Prod Lines—Continuation, Cessation, Maint, 1942–43.

orders to keep them fully occupied. For example, General Olmstead had noted the Fred M. Link Company, which six months earlier had been devoting 90 percent of its capacity to Signal Corps work, but which by August had only 25 percent of its plant busy with Signal Corps orders.[69]

The fight for raw materials had begun early and had continued without respite. All the services needed more materials than were available, thus necessitating the imposition of the Controlled Materials Plan.[70] This had gone into effect in late summer 1942, running concurrently with the Production Requirements Plan which it would entirely supersede on 1 July 1943. Neither the Production Requirements Plan nor the priorities system which preceded it had provided any effective method of controlling raw materials to channel them into the places where they were needed most.[71] With the advent of the Controlled Materials Plan, the Signal Corps reorganized its field and staff offices which dealt with materials and resources, and brought in four industrial experts to assist: J. P. Howland, assistant to the president of Zenith Radio Company, L. W. Greenwood and J. L. Huck, scheduling experts from the Western Electric Company, and W. A. Kelley from the War Production Board.[72] The Signal Corps was a relatively small user of most of the strategic materials under the Controlled Materials Plan, but it was highly important that its needs should not be overlooked.

The Controlled Materials Plan, like its predecessor allocation and priority systems, dealt with shortages of materials, critical components, and production facilities. Insofar as the production of items of electronic equipment was concerned, none of these systems alone would have been enough to assure a balanced flow of electronic items to the military services. Beginning in the late summer of 1942, and continuing until shortly after the victory over Japan in 1945, a special priority system known as the Precedence System, applicable solely to the electronic requirements of the armed forces and those of the Allies, operated within the framework of the War Production Board systems. The fundamental difference between the concept of "priority" and that of "precedence" lay in the fact that the latter was a measure of military urgency only.[73]

That some such precedence system was urgently needed became clear in the early months of 1942. The Signal Corps' enormous orders of electronic equipment for the Army had consumed almost the entire plant capacity of the industry, shutting out smaller but equally urgent Navy orders. Army and Navy expediters had swarmed into contractors' plants, subjecting the manufacturers to a cross fire of conflicting demands and competing fiercely for War Production Board priorities and directives. By midsummer, the various bureaus and divisions of the two services were even com-

[69] Memo, CSigO for Dir of Sig Supply Sv, 12 Aug 42, sub: Prod Control of Signal Corps Facilities, and 1st Memo Ind, Dir of Sig Supply Sv to CSigO, 16 Sep 42. File cited n. 68.

[70] Memo cited n 65. For a complete history of the Controlled Materials Plan and other priority systems, see Dr. R. Elberton Smith, The Army and Economic Mobilization, a forthcoming volume in this series, Ch. VIII.

[71] (1) CSigO, Annual Report, 1943, pp. 239ff. (2) W. P. Worrell (Prod. Div, Philadelphia SigC Proc Dist), Industrial Summary: Signal Corps Materials and Resources, 31 Jan 46, pp. 13ff. SigC Hist Sec File.

[72] Supply Sv OCSigO, Review of Production Plans, 12 Dec 42, p. 7. SigC DS 400.192 Prod, 1942–43.

[73] Joint Com Bd Rpt, History of the Precedence System (12 Dec 45), prepared by Electronics Precedence List Agency, pp. 1–12. SigC Hist Sec File. Unless otherwise noted, the account which follows is based upon this document, which contains a detailed account of the Precedence System.

peting among themselves, to the utter confusion of the manufacturers who were trying to set up workable production schedules. The creation of the Army and Navy Electronics Production Agency (ANEPA) was a first step toward establishing order. But it was not enough.

The War Production Board, which had authority to take emergency action, lacked knowledge of the relative military necessity of any particular item of equipment as between the competing claims of the Army and the Navy. There had to be "a yardstick . . . to calibrate the urgency of various types of military electronic equipment within assigned priorities," particularly in the field of radar. At the urging of General Colton and other Signal Corps officers, the Radar Committee of the Joint Communications Board (a supporting agency of the Joint Chiefs of Staff) prepared the first radar precedence list in June 1942. In August formation of the Precedence Committee of the Joint Communications Board was authorized. The Committee soon became a workable organization of great importance, with a group of Army and Navy representatives preparing precedence lists of radio, radar, sonar, and associated equipmen in terms of military operational importance.

In October 1942 the War Production Board (through its Radio and Radar Division) issued Limitation Order L–183–2 making the precedence list for electronic equipment operative within the priorities system, effective 12 February 1943.[74] Thereafter the Precedence Committee published precedence lists establishing the relative urgency of certain types and quantities of electronic items of equipment within any single preference rating category, and forwarded the lists to the manufacturers on official forms called PL–1 forms. It was mandatory that the manufacturers schedule their production in accordance with these lists.

The Precedence System as it operated throughout the war proved to be of immense value to all those concerned with the electronic program, but most of all to the manufacturers. At first glance it might seem that integrating precedence listings into priority ratings would complicate manufacturers' problems, but in reality it did nothing of the sort. It enabled them to apply their facilities—plants, laboratories, labor, and all other resources—most effectively. Manufacturers welcomed the precedence lists, just as they did the creation of the Army and Navy Electronics Production Agency. Indeed, the electronic industry in general had responded to the wartime restrictions with admirable patience and resourcefulness, accepting each problem as a further challenge to ingenuity in producing equipment that fulfilled the exceedingly difficult requirements of warfare. One such instance arose early in the war in connection with patent rights.

Radio equipment generally employed large numbers of inventions covered by separate patents. There were few pieces of equipment wherein all of the patents applicable were in the hands of a single holder; in the case of new equipment, it was impossible for a manufacturer to know ahead of time whether or not he was infringing one or more patents. To protect manufacturers, there had arisen the trade custom of granting blanket licenses under large groups of patents held or controlled by a single company, a type of pool arrange-

[74] Joint Com Bd Rpt, App. VII, (a) Limitation Order L–183–a, App. XIX (d) Declaration of Policy by JCS.

ment. Under such a system, the manufacturer who sought a license obtained one which covered the use of all the patents within a single field. He paid a fixed rate of royalty whether he used many of the licensor's patents, only a few, or, in the case of a few licensors, none at all. There were perhaps a dozen or more such licensing groups, including the Radio Corporation of America, the Hazeltine Corporation, the Farnsworth Television and Radio Corporation, the Sperry Gyroscope Company, and others. The most extensive was the RCA group, which held licensing rights under about 20,000 patents, including its own, and patents of General Electric, American Telephone and Telegraph Company, Westinghouse, and other important electronics companies. About 150 of the patents were quite important to the manufacturers of Signal Corps equipment. Nearly 80 percent of the manufacturers, and a much larger percentage of the productive capacity of the industry, was licensed by the RCA group.[75]

Government practice had been to require the supplier of goods on a government contract to assume the risk of any costs that might be incurred by reason of infringement of any patent covering any part of the equipment to be manufactured. This requirement was incorporated in the contract in the so-called "save harmless" clause intended to "save" the government from "harm" in patent infringement. Contractors were loath to accept government contracts because of this clause. Either they refused to bid at all, or refused to execute a contract with the "save harmless" clause, or took out all the licenses offered by various groups, thus pyramiding royalties and increasing costs. Or, as most frequently happened, so contracting officers charged, they included in the cost of the contract additional money to be set aside as a fund to cover such a contingency. Well before Pearl Harbor, the Signal Corps had taken the initiative in War Department efforts to arrive at a satisfactory solution to the problem. On 9 December 1941 representatives of the radio industry met in the Office of the Under Secretary of War and formed a committee on research information, whose chairman was the Signal Corps patent expert, Maj. Donald K. Lippincott. The recommendations of the committee, adopted by representatives of the industry meeting in New York early in 1942, in effect promised a pooling of technical information by all radio manufacturers, in return for which the government would obtain licenses from patent holders, and would eliminate the "save harmless" clause from its contracts.[76]

By April of 1942 the government had been offered licenses, most of them royalty free, from 37 patent holders, including all of the important licensors of electronic equipment except Radio Corporation of America.[77] That company took the position that, because it had already licensed more than 70 potential suppliers and offered to license all others, and because it had reduced its royalty rates so that it would not make more profit in the war years than in the last year of peace, it should not be re-

[75] Memo, Maj Donald K. Lippincott, Legal Br OCSigO, for Maj E. S. Patterson, OUSW, 16 Dec 41, sub: Radio licenses and save harmless clause. JAGO (Pats Div) 201.3 National Defense Commercial Committee, Radio Valve Info Pool.

[76] (1) Report of Recommendations Adopted by Representatives of the Radio Industry at a General Meeting in New York on 20 January 1942. SigC 095 (LG–3A–78) R. Info. (2) Memo, Exec Officer Mat Br OCSigO for Exec Officer Control Div, 27 Mar 42, p. 6, Item 4. Weekly Achievement Rpts, 21 Jan 42–21 Apr 42. SigC Central Files.

[77] Memo, Maj D. K. Lippincott for CSigO, 14 Apr 42, sub: RCA licenses—government position. SigC 095 (LG–3A–78) R. Info.

quired to give the government a license, and that "the Government should continue to require its suppliers of radio equipment to assume normal and usual responsibilities for infringement by their products, which responsibility can be met by their acquiring the necessary patent rights." [78]

General Colton, replying to RCA, merely inclosed a copy of a very recent contract in which RCA itself had objected to the "save harmless" clause, and said, "The instance cited shows . . . that [the question] does arise with your company, and we cannot feel that the 'Save Harmless' clause should be used only when it works to the advantage of your company and omitted when it works to your disadvantage." He mentioned the fact that royalties accruing to RCA during 1942 would be in excess of $30,000,000, and added, "We do not believe that even your admittedly great contribution to the war effort warrants a tax of this magnitude, especially since the principal justification for royalties is to pay for continuing research work, and since your own current research, to which you retain the commercial rights, is now being done largely by government contract and on government funds." [79]

After a certain amount of legalistic skirmishing, RCA did arrive at a satisfactory basis for licensing the government, at terms considered quite generous. Under the terms of the license, RCA waived royalty payments from the more than 90 manufacturers already licensed, and gave the government a nonexclusive license to run "during hostilities and for six months thereafter" in return for the payment of $4,000,000 annually.[80]

The November Drive for Production

Thus throughout the summer the Signal Corps struggled with a host of production problems. When the planning to supply North Africa finally got under way late in August, Signal Corps procurement was less than ready to meet the test. The fact that many of the problems affecting Signal Corps procurement were not unique did not make them less real or less critical. The disturbing thing was that the Signal Corps apparently was not succeeding in overcoming them as well as the other supply services. The August production meeting which had reflected the Signal Corps in so poor a light caused repercussions that rumbled through the entire organization. General Olmstead himself was puzzled. What was wrong, he queried his deputy chief signal officer, General Code, that could "occasion the adverse comments and charts from SOS with which I am constantly being confronted?" Code's answering memorandum acknowledged that the Signal Corps was not meeting either its "required" or its "anticipated" goals—that is, neither the long-range forecast of requirements established by the Army Supply Program, nor the more realistic self-set objective, which represented the portion of the ASP the Signal Corps thought it could produce for the period ending 31 December 1942. Code felt that "small but powerful manufacturing groups (had) a strangle hold on [Signal Corps] contracts"; that too little use had been made of small concerns; and that the Signal Corps had wasted vital strategic materials

[78] Incl, Patent Licenses to the Government and "Save-Harmless" Provision, to Ltr, Dr. C. B. Jolliffe, Chief Engr RCA Labs, to Colton, 7 Mar 42. File cited n. 77.

[79] Ltr, Colton to Jolliffe, 14 Mar 42. File cited n. 77.

[80] License OCSO–DP–43–MR–1, Contract W1049–sc–506. JAGO Files (Patents Div.)

by trying to maintain specifications on a peacetime basis instead of making use of substitutes. He suggested that the Signal Corps ought to have "an integrated, expert production program run by specialists." [81]

In a memorandum to General Colton, a specialist in development rather than in production, Code had already set forth the alarming statistics. The Signal Corps would need to have over $165,000,000 in signal equipment delivered monthly from August through December. In July it got only $65,363,000. That did not include some $28,000,000 in components, but adding them gave only $92,000,000, a little more than one half the requirement. And in the first week of August less than $3,000,000 worth of equipment was delivered. If the same rate was maintained through the month the Signal Corps would get $12,000,000 in deliveries when $165,000,000 was needed. What did Colton propose to do about it, asked Code? [82]

Colton's first response was to ask that David Sarnoff, president of RCA and a colonel in the Signal Corps Reserve, be called to active duty for a few months as the executive assistant to Colton.[83] Sarnoff did come on duty (for 30 days), and General Olmstead at once set him to studying the whole procurement structure.[84] A few days later Sarnoff reported that "95 percent of the Signal Corps' problems were in the Supply Service," a conclusion which surprised no one. Sarnoff found many minor flaws which needed remedying, and recommended corrective measures in a concise report to Colton, who approved almost all of them.[85] To General Olmstead, Sarnoff in his capacity as a member of Olmstead's Advisory Council addressed a second report.[86] Stripped of its excess verbiage, it said that the position of Chief Signal Officer had grown too big for one man to handle with competence. The function of supply should be segregated, the report went on, and placed under one man who would have authority to act without intervening layers of command obstructing him.[87]

There is no record that Olmstead took immediate action on this memorandum, possibly because very soon thereafter he entered the hospital for treatment. October passed in a flurry of worried consultations

[81] (Draft) Memo, Deputy CSigO for CSigO, 10 Sep 42, sub: What is wrong with our supply picture? Deputy CSigO Stayback Correspondence File. See Deputy CSigO Folder, pp. 191–92. SigC Hist Sec File.

[82] OCSigO R&W Action 1, Deputy CSigO to Dir of Sig Supply Sv, 19 Aug 42, sub: SigC deliveries. SigC EO Prod. Deputy CSigO File.

[83] Log entry, 24 Aug 42. Deputy CSigO Folder, pp. 94 and 175. SigC Hist Sec File.

[84] Memo, Olmstead for Col Sarnoff, 12 Sep 42, sub: Investigation of supply procedures. SigC EO 400.192 Prod (To Chief of Mat Br from CSO Memo—File 2) 1941–42.

[85] Memo, Dir of Supply Sv, for CSigO, 28 Sep 42, and Incl 11, Preliminary Rpt from Sarnoff. SigC EO 400 Rpt of Supply Svs, 1942. Deputy CSigO File.

[86] Olmstead had revived the Advisory Council of Reserve Officers late in 1941. See (1) Terrett, *The Emergency*, p. 298; (2) CSigO, Annual Report, 1952, pp. 27–28. Three other officers joined in the report. They were Col. Carroll O. Bickelhaupt, assistant vice president, American Telephone and Telegraph Company; Col. William C. Henry, president of the Northern Ohio Telephone Company and vice president of the U.S. Independent Telephone Association; and Lt. Col. Clinton B. Allsopp, vice president, Postal Telegraph and Cable Company. All were on active duty with the Signal Corps.

[87] It was suggested that this man should be "able experienced, possess imagination, courage, initiative, tact, and facility for getting along with people above and below him." His title should be Assistant Chief Signal Officer, and he should have several Deputy Chief Signal Officers to assist him. Memo, Sarnoff *et al.*, for CSigO, 24 Oct 42, SigC 334 SigC Advisory Council (Memo for CSigO from Members of SigC Advisory Council) 1942. Deputy CSigO File.

within the supply service, but without many concrete results. At his staff conference of 3 November, General Somervell told the Signal Corps that it must meet at least 90 percent of its own forecast. After all, he said, the Signal Corps had set its target, and should have no alibis.[88]

With Olmstead in the hospital, Code felt that it was up to him to take over. Calling the top supply men of the organization together, he mapped out an intensive program designed to bring in $150,000,000 in deliveries that month. Within a week telegrams urging greater production went to all manufacturers working on Signal Corps contracts. They brought no results—deliveries the next week stayed at the same low level. All that happened was that some congressmen heard of it, and complained of the waste of taxpayers' money. Code intensified his efforts. He told Signal Corps expediters to get the raw materials that manufacturers needed, to be "clever, not orthodox," letting "nothing" stand in their way. He ordered the inspectors to redouble their efforts to complete clearances of finished equipment from plants. He organized a publicity campaign to enlist the co-operation of defense plant workers; set up daily "situation charts"; and assigned Colonel Bickelhaupt to get in touch with his friends in the world of big business to plead with them for more production in November.[89] Finally, Code spread the word to cut red tape ruthlessly, no matter whose toes were stepped on in the process. Reporting his efforts to Somervell, Code found the chief of SOS ready to back him up. Somervell said, "Better to be in jail having gotten the $3,000,000,000 than to be in jail because we did not get it." There would be repercussions from many places, warned Code. Somervell answered, "Let them come." [90]

The month flew by. Everyone put aside other assignments to work on the production drive. Still in the hospital, General Olmstead could do little but worry. "The quickest way for you to get me thrown out by January 1st is to fail to meet that forecast," he told Code.[91] But the drive was succeeding. On the anniversary of Pearl Harbor, Code was able to call SOS to report the good news—that the Signal Corps had not only met its November procurement objective of $141,000,000 in full, but had surpassed it for a final total of $174,000,000.[92]

The Signal Corps was elated. Yet organizationally, little had changed. The top-heavy and cumbersome structure remained. The supply function was still tied to research and development, and still lacked the single-minded attention of a production expert. Whether it would falter or fail under the extra strain of the Army's first major offensive remained to be seen.[93]

Plans and Preparations, at Home and Overseas

In General Olmstead's office there were two groups to perform the highly technical

[88] (1) Personal Memo, Code for Colton, 4 Nov 42; (2) Memo, J.A.C. (Code) for personal attention Colton, 13 Nov 42, quoting Personal Memo, Somervell for Olmstead. SigC EO 400.192 Prod.

[89] Bickelhaupt found some interesting things—for example, that the biggest supplier of Signal Corps equipment was devoting most of its efforts to developing its own equipment rather than filling Signal Corps orders. Memo J.A.C. (Code) for CSigO, Prod Expediting, 20 Nov 42. Deputy CSigO Folder, p. 194.

[90] Log entry, Nov 17–19. Deputy CSigO Folder, pp. 179–80.

[91] Personal Memo, Code for Colton, 6 Nov 42. Deputy CSigO Folder, p. 194.

[92] Log entry, 7 Dec 42. Deputy CSigO Folder, p. 182.

[93] The subject of Signal Corps procurement is continued to mid-1943 in Chapter XV, below.

work that constituted the Signal Corps' participation in staff planning for actions in Atlantic areas, in Pacific areas, and in any other area where an invasion might be launched. Olmstead had created the Planning Directorate on his executive staff following the March reorganization of the War Department, and had picked Colonel Meade to head it.[94] The other planning group, the long-established War Plans Division, was one of the units of the Signal Operations Service. Col. Francis H. Lanahan, Jr., served as its head until late July, when he was replaced by Lt. Col. Victor A. Conrad. Lanahan moved up into the Planning Directorate under Meade.[95]

As early as January, the Signal War Plans Division had labored over a plan called GYMNAST, which contemplated an invasion of the Casablanca area. Toward a radio and wire net planned to extend throughout French Morocco, the Signal Corps drew up call signs, prepared frequency assignments, and began readying equipment and signal units. Then in March GYMNAST was shelved, although it was to reappear a few months later polished and expanded as TORCH. In June the Joint Chiefs of Staff appointed a committee to draw up a communication plan for the South Pacific. The Army member of the committee was Colonel Lanahan, and another Signal Corps officer, Lt. Col. Francis L. Ankenbrandt, represented the Air Forces, to which the Signal Corps had detailed him. Together with naval Comdr. A. J. Detzer, they rushed their report to completion in July.[96]

Late in May a big assignment fell to the Signal Corps planning units. It was the demand for communications for BOLERO, the build-up operation in the United Kingdom. This plan was designed to provide a force of a million men specifically equipped to carry out an air offensive against the European continent in 1942, possibly a continental operation in conjunction with the British in 1942, and a major joint invasion in 1943.[97] The Signal Corps learned that it would have to provide hundreds of specialists in dozens of categories, besides tons of signal equipment, all on very short notice. Some of the units to be shipped in August would have to be activated before the publication of their tables of basic allowances.

During June Signal Corps planners toiled over the assignment of officers and units. Ten types of signal units, and many of them, were contemplated for Army Air Forces needs. Large numbers of specialists in 48 categories would have to be provided for the Signal Corps replacement pool for

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[94] Signal Corps Administrative Log, 1939–1945, OCSigO Orgn Chart 16, 30 Mar 42, p. 42. SigC Hist Sec File.

[95] OCSigO Orgn Chart 17, 22 Jul 42, p. 48. SigC Hist Sec File.

[96] (1) Incl 1, SigC Activities in the SPA, with Ltr, Actg CSigO SPBC to Dir of Plans and Opns Div, OCSigO, 31 Jul 42; (2) Rpt of Liaison Com Officers to Joint U.S. Staff Planners, Joint Command (Communication) Centers for the Island Bases in the South Pacific, 15 Jul 42. SigC OT 322 Gen.

[97] (1) Incl 6, Somervell to CSigO [and other supply service heads], attention: Lanahan, 28 May 42, sub: Planning and Opns, BOLERO, and Incl 7, Résumé of Studies Required, unsigned and undated, on unsigned basic, 3 Jul 42, sub: Notes for conference on BOLERO. SigC 320.3 BOLERO, May–Jul 42, (MT–24). (2) Memo, Actg Chief of Opns Br, OCSigO for Exec Control Br, 22 May 42, sub: Weekly prog rpt, p. 3, Item 30. Weekly Achievements Rpts, 27 Apr–8 Jun 42. SigC Central Files. (3) For a detailed account of high-level strategic planning, see Gordon A. Harrison, *Cross-Channel Attack* (Washington, 1951), Ch. I, and Maurice Matloff and Edwin M. Snell, *Strategic Planning for Coalition Warfare, 1941–1942* (Washington, 1943), both in the series UNITED STATES ARMY IN WORLD WAR II.

BOLERO.[98] Late in June the planners agreed that for all Army radio, radar, and wire installation and maintenance needs, the advanced section of SOS BOLERO would require six signal depot companies, three signal repair companies, five signal companies (depot aviation), twenty-eight signal companies (service group), and one photographic laboratory.[99] The task of assigning officers was complicated by the fact that dispute and confusion existed both in London and in Washington over the areas of responsibility and channels of command for the BOLERO operation in the United Kingdom.[100]

The SOS supply organization for the build-up was being formed in the United States. It was to be headed by Maj. Gen. John C. H. Lee, and General Somervell had instructed his technical service chiefs to make some of their best men available for Lee's staff. The Signal Corps had chosen General Rumbough, the commanding officer of Camp Crowder, Missouri, for this assignment.[101] But on 8 June 1942 the formation of the European Theater of Operations United States Army (ETOUSA) was announced, to replace the planning, supply, and tactical command known as USA-FBI. Under General Order No. 2, Rumbough was named Chief Signal Officer of ETOUSA.[102] Thus he assumed a dual role, operating as the chief signal officer of both ETOUSA and the SOS organization. The situation was somewhat clarified in July, after General Eisenhower assumed command of ETOUSA. The chiefs of the operating services were placed under the direction of the Commanding General, SOS, who was designated deputy theater commander shortly thereafter. While the supply chiefs moved with General Lee to his headquarters at Cheltenham, ninety miles northwest of London, a representative of each service remained at theater headquarters. For this duty, Col. Jerry V. Matejka was designated for the Signal Corps.[103] Matejka had been in England since May 1941 as signal officer of the Special Observers' Group, and had already established working arrangements with the British signals organization on the use of British installations and equipment. He had also ironed out many of the difficulties that beset the early contingents of the Electronics Training Group officers sent to the United Kingdom for schooling in 1941 and early 1942.[104] Largely because of Matejka's

[98] (1) OCSigO R&W Action 1, Lt E. E. Sullo, Dir of Planning, to War Plans Div, 23 Jul 42, sub: Tentative BOLERO complete, with AAF R&R, 15 Jun 42, same sub; (2) Memo, Lanahan for Opns Div SOS, 5 Jun 42, sub: Specs required for SigC replacement pool—BOLERO, with Incl, Spec List. SigC 320.3 BOLERO May–Jul 42 (MT–24).

[99] Incl, Memo, Colton for CSigO, 29 Jun 42, sub: Inspec and maint of SigC equip, with OCSigO R&W Action 1, Meade to Dir of Sig Supply Sv, 10 Jul 42, same sub. SigC (EO) 475, SigC Equip Gen.

[100] For a detailed discussion of this point, see Roland G. Ruppenthal, *Logistical Support of the Armies*, I, UNITED STATES ARMY IN WORLD WAR II (Washington, 1953), Ch. I, *passim*.

[101] BOLERO Staff, Forward Echelon GHQ, and Sig SOS Rear Echelon, approved by CSigO, n. d. SigC 320.3 BOLERO May–Jul 42 (MT–24).

[102] Memo, Col M. D. Harris, Exec Officer OCSigO ETO, for Code, 5 Mar 45, sub: Orgn of Hq, ETOUSA and responsibilities of CSigO, and Incl 2, GO 2, Hq ETOUSA, 8 Jun 42, sub: Staff of Hq ETOUSA, Tab A, App. D, to Memo, Code for Maj Gen Harry C. Ingles [1945]. SigC 370.2 ETO (App. D., Orgn of Theater Sig Pers ETO) 1942–45.

[103] Memo, cited n. 102, and Incl 3, GO 19, Sec. I, Orgn of Hq ETOUSA and SOS ETOUSA, 20 Jul 42.

[104] Ruth F. Sadler, History of the Electronics Training Group in the United Kingdom (1944), SigC historical monograph C–5, pp. 68–69. SigC Hist Sec File. Upon establishment of ETOUSA, administration of Electronics Training Group matters was assigned to SOS, ETOUSA, by GO 3, 8 Jun 42.

efforts, the Signal Corps appears to have been the first of the technical services to acquire practical working experience in England.[105]

Though the planning for the BOLERO build-up had begun on a grand scale, a sober study of the cold realities imposed by the critical shortage of shipping soon demonstrated that the supply targets would have to be scaled downward. Even while the United States embarked on the build-up to the limited extent possible, the strategy which underlay the plan was being questioned and revised.[106] By mid-July plans for a 1942 attack on the Continent were abandoned, and the Allies settled upon an invasion of North Africa instead. TORCH became the design which would launch American troops on their first invasion across the Atlantic. While a planning committee in London under Maj. Gen. Mark W. Clark set to work on 13 July to map out the grand strategy for the invasion, the Office of the Chief Signal Officer in Washington turned to a survey of communication facilities in French and Spanish Morocco, in Algeria, and in Tunisia.[107]

Top-level planning suffered from confusion, haste, and conflict between the British and American viewpoints on the scope and objectives of the operation.[108] To begin with, mounting the invasion would be something of a three-ring circus, the actors in each ring performing rather independently of the others. American troops comprising Task Force A, under General Patton, assigned to the western third of the invasion around Casablanca, staged wholly in the United States. Task Forces B and C, comprising both American and British troops aiming for the center and eastern sectors around Oran and Algiers, staged in England. Even with the best of communications, co-ordination between the widely separated groups would have been difficult. And Army's communications were not at their best during the summer and autumn of 1942. It was to be many months yet before new Signal Corps developments and installations would make them so.

Furthermore, the BOLERO build-up had been intended to supply American troops in lands well equipped with communications, which North Africa lacked. To remedy the defect, the Signal Corps proposed the "A to H Wire Plan." [109] This plan aimed to provide a trunk line about 900 miles long between Casablanca and Algiers, together with subsidiary telephone communication to major headquarters. The Signal Corps planners reckoned on carrier telephone lines, with repeater stations, and upon voice frequency carrier telegraph. Also, they planned to link various air force and ground force headquarters by means of a new development called rapid pole line.[110]

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[105] Ruppenthal, *Logistical Support of the Armies,* p. 50.

[106] Harrison, *Cross-Channel Attack,* pp. 21–31.

[107] (1) Capt Sidney L. Jackson, Tactical Communication in World War II, Pt. 1, Signal Communication in the North African Campaigns (1945), SigC historical monograph E–3a, p. 2. SigC Hist Sec File. (2) Interv, SigC Hist Sec with Maj C. B. Riggs (formerly SigC planning officer for Task Force A), 17 Nov 43.

[108] For complete discussion see Leighton and Coakley, *Global Logistics and Strategy, 1940–1943,* Ch. XVI.

[109] So-called for reasons of security. The North African station sites were designated simply as Station A, and so on, through station H. Sig Sec, AFHQ, History of the Signal Section, Allied Force Headquarters, 24 July 1942–10 November 1945 (1945), p. 15. (Hereafter cited as Hist Sig Sec AFHQ.) SigC Hist Sec File, A47–200, Drawer 15.

[110] Capt Sidney L. Jackson, Fixed Wire, NATOUSA: Chapter I of Theater Fixed Networks (1944), SigC historical monograph E–1a, pp. 1, 8. SigC Hist Sec File.

The Signal Corps planners trusted that the first troops ashore would need little more than switchboards in the way of wire equipment (they would be well supplied with portable radios of course). They intended the Signal Corps units to put local facilities to work, rehabilitating and improving them. But trunk lines over the large distances of North Africa called for large-scale arrangements. For the Oran and Algiers area, the planners in their "Operation TORCH Wire Plan," edition of 22 September, presented the details in fine order, on paper be it remembered. They planned good wire and cable systems, utilizing local facilities when available; but for the most part, the equipment would have to come from the United States, and in large quantities, in order to provide, for example, seven voice and eight telegraph circuits over the 836 miles between Casablanca and Algiers; six voice and ten telegraph circuits over the 267 miles between Algiers and Constantine, and so on.[111]

Toward getting material to implement the A to H plan, Captain J. D. Stewart, Army Communications Division, conferred in September with the Long Lines and Operations and Engineering Departments of the American Telephone and Telegraph. Long Lines agreed to prepare the detailed material and equipment lists. Facilities would include hundreds of miles of cable and four-wire lines for carrier C and H operation. Local facilities would make it unnecessary to construct new pole lines in some cases, the planners were assured. This, however, was to prove a painfully misleading piece of optimism. As the deadline for shipment approached, the heat of activity intensified. The requirements by 23 September included the new packaged No. 11 telephone switchboards, 69A1 teletypewriter switchboards, C and H carrier telephone systems, AC–operated repeater stations, and DC telegraph. Some, probably unaware of current radar developments, thought this was "the hottest job at present for the Signal Corps" in Western Electric shops, and the Kearny plant was asked to rush it in every way. It lagged, nonetheless, and by October the Signal Corps became so frantic that it waived all government inspection while granting permission to fill the A to H project needs by diversion from any other, save only the Alcan Highway job.[112]

The equipment thus planned did not arrive in North Africa nearly as soon as intended, despite all efforts and deadlines. The planners who thought the troops would find sufficient equipment to get along well enough initially and who thought they possessed a fairly complete summary of what would be available in the way of wire, were to get some dismal jolts.[113]

As for large fixed radio installations, the planners knew that several high power stations already existed in North Africa. The Signal Corps, organizing the 1st and 2d Radio Broadcasting Detachments to take them over,[114] could expect some damage, and therefore ordered equipment of a type required to repair and rebuild them if need be. How to get the right parts and components was a poser until someone discovered that a French communication company had operated in New York several years earlier. The equipment was still there, idle, and was presumably the same type as would be found in French Morocco. Arrangements were made for Western Union to buy up

[111] *Ibid.*, pp. 2–4.

[112] *Ibid.*, pp. 5–10.

[113] (1) *Ibid.*, p. 15. (2) Interv with Maj Riggs, 17 Nov 43.

[114] CSigO, Annual Report, 1943, p. 305.

the company, whereupon the Signal Corps requisitioned the equipment to ship to North Africa. But of course most of the larger radio equipment would have to be brought in.[115] TORCH radio plans touching Oran alone called for a complete corps signal battalion, with additional men to handle extra equipment which would be issued beyond the table of basic allowances. The equipment list included six SCR–299's, power units, portable masts, and accessories, not to mention parts and supplies for 60 days' maintenance. Included, too, was a 40-kilowatt radio station, able to provide high speed multichannel facilities. In case it could not be had immediately, the planners allowed for two smaller stations, of 10- and 1-kilowatt outputs, to be landed directly after the assault to serve until the 40-kilowatt set could be obtained.[116]

Nevertheless, hard work and the best of plans could not completely offset the short time allotted to TORCH preparations and the difficulties which attended the physical separation of the planners. The Western Task Force was to be equipped wholly from the United States, and was thus the focus of planning in Washington. In theory, the American forces within the central and eastern groups in England were to be supplied largely from resources on hand from BOLERO shipments. The rub was that too little had been sent under the BOLERO plan. Furthermore, as D Day drew near, it became apparent that many of the items which had arrived were hopelessly lost in British warehouses. The SOS, ETOUSA, had not had time to become firmly and efficiently organized to handle the daily increasing tonnage of supplies for TORCH. There were far too few service troops available in the theater. Moreover, equipment was poorly marked, badly packaged, hard to identify, and often misrouted. Under the task force shipping plan then used, organizations were shipped to the United Kingdom on fast transports and the bulk of the organizational equipment by slow convoy. The equipment was supposed to be marked in such a manner that it would catch up with the unit in England. Actually, this "marrying" of equipment and organizations was exceedingly difficult. Either the equipment arrived first and was stowed away in warehouses where it could not always be located when it was needed, or the unit arrived first, and, lacking equipment, drew new items from stock, thus depleting the already scanty supply.[117]

In the last weeks of preparation, the theater demanded so many items which had already been shipped "once or twice" that supply officers in the United States who were concentrating their efforts toward equipping the Western Task Force became alarmed lest General Patton's force should be stripped of essentials. They took equipment from units in training, diverted items from lend-lease shipments, and "borrowed" from equipment already earmarked for other destinations.[118]

The Signal Corps officers, like those of all the other technical services, spent hectic weeks of preparation in a most confused situation. Some planners were in Washing-

[115] Interv with Maj Riggs, 17 Nov 43.

[116] Msg, OPD to CG ETO (6769), R–25, 21 Aug 42. [WD Gen] Staff Com Center Msg Log File.

[117] (1) Extract of Sig Com Items, from Lessons on Operation TORCH, Hq Mediterranean Base Sec, Office of CG, 4 Jan 43. SigC Hist Sec File, North Africa Folder 2. (2) Leighton and Coakley, *Global Logistics and Strategy: 1940–1943*, p. 430. (3) Ruppenthal, *Logistical Support of the Armies*, pp. 95–97.

[118] Interv with Maj Riggs, 17 Nov 43.

ton, some in Norfolk, and some in between and up and down the coast. The headquarters of the Amphibious Force (Atlantic Fleet), and its training facilities, were in the Norfolk area, and there the Amphibious Force staff, responsible for specialized training, naturally remained. But the headquarters of "Task Force A" was in the Munitions Building, Washington. This separation at once presented difficulties of maintaining liaison, co-ordinating planning, and maintaining secrecy. "These difficulties," one officer described in a post mortem, "cannot be over-emphasized." Signal officers found their plans bedeviled by numerous factors, on which they were badly informed or about which they were uncertain, for reasons often beyond their control. They overestimated the capacity of ports to handle the equipment which they planned to supply, and they failed to grasp the limitations of convoys. Ships would have to serve as communication centers in some cases, and here the planners had to wait upon Navy's choice of ships before they could estimate equipment needs and engineering. Often the choice remained uncertain until very late. Furthermore, the signal officers in subordinate headquarters, which were dispersed along 500 miles of the Atlantic coast, were unable to participate in the planning, and the Force Signal Section had to do the job for the Sub-Force as well as for the parent organization. Worse, there was no opportunity for the Sub-Force signal officers to become familiar with the plans thus formulated. Not one of them had had experience in amphibious operations or had even witnessed the training of signal personnel in the exercises at Solomon's Island, Maryland.[119]

[119] Jackson, Fixed Wire, NATOUSA, pp. 5–6.

Thus, the scene which Colonel Hammond, the signal officer of the Western Task Force,[120] entered when he arrived in Washington to assume his duties was anything but bright. He had scarcely two months before D Day, 8 November, in which to complete enormous tasks such as (1) working out the details of the complex communications required; (2) determining the specific signal troops and equipment needed for the invasion; and (3) preparing the signal troops and their thousands of tons of equipment for shipment on the assault and supporting convoys. Undoubtedly, he received invaluable assistance from officers in the Signal Corps Directorate of Planning and in the War Plans Division (the annual report of the Chief Signal Officer lauds especially the Directorate of Planning). These men, working under conditions of extraordinary secrecy, hastened the activation of special units, the training of signal troops, the procurement, assembly, and shipping of equipment. In general they co-ordinated the multifarious activities of the Office of the Chief Signal Officer toward meeting the D Day of America's participation in the first great Allied amphibious landing upon hostile shores.[121]

In England signal plans for TORCH progressed at Allied Force Headquarters, officially activated on 15 September under General Eisenhower. His Chief Signal Officer, Brig. Gen. Jerry V. Matejka, was well

[120] Colonel Hammond served as signal officer for General Patton throughout World War II. Col Elton F. Hammond, "Signals for Patton," *Signals* II: 1 (September–October 1947), 5.

[121] (1) CSigO, Annual Report, 1943, pp. 76–77. (2) Memo, Lt Col J. E. Watters for Directorate of Planning, 16 Nov 42, sub: Summary of special units and equip for Task Force A. SigC 475 (EO–4–9) Equip and Movement Orders NATO, 1942–43.

aware of the difficulties imposed by the isolation of the Western Task Force group, far from the central and eastern groups in England. To this factor he afterward ascribed "many unfortunate developments which should be avoided." [122] Matejka was an ideal choice for the position he filled. The year and a half he had spent in England working closely with British signal officers had given him a familiarity with British signal matters and personnel that proved invaluable for the task of co-ordinating the signal procedures of the two nations. Matejka's deputy was a British officer, Brig. W. A. Scott. In all matters, British and American signal experts worked side by side. For example, Matejka's radio officer and authority on frequency allocations was Capt. Esterly C. Page, whose British counterpart was Maj. C. A. Henn-Collins.[123]

These signal officers were pioneering something new in military communications, setting a precedent for things to come. There were many novel problems to contend with. Patton's force would be all American, but the force staging in England would include both American and British units. This meant that American and British communications would have to be co-ordinated. There were no precedents, and neither nation's set of rules would do by itself. Hence a Combined Signal Board, which met daily during the planning phase, had to sit down and hammer out new techniques and arrangements. Further, since the signal officer in the United States Army was responsible for radar, signal supply, communication intelligence, and photography, all outside the province of his British counterpart, the Signal Section of the Allied Force Headquarters had to deal not alone with the Royal Corps of Signals, but with several other components of His Majesty's forces as well.[124]

Matejka and his British and American officers in the AFHQ Signal Section were expected to furnish communications for the entire headquarters with all its amazingly diverse elements. That meant providing service for representatives of the United States Army and Navy, Royal Navy, British Army, Royal Air Force, and American and British civilians, diplomatic, political, economic, propaganda, and counterintelligence agencies. All this lay far beyond the service which a headquarters signal section, United States Army, had been accustomed or designed to provide. Much had therefore to be extemporized, or rather pioneered. There were additional jobs, too, such as providing fixed plant equipment for the British since the American radios were more powerful and better suited to the long distances of North Africa. Yet the American signal supply was already more than fully occupied with American troop requirements for all three task forces. Moreover, time was desperately short. It was August before planning began; it was September before the Allied Force Headquarters was actually activated. Each problem had to be solved in some fashion, nevertheless.

In the Signal Section, the American share fell to four Signal Corps officers, who started work on 15 August; they with several others who came in subsequently worked thereafter night and day.[125] Radio circuits had

[122] Jackson, Fixed Wire, NATOUSA, p. 3.

[123] Interv, SigC Hist Sec with Lt Col Esterly C. Page, Sep 44.

[124] (1) Jackson, Tactical Communications in World War II, Pt. I, pp. 3–4. (2) Hist Sig Sec AFHQ, pp. 7–14. (3) Interv, SigC Hist Sec with Matejka, Apr. 47.

[125] The first four were General Matejka, Captain Page, Maj. Frederick C. Lough, and Lt. Col. Harold G. Hayes, the last a signal intelligence officer. Sub-

to be decided upon, frequencies allocated, combined procedures ironed out. At one point the officers had developed the necessary schedules for sixty days in advance, but then were compelled to recast everything in consequence of a major change in the over-all plan. Improvising became the rule rather than the exception. Small wonder that Captain Page felt it "a great relief" when he left "the frenzy of last minute changes" for North Africa and Algiers and could "relax and rest in a comfortable bunk with nothing particular to do." [126]

Communication procedures were bound to be most perplexing. They are bad enough when only one homogeneous army is operating, for they must insure clarity, make certain that men know with whom they are communicating, and conceal as much information as possible from the enemy's intercept service. But in TORCH the normal perplexities would be compounded. There would be not one army, but several. In August General Eisenhower warned the Americans not to affix topmost priority notations to their messages, as was the practice, according to American Signal Operating Instructions. The British had no equivalents for such notations and, if the priority symbol appeared in their traffic, it would immediately flag the message for the benefit of any enemy monitor intercepting and copying British radio communications. The priority symbol would by itself indicate that the message was American and might even indicate the location of the general himself.[127]

Eisenhower ordained that each service use its own communication procedures for its own intercommunication. He added that two services, if not of the same nation, would use the signal procedures already in effect between them. American-British communications, if not already provided with an agreement, would employ the standard radio procedure, the self-evident code, or "Q" signals.[128] Obviously, much remained to be done, and this was the job of the Combined Communications Board (CCB). The AAF in the European Theater of Operations was especially concerned about keeping up to the minute on all communications procedures, instructions, promulgation orders, and the like issuing from the CCB, and Eisenhower asked on 7 October that his ETO air force be so posted.[129]

General Eisenhower's staff in London and the planners in Washington were now feverishly laboring at TORCH arrangements, which, in Signal matters, revolved around trained operators, intricate equipment, and complex communication procedures. Late in August they contemplated for signal troops: One battalion armored; one corps battalion; one radio intelligence company; one operations company separate; one construction company separate for the Allied Force Headquarters; one signal operation company separate; one signal construction battalion; three port signal service companies; one signal service company to include a 115-kilowatt team; four 300-kilo-

sequent arrivals included Col. F. L. Gillespie, Maj. K. Buchak, and Capt. R. Jones. Intervs, SigC Hist Sec with Col Page, Sep 44, and with Lt Col Frederick C. Lough, 5 Oct 44. For the complete list of Allied officers in the Signal Section, see Hist Sig Sec AFHQ, pp. 8–9.

[126] (1) Interv with Page, Sep 44. (2) Jackson, Tactical Communications in World War II, Pt. I, pp. 4–5. (3) Capt Frederick Reinstein, Signal Corps Fixed Communication in the European and Africa-Middle Eastern Theaters (1945), SigC historical monograph E–7, pp. 69–70. SigC Hist Sec File.

[127] CG ETO (10805) No. 1570, 27 Aug 42. Msg Log File, Staff Com Center.

[128] CG ETO (7716), No. 1339, 20 Aug 42. Msg Log File, Staff Com Center.

[129] CG ETO (2826) No. 3208, 7 Oct 42. Msg Log File, Staff Com Center.

watt teams; four SCR–188 teams; six SCR–299 teams; one pigeon platoon; one cable operation section of 18 men; and one administrative section of 13 officers and 238 enlisted men. The 299's and 188's, Eisenhower intended to be used for immediate communication upon landing. Fixed radios would follow for Army use, not to mention the array of radio and radar which the Air Forces would have to have, principally the very new, very high frequency equipment for air-to-air and air-ground communication, together with LW and GCI radars.[130] An added wrinkle was communications for psychological warfare. Eisenhower on 6 October desired equipment and operators for three American-British teams intended to broadcast to Arab and French citizens, to French troops, even perhaps to German and Italian troops. The teams planned to operate transmitters and sound trucks based at Casablanca, Fez, and Oran.[131]

The signal plan for TORCH did not attain printed status till 28 September. Worked over by signal officers, both American and British in London, and by Colonel Hammond and his associates in Washington, it laid down in general outline the communication arrangements for the several phases of the great effort: the approach and assault phases under naval control, and the stages of Army consolidation ashore. The combined signal center would be at Gibraltar initially, in the advanced command post. The three invasions would establish signal centers for their command posts as they landed, at Algiers, Oran, and Casablanca, and would at once set up radio channels between themselves and between them and Gibraltar. These would be the essential command nets, relying upon radio until wire facilities could be taken over from the Moroccans or could be installed by Army units. The plan included diagrams which set forth the channels appointed for the United States Army and the Air Forces, for the British Army and the Royal Air Force, and also channels for naval shore stations. Many details together with plans for tactical nets within the infantry and armored force were left to the task force commanders, since in this effort as elsewhere Signal Corps responsibility stopped at the division. Below that, the several signal users took over, within a framework of limitations, such as frequency allotments and cryptographic regulations, imposed by the Chief Signal Officer.

Above the division, the Signal Corps retained responsibility for communications, for the operation of headquarter message centers and the large linking networks. Here the signal plan for TORCH went into detail, assigning the equipment and the men to operate it. The radio sets were the large SCR–299's and 188's, and the men were the members of three companies of the 829th Signal Service Battalion. The Algiers assault to the east, principally a British operation, would receive two 299's (to communicate with the 299's at Oran), four 188's, two one-kilowatt and two 300-watt transmitters, all this to be handled by Com-

[130] (1) OPD to CG ETO (6769) No. R–25, 21 Aug 42, and reply, CG ETO (9469) No. 1453, 24 Aug 42; (2) CG ETO (8238) No. 2387, 18 Sep 42; (3) CG AAF to CG ETO (7669) No. R–1098, 23 Sep 42. Msg Log File, Staff Com Center.

[131] CG ETO (2552) No. 3186, 6 Oct 42. Msg Log File, Staff Com Center. Two weeks later the Chief Signal Officer urged that the 2d Signal Radio Service Section (Psychological Warfare Unit) be activated at Fort Monmouth about 2 December 1942, including propagandists and foreign-language announcers to broadcast "for the enlightenment of persons to whom the broadcast is beamed." Memo, Col Conrad, War Plans Br, for Control Div, 29 Oct 42, sub: Weekly digest of prog and problems, p. 3. Digest of Prog, 28 Oct–18 Nov 42. SigC Central Files.

pany A of the 829th Signal Service Battalion (the British of course would land radios of their own, such as their No. 33's for long circuits to the United Kingdom and Malta). At Oran in the center where both Americans and British would attack, the planners assigned six 299's and six 188's under Company B. Two of the six 299's at Oran would link up with their counterparts in Algiers, two with Casablanca, and two would make contact with Gibraltar. Such were the hopes and plans. To the several separate American landings planned in the Casablanca area were assigned four 299's and several 188's under Company C of the 829th.[132]

While the establishment of this command net linking the headquarters of the several task forces and the Allied Force Headquarters at Gibraltar would be Signal Corps' largest single responsibility after task force headquarters went ashore (until then, ship radios and message centers would have to serve), Signal Corps planners had many other tasks, such as apportioning the channels for all the lesser nets.

Consider, for instance, the Western Task Force alone, WTF, in Washington generally called Task Force A. First came the command net, entailing four SCR–299's: one at task force headquarters, one in the Port-Lyautey sector to the northeast, one in the Fedala sector near Casablanca, and one in the Safi sector far to the southeast. All four would tie together the three assault areas, widespread over several hundred miles of the western Morocco coast. This channel, designated F5, would operate on 2,770 kilocycles. Next came the administrative radio channel F4, on 1,610 kilocycles, which would net WTF headquarters, using an SCR–193, with an SCR–177 of the Port-Lyautey main shore-party command post, and with an SCR–197 of the Safi main shore-party command post. Still another long-range radio net would use channel F29, on 4,070 kilocycles, tying the command posts of each sector with regimental headquarters and the main shore-party command post, all using, in the case of the Port-Lyautey sector, SCR–193's.

Numerous nets, smaller in scope but larger in the number of stations, entailed many short-range radios such as the SCR–511, the SCR–284, and the Navy's TBX's and TBY's. These were nets for the beach battalions in each sector, for the naval ship-shore circuits, for the Army interbeach nets (in each sector were numbers of landing beaches, Red 1, Red 2, Yellow 1, and so on), and for the boat-control circuits. Then there were frequencies for the very short range SCR–536's, good for a mile or so, within small infantry units. Finally, there were special channels—special frequencies set aside, for instance, for naval air support, different in each sector, and special frequencies for fire control nets, using SCR–284's. All of these were amplitude-modulated radios: the vehicular 193, mounted in a jeep or half track; the not very portable 284, which weighed over 100 pounds and which had to be set up and hand-cranked to operate; and the genuinely portable 511. All of them operated on the old conventional

[132] Ltr, Brig Gen W. B. Smith, by order of Eisenhower, to CGs WTF, CTF, ETF *et al.*, 28 Sep 42, sub: Sig Com Opn TORCH with diagrams and with App. A, Sig Operating Instructions Radio Com 3, the whole constituting Incl 4 with Memo, Gen Handy, ACofS, for Secretariat Combined Chiefs of Staff, 16 Oct 42, sub: Data from AFHQ. OPD 381 TORCH, Case 9. A detailed account, "Case History in Confusion," describing the hasty readying of the 829th Signal Service Battalion is given in Ray S. Cline, *Washington Command Post: The Operations Division,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1951), pp. 183–87.

amplitude-modulated waves. They were, therefore, subject to interference and static.

But now for the first time new frequency-modulated radios would see action, installed in Armored Force tanks and cars and in Artillery Corps vehicles also. The 1st Armored Division had some of the very first military FM sets, the stopgap Link-built SCR–293 and 294. The 2d Armored Division had the new FM "500" series sets: 508, 528, and 538. The Artillery had its "600" series counterparts, including some portable battery-powered S C R – 610's. These frequencies were determined by the crystals supplied with the radios. They would not interfere with AM nets or with each other. The Signal Operation Instructions needed to say little respecting them, other than that "existing FM channels will be utilized . . . and will be retained after the conclusion of the Assault Operation for subsequent operations. . . . The Division Signal Officer will co-ordinate channels used and allocate any special frequencies required." [133]

Late September saw the days of planning and preparation grow fewer as they merged into the days of loading the ships, for by the 24th of October, the convoy of the Western Task Force would sail from America's east coast. On 3 October Colonel Hammond, General Patton's signal officer, got out the signal plan specifically for Task Force A, nineteen pages of details with many appendixes and circuit diagrams. General Patton planned to maintain his headquarters aboard the heavy cruiser USS *Augusta,* until the signal officers could move ashore at Fedala and thence to nearby Casablanca. There would be three subordinate forces, North, Center, and South. The North Force was commanded by Brig. Gen. Lucian K. Truscott, Jr., whose signal officer would be Maj. Eugene A. Kenney, the divisional signal officer of the 9th Division. Its headquarters would remain aboard the transport USS *Henry T. Allen,* until it could land at Port-Lyautey and thence move by D plus three to Rabat. The Center Force under Maj. Gen. Jonathan W. Anderson had as its signal officer Lt. Col. James F. Brooke, Jr., signal officer of the 3d Division. The Center Force headquarters would remain on the transport USS *Leonard Wood* until it could go ashore at Fedala, thence to Casablanca. The South Force, under Maj. Gen. Ernest N. Harmon, was served by Lt. Col. Donald H. Nelson, the signal officer of the 2d Armored Division, who would maintain headquarter communications aboard the USS *Harris* till Safi might fall.

Colonel Hammond issued details on radio, wire, and visual communications; on call signs and frequencies; on codes and ciphers; on radio intercept, radio jamming and countermeasures; on naval fire control parties using SCR–284's; on air support parties using SCR–193's mounted in jeeps; on ground-air support parties using SCR–299's and 522's. He dealt with supplies and depots, even with the marking of supplies for particular units, emphasized as signal by an orange stripe and marked whether radio or telephone equipment. According to the Task Force A plan, Hammond completed arrangements with the Navy, with the British, and with the Air Forces. "The Navy and Army Air Force is trained in Joint U.S. Army-Navy Procedure FM24–10," assured the plan. It gave assurances too that "the British Navy, Army and R.A.F. are trained

[133] Signal Operation Instructions Item 3bl, 28 Sep 42, Task Force A Signal Operation Instructions, Serial 32. SOI Folder, OPD 381 TORCH.

in the use of basic British-U.S. W/T Procedure." [134]

All this, which was set forth in the plan with the plausible appearance of a *fait accompli,* was far from accomplished. As a plan it was doubtless good, but like any large blueprint, it could not be carried out overnight. In some cases, the units lacked even training. They were being formed hastily, their equipment packed sight-unseen too often. In all cases, the full quota of equipment would not be sent. It was already 3 October and shipping exigencies were even now compelling the AFHQ to ship only one quarter to one half of the quota of vehicles alone.[135] Men and equipment were already moving to the ports of embarkation amid haste and confusion. Most notable was the failure to comply with all the details of the printed plan which touched batteries and waterproofing.[136]

Every morning, beginning 25 September, Colonel Hammond held a short conference in the Office of the Chief Signal Officer with his assistants, such as his executive officer, Maj. William B. Latta, and his communications officer, Maj. Jesse F. Thomas. Col. Emil Lenzner participated heavily as Signal Corps representative for the Services of Supply. The signal plan and Signal Operating Instructions, SOI's, were being rushed, continually revised, and brought up to date. In particular, the SOI's of the several divisions, the 3d and 9th Infantry, the 2d Armored, and so on, had to be correlated and completed. The Signal Corps had to work across differences between services. Colonel Hammond had planned for joint Army-Navy message centers on Navy ships, only to get word on 7 October that the Army would be eliminated. The Navy would be responsible for all communications until after the assault phase. Yet how could Navy expect to know how to handle Army's own particular brand of communications? And in truth at the invasion the Army did have shipboard signal centers and operators. The Air Forces at the last moment on 16 October altered its radio frequencies.[137]

A sore point with the Navy was the installation of a broadcast transmitter on a naval ship—a propaganda station favored by G–2 both of the War Department and of Task Force A. But "the Admiral," Ham-

[134] Annex 3 to Opns Plan Hq Task Force A, Sig Com Plan, 3 Oct 42, from G–3 to CG Task Force A. OPD 381 TORCH. The plan designated ten Signal Corps units to participate with the ground forces in the assault, with many more units to follow soon on subsequent convoys. About 700 men, it was planned, with about 100 vehicles would serve the ground forces. Several hundred more served Army Air Forces units.

[135] See Leighton and Coakley, *Global Logistics and Strategy: 1940–1943,* Ch. XVI.

[136] These details of the plan for the Western Task Force read as follows:

"*Batteries.* Every radio set operated from dry batteries will land with new batteries installed and three new sets of batteries spare. These spare batteries will be carried in a watertight container. All batteries will be tested with a voltmeter prior to landing, and dates on batteries checked. No time-expired batteries will be used. . . . Storage batteries will be fully charged prior to embarkation. Arrangements will be made by communications officers aboard ship with the ship's engineer staff for periodic charging of all storage batteries, radio or vehicular, during the voyage. All storage batteries will be landed fully charged.

"*Waterproofing.* . . . Every portable radio set, combat loaded, will be enclosed in a watertight container. Special canvas bags are being issued for this purpose. These bags will not be removed until radio sets are landed, except in case of those radios which may be required to operate during the ship-to-shore movement, and for the purpose of inserting new batteries prior to embarkation into landing craft."

Annex 3 to Opns Plan Hq Task Force A, 3 Oct 42, p. 10, cited n. 134.

[137] Log, Hammond, Hq Task Force A conf, 7 Oct 42, par. 3; conf, 17 Oct 42, par. 18. SigC (EO) 320.2 Orgn, Tng and Equip for Overseas Sv, Jan–Feb 43 (EO–4–8 No. 2).

mond reported in the morning conference of 25 September, "stated that this [station] should not be brought along unless absolutely necessary." Necessary it was made out to be, and Western Electric hurriedly acquired one of its five-kilowatt transmitters back from the purchaser, a Jersey City broadcast station, and dispatched it to Norfolk. The Navy would make the installation supervised by one Signal Corps officer, and the Navy insisted upon mounting it in a battleship, the *Texas,* so Major Thomas reported to Colonel Hammond on 29 September. Hammond foresaw the trouble which might ensue if the ship's big guns were fired, shocking the commercial set which had not been built to take the Navy's hard knocks. The next day he insisted that extra parts be provided against breakage, which did, in fact, occur when the *Texas* fired her heaviest guns against North African targets. The demand for the propaganda radio was so strong that on 1 October Hammond described the broadcast unit (he was evidently thinking of the operators whom the Signal Corps had to provide) as "now No. 1 priority in the country." On 6 October he asked again about spare parts against breakage. Major Thomas assured him that they were being provided. No mention was made of spares for the signal equipment which would be mounted in Patton's signal center on the USS *Augusta,* where, as on the *Texas,* gunfire shock would also damage and cripple communications.[138]

The problem of waterproofing the assault radios constantly plagued Colonel Hammond and his staff. The signal plan had directed that "every portable radio set, combat loaded, will be enclosed in a watertight container." Fine, if done, but what about vehicular radios? The question arose on 6 October and again on the 8th, when Hammond asked if the radio sets in vehicles had been waterproofed. Major Latta thought that they had been, but Hammond wanted to be sure and asked Major Thomas to check up. Thomas found that they were by no means waterproof, not to the extent that they could be immersed. Evidently they had only covers to keep out weather and rain, for Thomas replied on 11 October "that the only thing they do is to use the covers provided with the sets and keep them covered." However, the men of the 1st Armored Signal Battalion were waterproofing their vehicular sets in a superior way. Colonel Hammond asked that the radios of the 3d Division be similarly protected.[139]

Time was too short. As late as 30 September the signal planners of Task Force A admitted that the instructions they were drawing up for radio nets were a bit confusing. "Is the data in the SOI," Hammond asked, "sufficient so that anyone can work the nets from it?" "Will everyone," he added, "know that they have to work such and such a station?" Major Thomas admitted that "it is rather confusing right now, but it can be improved." [140] Yet, if these details were not crystal clear at the planning level by September's end, how could the signal operators master them and when would they have the time? Indeed, some of the signal units had hardly been scraped together yet, neither the men nor their equipment. Some, to be sure, were ready, notably the 1st and the 141st Armored Signal Battalions, the men well trained, their equip-

[138] (1) *Ibid.,* conf, 25 Sep 42, par. 1a; conf, 29 Sep 42, par. 23; conf, 30 Sep 42, par. 10; conf, 1 Oct 42, par. 10; conf, 6 Oct 42, par. 6. (2) C. L. Stong, "Allo Maroc!" *Bell Telephone Magazine* XXII (September, 1943), 151–52.

[139] Log, Hammond, Hq Task Force A conf, 6 Oct 42, par. 8; conf, 8 Oct 42, par. 13; conf, 11 Oct 42, par. 12; conf, 12 Oct 42, par. 6.

[140] *Ibid.,* conf, 30 Sep 42, par. 15.

ment in hand and in shape. But some were decidedly not ready, for example, the Signal Section Headquarters unit, Task Force A. The signal plan as printed on 3 October left the status of this unit in limbo, putting question marks where the numbers of officers and men should have appeared.[141] In his morning conference on that very day Colonel Hammond spoke of thirty-eight radio operators for the Signal Section Headquarters; he wanted to know when they could be had. It was late, two weeks till time to embark. Yet eight days later, on 11 October, Hammond complained that the unit was still "seventeen radio operators short, as of last night." [142]

There were uncertainties also about equipment in some categories: batteries for example, and vehicular radios, such as SCR–193's, mounted in jeeps or in half-tracks. Not till 12 October did the 2d Division get its batteries. On 17 October, two days before the conferences ceased entirely and the officers packed up their plans and departed to their transports, Colonel Hammond asked if the half-tracks with SCR–193's were ready yet, and would the radios work. They were ready, he was assured, "all fixed up to the satisfaction of G–3." [143] But were they waterproofed, would their batteries be charged, come 8 November? Would they be loaded on the right ships and put ashore when and where their operators needed them, ready and able to put a signal on the air? These questions now awaited the test.

The rush to ready the Western Task Force had, of course, its counterpart in the mounting of the other two North African task forces in England. American and British troops there were preparing to leave for Oran and Algiers in a fever of haste that matched the situation along the east coast of the United States. Much of the equipment for the American troops staging in Britain had to come directly from America, one consignment of radio batteries arriving for the 1st Division by air transport. Their absence till the last moments before sailing, Col. Terence J. Tully (Signal Officer, II Corps, staging in England) later said, "almost wrecked the whole signal plan." His men, moreover, had been unable to train with their sets while they lacked the batteries.[144]

Amid the apparent confusion of routing men and equipment to the dock areas, getting the ships, getting them loaded and under way, order must often have seemed conspicuously absent. Units were often separated from their equipment. Indeed, some of it was never loaded, or was stowed

[141] Annex 3 to Opns Plan Hq Task Force A, 3 Oct 42, cited n. 134.

[142] Log, Hammond, Hq Task Force A conf, 3 Oct 42, par. 1; conf, 11 Oct 42, par. 16. The officers got busy and obtained all 38 men that day, but still had to assemble them. It was reported to the conference on 12 October that 13 of the 38 had arrived at the assembly point, A. P. Hill Military Reservation in Virginia, the staging area for the Hampton Roads Port of Embarkation. As for the rest of the 38, "two operators from Camp Forrest are travelling by air and should have arrived yesterday. Twenty-two of the 23 from Chicago were also due yesterday afternoon." *Ibid.*, conf, 12 Oct 42, par. 11.

[143] *Ibid.*, conf, 12 Oct 42, par. 3; conf, 17 Oct 42, pars. 1, 2, 7.

[144] (1) Maj William C. Frierson, Preparations for TORCH, p. 63. OCMH. (2) Interv, Lt Col A. A. McCrary with Col Tully, Feb 43, p. 4 [p. 113]. SCIA 28, McCrary Rpts. A51–135, DRB AGO. This is one of a group of miscellaneous folders from Plans and Operations Branch, Office of the Chief Signal Officer, containing intelligence reports, observers' reports, and other important documents, which were turned over to the Signal Corps Intelligence Agency (SCIA) after World War II. They are preserved in the Departmental Records Branch, AGO, under job lot A51–135, with SCIA file numbers and titles added.

deep in holds quite inaccessible for the first landings.[145] Yet sufficient order emerged to launch the invasion of hundreds of ships from the United States and the United Kingdom carrying a large force of men and supplies, and to converge the two armadas into a mighty co-ordinated flood and dash it overwhelmingly against North Africa.

[145] SOS was harassed especially with late changes in unit assignments, or with new assignments, which made order in the loading arrangements impossible. There was the specific complaint that detachments of the 122d Signal Company (RI) and the 239th Signal Company failed to receive their orders to embark with Task Force Blackstone (Safi Sector) until as late as 10 October. Frierson, Preparations for TORCH, p. 92.

CHAPTER XII

The Test at Issue in North Africa (November 1942-May 1943)

The assault into North Africa was remarkably successful, in view of the haste and improvisation with which it had been prepared.[1] Like nearly every element of the attack, communications, though much less than perfect, proved to be good enough under the circumstances. The signal equipment turned out to be excellent, but too often its usefulness was canceled in the hands of inexperienced signal troops. This was true particularly of radio, which in an amphibious assault bears the initial burden of military communications.

Communications, Assault Phase

In both the Eastern and the Center Task Forces, command and administrative radio communications were at least fair, thanks especially to two communication ships, the *Bulolo* and the *Largs* (employed respectively at Algiers and Oran), which the British had outfitted for the purpose, an innovation the Americans were soon to adopt. General Matejka, Eisenhower's chief signal officer, subsequently judged that without them the Allied Force Headquarters in Gibraltar could hardly have maintained adequate contact with the Eastern and the Center Task Forces.[2] These communication ships provided vital service during the initial absence of the SCR–299's, which the signal planners had assigned to the 829th Signal Battalion in order to handle the command and administrative nets ashore, allotting 2 sets to Algiers, 6 to Oran, and 4 to the Casablanca area. But they were tardily discharged, both because of rough seas and because the SCR–299 trucks and trailers were stowed deep in the holds of the convoy ships.[3]

At Oran only one SCR–299 got ashore very early in the invasion. As the combat command of the 1st Armored Division moved to capture the airport at La Senia, this SCR–299 was the only set available which had enough power to reach the headquarters of the II Corps still at sea. Shortly thereafter, upon the capture of the French fortress protecting Oran, Lt. Col. Grant A. Williams, signal officer of the 1st Armored Division, sent the first word over this set

[1] For a full discussion of the campaign, see George F. Howe, Operations in Northwest Africa, 1942–1943, a forthcoming volume in UNITED STATES ARMY IN WORLD WAR II.

[2] Incl, Matejka, Answers to Questions, with Ltr, Matejka to CSigO, 18 Apr 43, sub: Questions desired answered by OCSigO, p. 1. SCIA File 13, Matejka Rpts. (See Bibliographical Note.)

[3] History of the 53d Signal Battalion (1 Jun 41–20 May 43), p. 6. SigC Hist Sec File, A46–160, Drawer 15.

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reporting to headquarters that Oran had fallen.[4]

The lesser radios in the local radio nets of the invaders performed well. Colonel Tully, signal officer of the II Corps, Center Task Force, reported that the first ship-to-landing party contact was made over an SCR–284 operated by one of the regimental combat teams. A second contact with the division headquarters ship was made by a unit of the 1st Armored Division using an SCR–193.[5] The 18th Infantry, part of the 1st Infantry Division, used SCR–511's for its regimental command net. The regimental commander and each battalion commander had a set, and they were never out of contact during the battle for Oran. Other units declared that the SCR–511, though good only while its batteries lasted, provided a very successful link between ship and shore.[6]

Unfortunately, signal personnel for the most part were not familiar with their equipment. Perhaps the worst example in the Center Task Force was one battalion which had never been engaged in a maneuver. Thirty percent of its men were Class IV and V enlisted men who had been received only a few days before leaving the United States. They had no opportunity to work a single problem with all subordinate units before they engaged in actual combat.[7]

Even the best troops tardily established signal communications, mainly because equipment was slow getting ashore. Some of it, notably vehicles, had simply been left behind, crowded off the transports. The decision to leave off many vehicles had been made at the highest levels before the convoy loading. in view of the shortage in shipping.[8] The decision cut heavily into the supply of vehicles for all invading units, and slowed operations in many ways. Certainly the lack of trucks was one big reason why supplies in some areas could not be cleared rapidly from the docks, which became congested with material, in turn slowing the rate of discharge. Some signal units arrived with only 25 percent of their transportation, and on D plus 13 were still short by 30 percent.[9]

One consequence which arose from the separation of men and their equipment, as well as from the inability to unload them quickly, was that too few message center troops and too little communications equipment reached shore in the early assault phase. In fact, at H plus 20 hours in the Oran area, only three men were ashore to run the advance message center for the American troops, and through D plus 2 the principal means of communication between the message center and the command ship were the battery-operated SCR–511 radios. The 53d Signal Battalion landed on the night of D Day. But, separated from its equipment, the unit was unable to take over the tactical net until D plus 3. A de-

[4] The SCR–299 truck and trailer came under fire a few miles from La Senia. A battery of French artillery "shot the antenna off of a set in a scout car behind us but we were untouched. But do not let anyone tell you that this vehicle is not capable of a high speed—I can personally assure you that it is." Ltr, Col Grant A. Williams, USA, Ret., to Dr. G. R. Thompson, OCMH, 31 Dec 49, p. 7. SigC Hist Sec File.

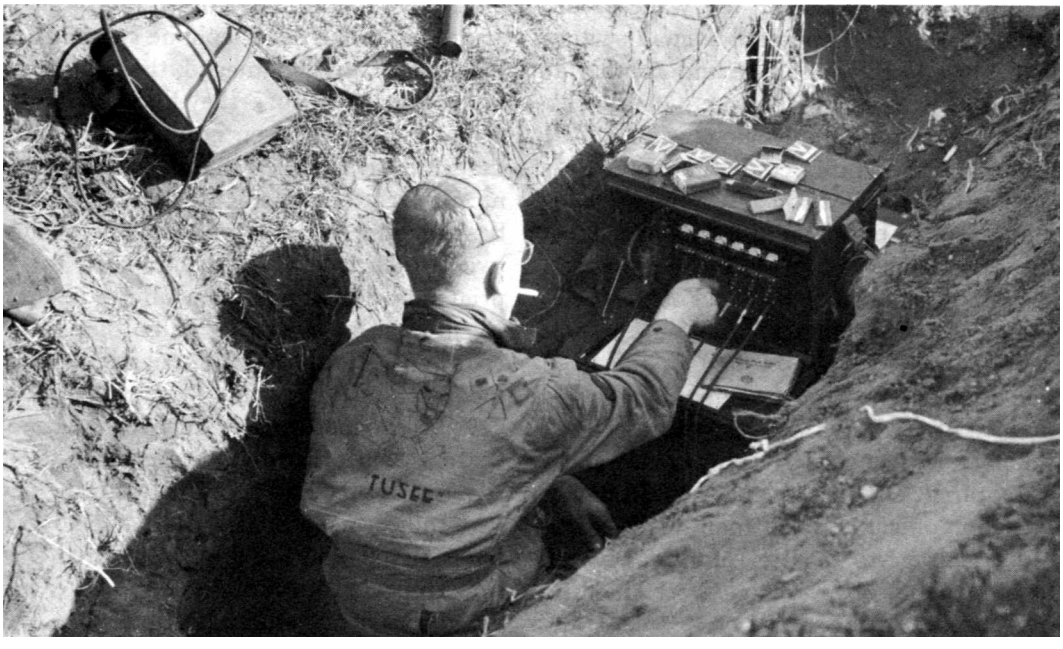
[5] Interv, McCrary with Tully, Feb 43, pp. 4–5 [pp. 113–14] SCIA File 28, McCrary Rpts.

[6] (1) Interv, McCrary with Capt R. W. Green, Com Officer 18th Inf Regt, 26 Feb 43, p. 2 [p. 26] SCIA File 28, McCrary Rpts. (2) Interv McCrary with Tully, p. 5 [p. 114].

[7] Interv, McCrary with Tully, p. 4 [p. 113].

[8] The theater reported on 14 October that the number of organizational vehicles accompanying the inside forces had been cut in half. Leighton and Coakley, *Global Logistics and Strategy: 1940–1943*, pp. 437–38.

[9] Interv, McCrary with Tully, p. 4 [p. 113].



COMMUNICATIONS ON THE BEACH IN NORTH AFRICA *were established through such equipment as telephone switchboard BD-71 (above) and radio SCR-284 (below)*

tachment went ashore in the wake of the assault troops and operated a small switchboard in a dock warehouse and another at the French naval air station. On the 9th several jeeps and radio vehicles were landed and established radio communication with the 1st Infantry Division and Combat Command B. The battalion also took over from the 1st Signal Company the commercial switchboard in the PTT (Postes, Telegraphes et Telephones) building. Corps headquarters was established in the local school for girls but the command group remained aboard HMS *Largs* now docked in the port. Messenger service was maintained as required. On 10 November a 53d Signal Battalion officer and two men, while carrying a message to the 1st Infantry Division in the vicinity of St. Cloud, were killed by fire from an artillery battery.[10]

Some signal units, such as the 32d Signal Platoon Air Base, found themselves in the predicament of coming ashore with no equipment and with no immediate prospect of getting any. Having landed at Arzeu docks, near Oran, early on 9 November, uncertain of its assignment, the unit marched to St. Leu, six miles distant, to report to the headquarters of the XII Air Force Service Command. They were ordered to wait in a field nearby. There they camped during 9 and 10 November in a cold rain with but one blanket and a shelter half to a man. On the 11th, under orders from the headquarters, the men moved to the Tafaroui air base. They arrived by evening, only to have their confusion compounded, for no one at the base knew what to do with the orphan unit. On the following day, receiving orders from the signal officer of the Twelfth Air Force, the men moved again, this time to the La Senia airdrome. Since the telephone system there had been severely damaged, the men at last had a job to do. But—they had no facilities at hand. Some of their equipment, such as that shipped in their convoy from England, now lay scattered along the miles of landing beaches and docks. After a time they found two of their trucks, which had been appropriated by other units at the time of landing. Eventually, by searching daily, they recovered most of their communication equipment.[11]

A bright spot in the signal scene around Oran was afforded by units assigned to the Armored Force and equipped with the new FM radios in the 500 series. Colonel Williams, signal officer of the 1st Armored Division, reported enthusiastically: "We provided excellent communications. We even furnished communications for General Doolittle. We drove a tank up to a command post and sent his messages to the tank battalion headquarters, and from there they went to the combat commander, to the II Corps to Gibraltar and it really worked. Toward readying portable radios for the landing," Williams commented "we made bags out of heavy shower proof canvas with a draw string at the top and made handles at the sides. . . . We even devised a special antenna so that the equipment would operate while it was being carried. We used these small radio sets until the vehicles arrived and as soon as the latter landed, we sent them inland and established tactical communications." He added that the SCR–509's were used to exchange messages pertaining to unloading the ships.[12]

[10] (1) *Ibid.*, p. 5 [p. 114]. (2) History of the 53d Signal Battalion, p. 6.

[11] History of the 1032d Signal Company Service Group. AF Archives Sig 1032–HI, 6621–50.

[12] Interv, McCrary with Williams, CofS 1st Armored Div, 24–25 Feb 43, p. 1 [p. 6] SCIA File 28, McCrary Rpts.

The Signal Corps unit serving the 1st Armored Division was the 141st Armored Signal Company. Twenty men of the 141st made up the beach signal party. Disembarking onto an LCP about 0230, 8 November, they took six SCR–509's, six EE–8 telephone sets and a quantity of assault wire to the beach. There they established contact with a 509 radio and its two operators who had remained at the headquarters aboard the transport, and they set up lateral wire lines along the beach to adjacent troops. Their first vehicular signal center ashore sprang up around an SCR–193, which had been brought in by dawn to establish communication with a British radio, a No. 19 set, aboard the headquarters ship. "During the landing and in the action which followed in taking Oran, the communications of the invasion force were of the highest order," the historian of the company congratulated its men. "Radio nets," he added, "were established without much difficulty, signals were good, contact was maintained throughout the whole battle which lasted for three days." [13]

This unit was undoubtedly one of the best signal outfits in the Army, including as it did many a radio enthusiast, beginning with Grant Williams himself, who was the commanding officer when the unit first took form in 1940 as the 7th Signal Troop, soon redesignated the 47th Signal Company. It was during the formative period of this signal unit that Williams did much to modernize vehicular radio, promoting FM crystal-controlled sets, especially for the Armored Force.[14] The service provided by this crack unit suggested how effective communications could be in the hands of experienced troops. In general, communications were not quite so good during the assault upon Oran but, on the whole, the signal plan for the Center Task Force met the test rather well.

By contrast, communications in the Western Task Force area fell short of the plans, even broke down at times. This was the case in General Patton's headquarters, the Army message center aboard the heavy cruiser, USS *Augusta*. The Signal Corps consequently received some scathing criticism. "A glaring deficiency," read an official report on TORCH, "was the almost complete breakdown of communication in certain instances. . . ." [15]

The ships of the Western Task Force steamed within gunshot of the Atlantic littoral of French Morocco at three points: off Port-Lyautey, about seventy-five miles northeast of Casablanca; off Fedala, the beach resort of Casablanca itself (Casablanca harbor held dangerously strong units of the French Navy); and off Safi, well over a hundred miles down the coast, southwest from Casablanca. Throughout its voyage, the armada had observed strict radio silence to avoid giving notice of its approach. But before the zero hour, 0400, when the first landing craft were scheduled to touch shore, a short-wave news announcement from Washington, heard over receivers aboard the ships, reported to the world that American troops were landing on the west coast of Africa. City lights and lighthouse beacons which had been shining along the shore suddenly blacked out.[16]

[13] History of the 141st Armored Signal Company, 18 June 1940–20 May 1943, pp. 20–21. SigC Hist Sec File, A46–160, Drawer 15.

[14] Terrett, *The Emergency*, pp. 139, 145.

[15] Hq SOS Rpt, Lessons Learned from Recent Amphibious Operations in North Africa, 12 Feb 43. Appendixes to Preparations for TORCH. OCMH.

[16] (1) Incl, Brig Gen A. R. Wilson, Report on Operations in North Africa, with Memo, Wilson for CofS, 12 Dec 42, pp. 2, 4. OPD 381 TH (12 Dec

Now transmitters were turned on, as guide boats and landing craft left the darkened ships lying offshore and headed for the beaches. One powerful transmitter in particular went on the air at 0630, the five-kilowatt set aboard the *Texas,* speaking the recorded words of President Roosevelt, asking that the Americans be received as friends and liberators. Despite much skepticism the signal plan of the Western Task Force had included a psychological unit, its advocates having pushed it with the highest priority. Subsequent reports from the French revealed that many listeners thought the Allies had already landed and taken over the radio station at Rabat.[17] Certainly it is true that the French did not resist determinedly or for long, and "from that time on, there was no major Allied landing from Normandy to the Philippines that did not have a Psychological Warfare Division as part of the force." [18] When the *Texas* fired her big guns in support of the invasion, the blasts knocked out the transmitter, but it was soon repaired and put back on the air.[19]

On duty in the signal center at the AFHQ advanced command post in Gibraltar, where General Eisenhower and his staff awaited the news that morning, was a detachment of one officer and forty enlisted men from the Headquarters Company, 63d Signal Battalion, and a detachment from the 827th Signal Service Company, flown in from England, ETOUSA, the night before, together with British signalmen.[20] Reports filtered in scantily, according to Col. Darryl F. Zanuck, who was on hand to supervise Signal Corps photographic activities: "Battles are raging, and we seem to be in control of most of Algiers and Oran, but the Casablanca theater is ominously silent," he jotted in his diary. The next morning, just before taking off in a transport plane for Algiers, he noted, "Communications are still difficult." [21] Zanuck arrived in Algiers just after the airport had been secured. His first assignment there was to occupy and close down a radio station in the city. Existing radio stations were naturally immediate objectives for Signal Corps units. A small detachment of the 9th Signal Company, attached to the 39th Combat Team, had gone ashore in the early morning of 8 November with the first wave of invaders, landing at Surcouf near Algiers. Ashore at 0200, by 0700 they had reached and seized the important Radio Algiers and its powerful transmitter at Eucalyptus.[22]

Difficult was a mild word to describe

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42), Drawer 1219. (2) Brief of Action Which Took Place at Medhia-Port-Lyautey, n.d., attached to TORCH Action Report, 3 Dec 42. OPD 381 TORCH Sec. II, Item. 88.

General Patton, commander of the Western Task Force, angrily regarded the broadcast as premature. Robert E. Sherwood, *Roosevelt and Hopkins: An Intimate History* (rev. ed.; New York: Harper & Brothers, 1950), p. 650.

[17] (1) C. L. Stong, "Allo Maroc!" *Bell Telephone Magazine,* XXII (September, 1943), 149ff. (2) Brief of Action cited n. 16(2). (3) Incl with OCSigO R&W Action 1, Don W. Moore, SPSAY, to Mil Intel Br, 23 Feb 43, sub: Material for USW Patterson. SigC AY-18.

[18] Sherwood, *Roosevelt and Hopkins,* p. 630.

[19] Summary of Signal Communications at Casablanca (hereafter cited as West Coast Landings). North Africa Folder 2, p. 8, SigC Hist Sec File.

[20] (1) Capt Sidney L. Jackson, Tactical Communication in World War II, Pt. I, Signal Communication in the North African Campaigns (1945), SigC historical monograph E–3a, p. 11. SigC Hist Sec File. (2) Sig Sec AFHQ, History of the Signal Section, Allied Force Headquarters, 24 July 1942–10 November 1945 (1945), p. 16. SigC Hist Sec File, A47–200, Drawer 15.

[21] Darryl F. Zanuck, *Tunis Expedition* (New York: Random House, 1943), pp. 34, 38.

[22] (1) *Ibid.,* pp. 50–55. (2) Campaigns, The Battle of Algiers, History of the 9th Signal Company, 1 August 1940–1 October 1943. SigC Hist Sec File, A46–160, Drawer 15.

what was happening meanwhile at Patton's headquarters aboard the Western Task Force's warship, the *Augusta,* flagship of Rear Adm. Henry K. Hewitt's naval command. It had seemed best to the planners to set up a single combined message center which, during the amphibious assault, would handle all headquarters traffic: U.S. Army, U.S. Navy, and British Navy. The radio equipment, together with the message center coding and distribution facilities, could not be compressed into one room, and so was put into three widely separated locations spread over the crowded ship. The main room, Radio One, held jammed into its 300 or so square feet 11 radio receivers, 3 cipher machines, and other equipment, along with 25 operators.[23] The Army tactical and administrative radio nets had to be controlled from the flagship until Patton's headquarters could go ashore. They required two channels emanating from the net control centers on the *Augusta.* These Army control centers, it had been planned, would be operated by 9 Army radiomen, using naval equipment. But the 9 men, evidently from among the very ones whom Colonel Hammond had assembled during the last frantic days in Washington, proved to be too green. Their training insufficient, they had to be relieved, presumably by naval operators, before noon of D Day.

It was not till afternoon, therefore, that communications were established over the tactical net to all sectors ashore. Further misfortune ensued. The tardily accomplished contact was cut short, two hours later, when the *Augusta's* heavy guns fired on French warships off Casablanca. The shock knocked out the transmitter and rendered practically all radio circuits on the *Augusta* inoperative.[24] Since the circuits were the principal means of communication with the subtask force and General Eisenhower's headquarters, all echelons of command were left with very little information concerning the progress of the invasion. The only messages to reach AFHQ were sent by the Navy, but naval radio channels were so congested that the traffic moved slowly.

Finally, after repairs had restored the transmitter aboard the *Augusta* and traffic again flowed over the tactical net, the messages were found to be worthless. They had been improperly enciphered. As for the administrative net centered in the control station aboard the *Augusta,* it fared no better than the ill-starred tactical net. Its operators were likewise below par, and its equipment also had suffered from gun shock. Accomplishments on D Day were next to nil. The operators did keep a log, which revealed upon subsequent examination that, while the subordinate stations in the net had called in periodically, the headquarters had failed

[23] Jackson, Tactical Communication in World War II, Pt. I, pp. 16–18.

[24] Hammond, "Signals for Patton," *Signals* II:1, 7. General Patton subsequently wrote that ". . . a special command ship with adequate naval and military equipment is a paramount consideration for future operations. This ship must not be capable of engaging in battle." Extracts of Signal Communications Items from Reports on Lessons from Operation TORCH, remarks of Gen Patton to CG Allied Force, 30 Dec 42, p. 1. North Africa Folder 2, SigC Hist Sec File.

This very same lesson had to be relearned in the Pacific, during the assault on Tarawa, late in 1943. The battleship *Maryland* carried the communication center for the Marine assault. Her radios, inadequate and crowded, went dead when the ship's heavy guns fired salvos. The consequences here were much more costly than they had been in the Western Task Force in November 1942. Thereafter, the Navy provided special communication ships for subsequent amphibious assaults in the Pacific. J. A. Isely and Philip A. Crowl, *The U.S. Marines and Amphibious War: Its Theory and Its Practice in the Pacific* (Princeton: Princeton University Press, 1951), p. 216.

to answer. Late in the first day the operators even intercepted a French message in plain text, describing the damage done in Casablanca and recounting French battery counterfire. They recorded the message, but failed to report it.[25] Gradually, matters aboard the *Augusta* mended, until by the end of the second day the Army's tactical net in the Western Task Force was performing well.[26] But obviously during the crucial first hours, there had indeed been a "glaring deficiency" here.

Communications on the beachheads were only a little better than those aboard the *Augusta*. The planners had pinned much hope upon the large SCR–299 radios. They had assigned six, specially mounted upon half-tracks, to the 1st Armored Signal Battalion. But the battalion landed only one in time to be of any use in the landing operation, and that one not until 10 November, when it took over the Western Task Force command net. Five of the six sets had been loaded deep in one vessel. The sixth set was lost with the sinking of the ship that carried it.[27] Because of the lack of the 299's on the beaches, the secondary Western Task Force net contemplated in the plans was never established during the assault. A detachment of Company C, 829th Signal Service Battalion, eventually succeeded in putting six large sets on shore: three SCR–188's and three SCR–299's. Of the three 188's, intended, according to the plan, to establish contacts with Accra, Oran, and Gibraltar, only the contact with Gibraltar met success, and that success was considerably dashed by enemy jamming. The three 299's fared no better. They were intended to communicate with Gibraltar and Oran, and with the Western Task Force elements. But only the local Western Task Force channels actually performed at first, and not till the third day after the invasion did one of the other two sets establish a contact with Oran.[28]

The smaller radio sets, the SCR–511's and the 284's, and the larger 193's served less well in the western landings because of the seas and surf, which, many had thought, would utterly prevent amphibious operations along western Morocco and which were indeed rough enough to capsize landing boats in some areas. Waterproof bags, as ordered in the Signal Operating Instructions, had not been distributed for all sets. When soused in sea water, the power supply cords and contacts shorted and the radios died. Jeeps plunged into several feet of surf, soaking the 193's. On shore, although half-tracks carrying radios were able to get through, the radio trucks themselves slithered helplessly in the sand. In at least one instance a radio vehicle was wrecked by French strafing from the air.[29]

Some portable sets worked well, notably at Safi, on the southwest flank of the western assaults. Of all the landings in western Morocco that morning, the operation

[25] West Coast Landings, pp. 6–7.

[26] *Ibid.*, pp. 4–6, 8.

[27] Lt Col A. A. McCrary, Answers to Questionnaires Obtained in Atlantic Base Section, p. 15 [p. 62] SCIA File 28, McCrary Rpts.

[28] (1) Jackson, Tactical Communication in World War II, Pt. I, pp. 19, 70. (2) Ltr, Col Hammond, Sig Officer I Armored Corps, to CSigO, 11 Jan 43, sub: Rpt of Opn TORCH, 8–11 Nov 42. North Africa Folder 2, SigC Hist Sec File.

[29] (1) West Coast Landings, pp. 7, 10. (2) McCrary, Answers to Questions Obtained in Atlantic Base Section, No. 39, p. 10, and Answers by Major Pickett to Questions, No. 4; [pp. 57, 86, respectively] SCIA File 28, McCrary Rpts. (3) Jackson, Tactical Communication in World War II, Pt. I, p. 27.

A year later the Navy and the Marine Corps in the Pacific, participating in the assault on Tarawa, experienced the same communication difficulties, especially water-soaked radios going dead at the time they were needed most. Isely and Crowl, *The U.S. Marines in Amphibious War*, pp. 251–52.

against Safi was the smallest and the most successful, taking its objective with effective surprise and efficiency. A pair of SCR–511's and an unauthorized FM net provided valuable assistance. Two destroyers laden with troops headed for the harbor, to land men at the very docks. A scout boat had gone before them to locate the darkened harbor entrance and then to flash an infrared light seaward to guide in the destroyers' skippers. It was a guide light invisible to the unaided eye. To Safi citizens or guards it yielded no telltale gleam, but through the infrared telescopes of the watchers on the first destroyer it shone brightly. The ship gained the harbor entrance safely, then ran aground, yet in a sufficiently advantageous position so that her troops were able to land promptly over the bow. The watchers aboard the second destroyer, however, failed to see the infrared guide light, and their ship was heading toward the harbor's breakwater when the scout boat party hastily turned on a radio which they had brought with them, an SCR–511. With it they at once made contact with another 511 on the destroyer and gave warning just in time to avert a disaster on the breakwater's rocks. They then talked the ship into the harbor where it docked without incident.[30]

The communication radio nets which were intended, according to the plan, to serve the landing effort locally were AM, utilizing SCR–511's, 284's, 536's, and 193's, the usual Infantry radios of that date. But at Safi the actuality differed. Most of the radio communications passed over an extemporized FM radio net, based on Armored Force sets. Armored Force units of the 2d Armored Division participated in the assault on Safi. The men tried at first to use the Infantry AM radio sets according to the signal plan and to establish the authorized AM nets. But they failed. For one thing, they were unable to keep the sets properly tuned (both the 284 and the 193 required manual tuning). Armored Force men had their own pushbutton FM radios and turned to them, setting up an unauthorized FM net of four SCR–509's: one for each battalion commander, one for the subtask force commander, and one for the transport division commander. This net worked with the simplicity and clarity of FM radiotelephone operation, employing pushbuttons to select the correct frequencies. It actually handled "the bulk of the radio traffic in this operation for a period of three days," allowing good communication up to eleven miles and handling local requests for fire or air support without a hitch.[31]

Safi was the one bright spot in the communication scene along the coast of western Morocco on 8 November. Elsewhere, the adverse circumstances which harassed the Center Task Force recurred in the west: signalmen without equipment, equipment inaccessible under layers of other supplies still aboard the ships or scattered at landings far removed from the units to which it belonged. These difficulties were compounded in the west by the rough wet landings, overturned craft, and considerable opposition from the French. Not only did equipment lie at the bottom of holds, not being discharged till many hours or days after the initial need for it, but some of it was not unpacked at all. It remained in the

[30] West Coast Landings, p. 5.

[31] (1) Jackson, Tactical Communication in World War II, Pt. I, pp. 21–22. (2) Extracts of Signal Communications Items from Reports on Lessons from Operation TORCH, extracted from the report of Hq 2d Armored Div, pp. 1–2. North Africa Folder 2, SigC Hist Sec File.

holds of ships that returned to the United States to meet convoy schedules, since dockside congestion and other factors had delayed unloading too long. This happened to some of the heavier signal equipment, notably the radar sets intended for a number of the Aircraft Warning Service battalions assigned to the Army Air Forces. Other radars, too, were sunk when several ships, still laden with cargo some days after D Day, were torpedoed off Morocco. They carried down quantities of valuable radar equipment.[32]

Even when the troops in the western assault could lay hands on their signal equipment, they often found it damaged, watersoaked, or out of operating condition, alignment off and batteries low.[33] These difficulties were intensified as they were not at Oran and Algiers, by very considerable opposition, especially at Port-Lyautey on the northeast flank. Here there was fighting and not much communications the first two days. General Truscott and his staff, though they had planned to go ashore at 0600 on 8 November, delayed until some sort of communications had been set up on the beach. They did not disembark until 1340. On the beach there was still almost no communication with the front lines and Truscott visited the front himself to find out how affairs were progressing. Many small portable radios had come ashore drenched and quite dead. The same was true of vehicular sets.[34]

A detachment of about seventy officers and men from the 9th Signal Company landed at Mehdia, a village near Port-Lyautey. Coming ashore with the third wave of the 2d battalion, 60th Infantry, some of the men served on signal liaison duty at the village throughout the first day. That night they received orders to form an outpost on high ground guarding the battalion's left flank. Dawn of the next day found them outflanked by Moroccan soldiers. Attacked from the rear, the signal group suffered losses of six men killed and two wounded. Consolidating during the day in the village and reinforced, by the afternoon they established a radio contact with the ships offshore. By 10 November, as more men and equipment landed, they built up communications ashore for this subtask force.[35] Here, then, these Signal Corps men served as infantry. Here, too, another signal unit, the 2d Broadcast Station Operation Detachment, did everything but operate a broadcast station. First, they unloaded ammunition and threaded machine

[32] Interv, SigC Hist Sec with Col Lenzner, 5 Jul 44. SigC Hist Sec File. According to General Matejka, another ship with sixty tons of vitally needed equipment, whether radar or not he did not say, "was sent back to New York with the convoy since it was not unloaded in time for the sailing of the convoy on the return trip." Agenda A, Incl with Ltr, Col Hobart R. Yeager to CG AAF, 12 Jun 43, sub: Rpt of visit of Col Yeager, Air Corps, to NATO, Ninth Air Force, and ETO 6 Apr 43 to 7 Jun 43. SCIA File 75, Yeager Rpt.

[33] Packing cases broke, spewing out spare batteries. Paper cartons containing the valuable Haglin cipher devices, M–209's, disintegrated in the spray and rain, which corroded the delicate mechanisms. Ltr, Hammond, Report of Operation TORCH, 11 Jan 43, p. 5.

[34] Initially at Port-Lyautey, "All ship-to-shore communications failed." Memo, Gen Wilson for ACofS Opns Div, 1 Jan 43, sub: Brief of rpt of opns in North Africa, p. 4. OPD File 381 TORCH, Sec. IV, Item 95.

[35] (1) Jackson, Tactical Communication in World War II, Pt. I, pp. 20–21. (2) Campaigns, The Battle of Port-Lyautey, History of the 9th Signal Company, 1 Aug 40–1 Oct 43. SigC Hist Sec File, A46–160, Drawer 15. (3) Interv, SigC Hist Sec with Maj John C. Liggett (formerly Sig Officer of 9th Sig Co in the North African Opn), 19 Jan 45. SigC Hist Sec File.

gun belts; then they served variously, on burial detail, on guard detail, on baggage detail. Not until 20 November did they turn to their specialty, when they took over the operation of Radio Maroc, the large official Moroccan radio at Rabat.[36]

Stabilizing TORCH Communications

Communications for the AFHQ quickly became established in Algiers. An advanced echelon moved in with the Eastern Task Force on 8 November, followed by a second group of signalmen the next day. Maj. Kirk Buchak, General Matejka's administrative officer, at once pressed French fixed radios into service to supplement and then replace the temporary channels which had been set up by the British communications ship, HMS *Bulolo*, anchored in Algiers Bay. Company A of the 829th Signal Service Battalion, a detachment of the 63d Signal Battalion, and the 365th Independent Signal Battalion (British) soon converted the garages, the servants' quarters, the wine cellars, and the barroom of the St. George Hotel in Algiers into the AFHQ Signal Center.[37]

Signal Corps' big mobile SCR–299 radio sets now began to weave a dependable communication net over the entire sweep of the TORCH invasions. The sets served as excellent stopgaps ashore till permanent ACAN radios could be installed.[38] In the Oran area an SCR–299, which Company B of the 829th Signal Service Battalion put into operation, established a direct channel to England. The SCR–299, originally conceived as a radiotelephone good for "100 miles in motion," [39] proved to have surprisingly long ranges, in the hundreds and thousands of miles when used in radiotelegraph operation on sky waves radiated from the usual whip antenna or from a directional antenna array which could be set up quickly in any more or less fixed situation. So it was that here, in Oran, an SCR–299 maintained contact over the long distance to England, with little atmospheric interruption, until the Signal Corps replaced the set with a permanent 15-kilowatt fixed station in December 1942.[40]

During the days and weeks following the Allied invasion of North Africa, the SCR–299's provided the chief means of long-range communications. They operated over distances up to 2,300 miles, Colonel Tully reported enthusiastically. His sets at Oran made contact with Gibraltar on 9 November, with Algiers on the 11th, with Casablanca on the 12th, with Accra on the 17th, and with England on the 21st.[41] "The SCR–299 is far and away the best field radio equipment in the theater," reported Maj. Lawrence C. Sheetz, adding that "this is the unanimous opinion of all British and American officers. . . ." Stating that the 299 performance exceeded all expectations, he cited the fact that one set at Oran, using only its normal whip antenna, was maintaining contact both with England far to the

[36] History of the 2d Broadcast Station Operation Detachment, pp. 3–4. SigC Hist Sec File, A46–160, Drawer 15.

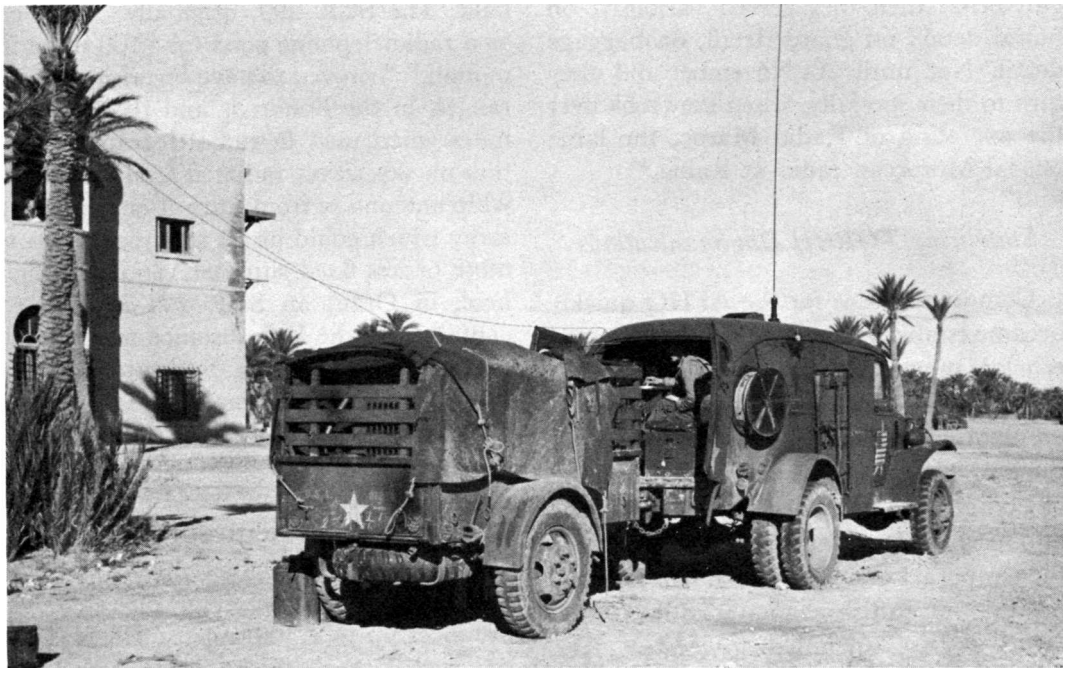
[37] Hist Sig Sec AFHQ, pp. 8, 17–19.

[38] See below, pp. 452ff.

[39] So General Olmstead had conceived it and so it had been termed as a laboratory project. Terrett, *The Emergency*, pp. 161–62.

[40] Interv, SigC Hist Sec with Capt Joseph E. Sweets (formerly Sig Officer of Co B, 829th Sig Sv Bn in the North African Opn), 29 Feb 44. SigC Hist Sec File.

[41] Ltr, Col Tully, II Corps Sig Officer, to Olmstead 9 Apr 43, sub: Use of SCR–299's. SCIA File 23, Tully Rpts, 1.



THE SCR-299 IN NORTH AFRICA

north and with Accra, even farther to the south.[42]

But good equipment could not by itself ensure good communications. Not until D plus 10 could the radio service connecting Casablanca, Gibraltar, Oran, and Algiers be considered really satisfactory and dependable. The delay stemmed from the men and the methods. Signal Corps men who had to communicate in radio nets with the British Army, the British Navy, the Royal Air Force, and the American Air Forces encountered almost insuperable difficulties in coding and decoding and in relaying and routing the traffic. Message center personnel, too few, too inexperienced, poorly trained or in some cases even incapable of absorbing the training, were further bedeviled by the fact that they had not been informed about the call signs for the many stations. Codes and ciphers entangled and snarled. Capping the whole confusion was the fact that changes had been made in the radio procedure plan at the last moment before the invasion, and not everyone had been informed. The men had to learn the tricks and adjust to the situation as they struggled with their task.[43]

Radio bore the brunt of the initial communications. Thereafter, as wire facilities built up, they took over from radio an increasingly heavy share of the traffic. But even from the first moments of landing, wire played a large part. Signal Corps wire units rushed in with their equipment alongside

[42] Incl Memo, Sheetz for CSigO, 18 Jan 43, sub: Rpt on observations on North African Sig matters, p. 3, with Ltr, Sheetz to CSigO, 21 Jan 43, same sub. North Africa Folder 1, SigC Hist Sec File.

[43] Jackson, Tactical Communication in World War II, Pt. I, pp. 44–45.

the first infantrymen. In the Oran area, two six-man teams of the 286th Signal Company, Composite, landed at 0100, 8 November, with the 1st and 3d Battalions of the 16th Regimental Combat Team and established wire circuits to the battalion command posts as well as local circuits in the beach area. At 0430 two officers and fifteen enlisted men landed with the headquarters of the 16th Regimental Combat Team and laid a local wire net for the temporary beach posts.

Hardly had these temporary, local lines been installed than the Signal Corps men began to make use of existing French facilities, such as pole lines which ran a bit inland and parallel to the shore. These were tapped by beach parties of the 141st Armored Signal Company in order to duplicate the laterals along the beach itself. The French system had a two-position switchboard in Arzeu, which the 1st Signal Company took over the first day. Later they transferred its operation to the 53d Signal Battalion. By D plus 3, the 53d assumed control over the entire telephone system of Oran and, by the day after, established telephone links over PTT facilities with Algiers and Casablanca. They set up Army equipment too, as fast as they could get it, for example, a BD–96 which they placed in the PTT building. Within forty-eight hours after the landings, the Gibraltar and Algiers cables were in use, as well as a cable link to Vichy, whence the Americans received a number of cable messages from the Vichy French government and turned them over to G–2.[44] The 53d Signal Battalion set up the Center Task Force signal center in the Grand Hotel, Oran, and was soon serving about 100 units in the area, besides establishing teletype service to AFHQ in Algiers, to the Western Task Force in Casablanca, to the Air Forces net, and to naval stations in the dock area.[45]

In the Casablanca area, the 239th Signal Operation Company established wire communications quickly, thanks to the French, whose help was badly needed. The Americans had received insufficient coaching about the French-type telephone exchanges, the French wire circuits, and outside construction. "If the French had not been co-operative," said Capt. Herman L. Purkhiser, commander of the 239th, "we would have had a great deal of difficulty operating the system." As for the wire units sent to North Africa, Purkhiser thought their organization was good, their equipment excellent. The only large inadequacy upon which he remarked, as did all other signal reports, was the insufficient training of the men.[46] But they would learn, on the job.

The first test posed by TORCH, the assault phase, concluded with the French surrender on 11 November. Whatever the specific failures, the assault had succeeded. The Signal Corps men, their organization, and their equipment had met the first test at least reasonably well in view of the circumstances. Such signal failures as occurred were by no means the fault solely of the Signal Corps. In a post-mortem dated in February 1943, the Services of Supply headquarters made emphatic some of the points which the Army had learned from TORCH: plans must be begun earlier in anticipation of an assault; men and material must be

[44] (1) *Ibid.*, pp. 45–45A. (2) Interv, McCrary with Tully, p. 5 [p. 114] SCIA File 28, McCrary Rpts.

[45] History of the 53d Signal Battalion, p. 7.

[46] McCrary, Answers to Questionnaire Obtained in Atlantic Base Section, No. 11, p. 5, and Answers on Organization, No. 5, p. 2 [pp. 52 and 67, respectively] SCIA File 28, McCrary Rpts.

RESTORATION OF COMMUNICATIONS FACILITIES *was aided greatly by French co-operation. French telephone cable is loaded on a charcoal-burning French truck (above), and French telephone operators assist American operators on a switchboard (below)*

carefully selected and assembled; above all, the men must be trained, not just in their specialties, but in the added refinements of amphibious operation such as techniques of loading and discharging the convoys. In particular, the SOS spotlighted the need for improved communications between armies, between the Army and the Navy, and among the Allies. This meant, first, agreement at top levels on equipment, frequencies, call signs, codes and ciphers, and procedures in radio and wire operation; and second, selection of competent operators and the training of them somewhat longer than overnight. "It is the responsibility of every person in the military service," SOS directed, "to take such action as lies within his power to insure that none of the lessons derived from the recent amphibious operations in North Africa shall go unheeded." Other landings lay ahead, far more dangerous. The Allies had been lucky in North Africa.[47]

New Developments in Combat Communications

Communications in war immediately suggest tactical command messages, officers taking and giving orders, commanders receiving information and directing their forces. Although the cutting edge of wartime signals, for which the whole Signal Corps exists, this is only a small part of the whole. It is sometimes less than 10 percent of the communications load in a theater of operations. The front cannot move forward without bases immediately behind and farther behind, and these require huge communication nets. "An Army needs a virtual AT&T system," said Maj. Gen. Francis H. Lanahan, Jr., after the war, "to carry huge and complex administrative traffic—hospitals, convoys, depots, transportation, press, personnel."[48] Further, as the fighting units move forward, taking along their tactical communications, they can rarely afford to leave a signals vacuum behind them. The terrain they have won must be laced with heavy-duty communication facilities. All this had been foreseen by the Signal Corps, whose research and development workers had readied military carrier systems and spiral-four field cable.

But the Army in North Africa was not yet ready to use such equipment. The Army had scarcely heard of it, had received no training in its use, and would have to be trained on the spot. The need was immediate and dire, in direct proportion to the speed with which the troops advanced from Casablanca, Oran, and Algiers, eastward along the coast to Philippeville and Bône, inland to Constantine, and southeastward to Tébessa, in order to grapple with the Germans in Tunisia. Movement was rapid, distances were great, and existing French wire lines were in poor condition, totally inadequate to handle the large volume of messages that had to go through.

TORCH planners had already ordered huge quantities of commercial-type carrier-wire equipment to implement the A to H project, contemplating an extensive, open-wire system for the Allies across great lengths of North Africa, first to Algiers and then to Tunis. Carrier facilities would be necessary to provide enough circuits. Gen-

[47] Hq SOS Rpt Lessons Learned from Recent Amphibious Operations in North Africa, 12 Feb 43. Appendixes to Preparations for "TORCH." OCMH. A similar report, in great detail (14 pages), is contained in Ltr, Maj Gen W. B. Smith to CCS, 19 Feb 43, sub: Sig com of Opn X. SigC 676 Gen Opn X.

[48] Interv, SigC Hist Sec with Gen Lanahan, CG Ft. Monmouth, 10 Feb 50, p. 3.

eral Matejka subsequently pointed out that, after the Tunisia Campaign, the preparations for the invasion into Sicily required 32 circuits alone between Constantine and Tunis. Already, by February 1943, the A to H equipment had all been shipped, having gone out in three lots, dispatched in November, December, and January, along with Signal Corps units to install it, the 27th, the 28th, the 63d, and the 251st Construction Battalions. In March Colonel Lanahan itemized the fixed-wire equipment which had been shipped, such as Western Electric switchboards so big that each required eight operators, quantities of C type commercial carrier terminal equipment, and pole line material sufficient for 500 miles, averaging ten wires. Then came orders for 1,350 miles of pole line material, weighing thousands of tons.[49]

All of this was heavy-duty, ponderous wire equipment which simply could not be installed rapidly enough. As late as April, when the Tunisia Campaign was in its last weeks, General Matejka reported that the only long-distance trunk circuits in use by the Army from Casablanca to the eastern boundary of the Tunisian battlefields were French lines.[50] Long before this Matejka had realized that the Army must have something that could be installed more quickly, and in December 1942 he had ordered large quantities of spiral-four, rapid-pole-line and military carrier equipment. Early in the year the quantities had begun to arrive, jamming the base sections and overwhelming depot personnel, who did not understand what the material was, or how to handle or issue it. Only little by little did it filter down to the troops, and then often in a damaged condition. Moreover, neither the troops nor their signal officers appreciated its use. A British expedient called multiairline (MAL) equipment saved the tactical communication situation, reported one Signal Corps officer, at a time when "the acute shortages of circuits in the area behind Army Headquarters, then near Constantine, became the principal problem confronting the Chief Signal Officer [Matejka]." [51]

Both the British MAL and the American rapid-pole-line, RPL, were expedients devised for a nearly treeless land where telephone poles could not be obtained locally. Standard 40-foot poles by the thousands were forbiddingly awkward and bulky to transport to North Africa. Hence RPL had been devised. The poles were 20-foot building studs, or 2 x 4's; that is, they were timbers sawed two inches thick by four inches wide. Two of them could be nailed together to form a 4 x 4-inch substitute for a pole or they could be crossed to form an X-shaped support. Naturally, they were easy to handle and could be packed neatly for

[49] (1) Incl, Signal Communication Talk by Brig Gen Jerry V. Matejka to Members of the Army Navy Staff College on 19 August 1943, p. 11, with Ltr, Capt J. S. Walter, Intel Br, to Lt Col Mason, Pers and Tng Sv, 7 Oct 43. SCIA File 13, Matejka Rpts. (2) Memo, C. B. Riggs for Chief of War Plans Br, 22 Feb 43, sub: Present status of projs for NATO; (3) Memo, Riggs for Rcd, 18 Feb 43, sub: Sig const units for NATO. SigC EO-4-9 (475) Equip and Movement Order NATO, 1942-43. (4) Memo, Col Lanahan, Dir of Plan, for CSigO, 9 Mar 43, sub: Rpt on Sig matters in NATO. North Africa Folder 2, SigC Hist Sec File.

[50] Incl, Matejka, Answers to Questions, with Ltr, Matejka to CSigO, 18 Apr 43, sub: Questions desired answered by OCSigO, p. 5. SCIA File 13, Matejka Rpts.

[51] Memo, Maj M. M. Bower for CSigO, 10 Aug 43, sub: Rpt of special mission to North Africa to introduce spiral-four cable carrier and temporary pole line equip, p. 2. North Africa Folder 1, SigC Hist Sec File.

transport, but they were expected to hold up standard crossarms, insulators, and hardware, which proved too heavy for them. Moreover, they had to be spaced twice as close as standard tree-type poles, every 150 feet instead of every 300. Since this doubled the quantity of crossarms and fixtures, the number of holes to be dug, and the installation time, rapid-pole-line turned out to be not so very rapid. Moreover, the studs twisted and warped under sun and rain and not infrequently broke or blew over. Consequently, RPL was not altogether a success.

"In construction in this area," said a Signal Corps officer speaking of North Africa, "it was found that a construction platoon could set up approximately 5 miles of RPL a day, and 8 miles of standard pole line a day, and, of course, the latter is much easier to maintain." [52] A substantial amount of RPL was used in North Africa, nonetheless, during the Tunisia Campaign, along with MAL, which was possibly the better of the two expedients.[53] Theater needs during early 1943 were met chiefly by a combination of rather conventional wire facilities, commercial French, British military, and American military. The American wire most used was field wire W–110, on poles of varied sorts or on the ground.

In such circumstances, extensive use of spiral-four cable might have been expected. With carrier installations at the terminals, one spiral-four field cable could do the work of many wire lines. The new cable was tested and ready, having been proven in the previous summer. The AFHQ had ordered it in quantities, but the sad truth was that no one in the field understood its use. When an early shipment of 2,000 miles of spiral-four arrived in North Africa early in 1943, it came without instructions or explanations. Supply officers simply placed it in depot stock and issued it as long-range field wire to all comers.[54] And as field wire the signal officers and wire crews at first treated the cable, generally mishandling it so badly that many concluded this new "wire" was worthless. They tugged and yanked it and hung it on poles in great long festoons, as often as not with a connector joint in mid-span. Under the stress of weight and wind, the connectors frequently failed and the manufacturer's splices within the cable parted.[55] Colonel Hammond concluded that "spiral-four is completely unreliable." "Dump it in the ocean," said another signal officer serving with the Army Air Forces; still another, "our troops had never seen this material prior to being put on it to construct the lines and I guess that we made every mistake in the book and a few of our own as well." [56]

The whole trouble was that there were no instructions or instructors until General

[52] (1) Lt Col J. M. Fronk, Signal Operations in the Communication Zone, Orientation Lecture, 15 May 44, pp. 9–11. North Africa Folder 1, SigC Hist Sec File. (2) Jackson, Tactical Communication in World War II, Pt. I, pp. 153–54.

[53] SigC (OR) 676 General, Wire, British Multiairline, *passim*.

[54] Remarks by Maj Bower Before Group Viewing Training Films, OCSigO, 8 Jul 43. North Africa Folder 1, SigC Hist Sec File.

[55] McCrary, Answers to Questionnaires Obtained in Atlantic Base Section, Col Purkhiser, CO 239th Sig Opns Co answering, p. 2 [p. 49] SCIA File 28, McCrary Rpts.

[56] (1) Incl 4, Ltr, Tully to Brig Gen Richard B. Moran, CSigO Fifth Army, 25 Aug 43, p. 3, with Ltr, Tully to CSigO, 11 Sep 43. Tully quoted Hammond's remark. SCIA File 23, Tully Rpts, 1. (2) Interv, McCrary with Lt Col Pruitt, Sig Officer 12th Air Support Comd, 28 Feb 43, p. 1 [p. 139] SCIA File 28, McCrary Rpts. (3) Fronk, Orientation Lecture, 15 May 44, p. 11.

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Matejka sent for them.[57] Consequently early in 1943 a team headed by Maj. M. M. Bower from the Ground Signal Equipment Branch went to North Africa to instruct everyone who handled spiral-four, carrier equipment, and RPL material. The team opened up schools in Oran and Algiers, set up demonstration lengths of spiral-four and RPL with carrier equipment at the terminals. They demonstrated proper methods of suspending spiral-four cable above the ground and of burying it quickly and efficiently in trenches dug by the useful cable plow LC–61. They prepared instruction folders and distributed them. In short, they provided the instruction which Signal Corps officers and wire crews should have had at home: instruction which normally they would have received had not the preceding months been crammed with such innovations as normally appear only over years. Training facilities and training time simply had not been able to keep up, let alone do justice to older equipment and methods.[58]

Major Bower and his helpers, D. L. Chaffee and H. E. Weppler, both from the Eatontown Signal Laboratory, provided the needed assistance toward getting the new developments installed in North Africa. Utilizing French commercial wire lines already in place, they got the first four-channel CF–2 military carrier telegraph system into operation in North Africa, between Oran and Algiers. They helped similarly on a 75-mile stretch of RPL from Mostaganem to Oran and on lines from Souk Ahras to Souk el Arba. And they saw to it that spiral-four lines went to work with an efficiency which completely refuted the "dump-it-in-the-ocean" reaction. A 20-mile length of spiral-four simply laid, like field wire, on the ground alongside an airline (MAL) installation, gave more continuous service, Bower reported, than the MAL did during three weeks of action around Kasserine Pass. Especially important were four spiral-four carrier systems totaling over 300 miles from Djidjelli along the coast to Mateur, some of it buried with the aid of the cable plow, some of it strung on poles on messenger wire (the supporting wire under which a cable is slung). It was spiral-four carrier systems with all their advantages of great speed of installation and of tremendous traffic capacity that provided the first and only telephone circuits from AFHQ in the Constantine and Bône area directly into the Mateur-Bizerte area of Tunisia when the campaign ended victoriously in mid-May for the Allies.[59]

Victory by no means ended the need for such heavy-duty communication facilities in North Africa. On the contrary, the need intensified. North Africa became the base area for staging and supplying further invasions into Sicily, Italy, and southern France.[60] Tactical communications in North

[57] The problem of introducing new signal equipment into a theater of war became very serious with spiral-four, with carrier, with facsimile, and with radar. Colonel O'Connell subsequently recommended that a technical service be set up in each theater and that technical experts be sent with each new type of equipment. Tab L, Incl with Ltr, O'Connell to CSigO, 9 Aug 43, sub: Rpt of observations in NATO. SCIA File 113, O'Connell and Glasgow Rpts.

[58] Memo, Bower for CSigO, cited n. 51, pp. 1–4.

[59] (1) *Ibid.*, pp. 4–5. (2) Ltr, Bower to CSigO, 2 Jun 43, sub: Application of spiral-four cable carrier and RPL construction. North Africa Folder 1, SigC Hist Sec File.

[60] General Matejka reported that after all operations in North Africa had ceased, the signal traffic handled at AFHQ increased "36.4 percent—from about 260,000 groups to 365,000 groups a day." Memo, Matejka for Heads of Staff Secs, 19 Jun 43, sub: Sig traffic, in Tab E Incl with Ltr, O'Connell to CSigO, 9 Aug 43, sub: Rpt of observations in NATO. SCIA File 113, O'Connell and Glasgow Rpts.

Africa then gave way wholly to its bigger brother, administrative communications. Spiral-four field cable together with the military carrier telephone and telegraph (CF–1 and 2) equipment filled the very need which General Lanahan described as "a virtual AT&T system." Eventually it was accomplished with the assistance of a very new development indeed, which tied together radio and wire facilities into one single integrated communication system by which a message could travel from a radio transmitter over the air, into a receiver and onto wire, to a switchboard, and so to an individual's telephone set, or vice versa. This development, child of the North African campaign, was radio relay. The idea that it might become a valuable military facility already had been circulating among some Signal Corps officers and laboratory engineers.[61] Early in 1943 the Signal Corps was able to put the idea to the test, thanks to General Eisenhower.

In the closing days of 1942 General Eisenhower demanded a radiotelephone with which he could call up his headquarters, however distant. Ordinarily, an SCR–299 radio truck and trailer accompanied Eisenhower's car. Whenever he stopped, the men ran a short line linking a telephone in the car directly to the radio in the truck. On 24 December, however, the day on which Eisenhower decided to call off the abortive effort against Tunisia, an urgent message came in from Algiers announcing the assassination of Admiral Jean François Darlan. Urgent though it was, the message could not be delivered at once. The general was absent from his temporary headquarters and was out somewhere on the road without benefit of signal personnel (this at his own request). A special dispatch rider searched, but could not find him. Not till nearly midnight did the radio officer locate the general near Souk Ahras. As soon as he returned to his headquarters and to the SCR–299, communications were quickly established with General Henri Honoré Giraud in the French sector of the front and then with Lt. Gen. Mark W. Clark in the Allied Forces Headquarters, Algiers. General Eisenhower dictated to the radio officer his message choosing Giraud as Darlan's successor, and the receipt came back from Algiers only six minutes later.[62]

It was incidents such as this, it seems, which made the general decide that he must have a long-range radiotelephone small enough to fit into the trunk of his car, and he sent a staff officer back to Washington to emphasize his demand. The demand fell upon General Colton, head of the Signal Supply Service, in his capacity as development chief. A radiotelephone, trunk size, able to reach from the Tunisian front hundreds of miles back to headquarters in Algiers, was obviously impossible. Yet something very like it was possible. In recent months Signal Corps laboratory workers had cogitated upon radio equipment able to link breaks in wire lines, as across water barriers. This had been accomplished in recent years by commercial companies in a number of applications using AM radio. New FM techniques so improved radio-link operation that by late 1942 the Signal Corps was developing radio-link equipment to meet the Air Forces needs for relatively short lines of point-to-point communication, replacing wire altogether.[63]

[61] See above, pp. 234, 236.

[62] (1) Jackson, Tactical Communication in World War II, Pt. I, pp. 89–92. (2) Interv, SigC Hist Sec with Lt Col Esterly C. Page (in 1942–43, radar officer in Sig Sec, AFHQ), Sep 44.

[63] (1) John J. Kelleher, "Radio Relay and the War," *Signals* 1:5 (May–Jun 47), p. 37. (2) See above, pp. 234ff.

General Colton, pondering Eisenhower's demand, called in Colonel O'Connell, one of his ablest officers in research and development, who suggested a series of radio relay stations strung forty miles apart from Algiers to the front. With an ordinary radiotelephone installed in his car, Eisenhower could talk to the nearest relay pickup station. Though the mobile radiotelephone would have to be reasonably close by, within twenty or forty miles, the nearest pickup could instantly flash the voice back through as many relays as might be needed to cover the distance to headquarters. That very autumn the laboratories had experimented with radio relay, trying to find military takers, at maneuvers in North Carolina. This equipment, so far unsolicited, Colton at once dispatched to Eisenhower, together with a crew of Signal Corps laboratory experts.[64] Eisenhower's specific demand would promote an idea, which some Signal Corps men had been trying to sell, into an actuality of tremendous import.

In January 1943 a team of six radio engineers from the Coles Signal Laboratory went to North Africa carrying radio equipment that was principally Motorola police radio, FM type. The radios would operate only on very high frequencies and therefore the sending and receiving relay stations had to be located in a line-of-sight, without obstacles intercepting the beams of signals. In so rugged a land as North Africa, that meant locating the relay stations atop high elevations. Aided by Company D of the 829th Signal Service Battalion, the men set up the first three stations on 4,000-foot heights averaging about 100 miles apart: Djebel Toukra near Bougie, Djebel Ouasch near Constantine, and Djebel Rorra on the border of Tunisia. The last station was installed in time to be of service to the II Corps while it operated in the vicinity, so that a mobile terminal accompanying the corps headquarters could flash messages to the Rorra station, whence it could transmit through the other hilltop stations back to Algiers, and vice versa.

The actuality differed somewhat from the demand. Eisenhower had wanted a command radiotelephone, emphatically for voice alone. Accordingly, the Signal Corps teams arrived with voice radio only. But the officers responsible for signal security objected. "We didn't get very far in putting any voice on the air," said Russell A. Berg, one of the civilian radio members of the laboratory team. "They wouldn't tolerate General Eisenhower going on the air and putting his latest thoughts on the air as to what they should do with the armies for the next two weeks." Instead, all traffic had to be enciphered and sent on teletype. The team did some quick calculations and procured British two-tone telegraph and teletypewriter equipment. This union of American FM radio and British teletype bore good fruit. Radio relay became a radioteletype for moving headquarters, only slightly short of a radiotelephone for the general's personal use. Mobile equipment at the front was loaded into a weapons carrier and was able to communicate back to the relaying station from any point up to fifty miles distant.[65]

[64] Interv, SigC Hist Sec with Maj Gen Roger B. Colton, Ret., exec vice president of Federal Telecommunications Lab, N. J., 14 Feb 50, p. 3. Some months earlier, O'Connell had gone on record in favor of radio links as a means of rapidly projecting combat communications. See above, p. 236n.

[65] (1) Draft of Min of Conf Held at Camp Coles Sig Lab, 12 Aug 43, sub: Visit of Berg to NATO, pp. 3–4, 16. North Africa Folder 2, SigC Hist Sec File. (2) Incl, Rpt of Operations, FM Radio Relay System for AFHQ NATO, by Capt O. D. Perkins and others (Durrer, Colaguori, Neidt, and Kinnaman), with Ltr, Perkins to Dir of Camp Coles Sig Lab, 8 Sep 43. SCIA File 23, Tully Rpts, 1.

About 20 April the relay system began to work, as a simplex single-channel radioteletype. As the campaign progressed and the mobile equipment serving the II Corps headquarters moved farther into Tunisia away from the third relay station atop Djebel Rorra, it became necessary to set up a fourth relay, which went up on the renowned Hill 609, known simply by its height in meters, as printed on Army maps. The Signal Corps crew put this fourth relay station into operation nine days after the Germans had been driven from the stubbornly held height. Upon the fall of Tunis in May, the mobile headquarters station radioed the news to Hill 609, whence it flashed back in four giant mountain hops over the 400 miles to Algiers, some twelve hours before the usual wire circuits became available and a message center was set up at Tunis. This first American Army radio relay system handled large quantities of II Corps traffic and press reports, with interruptions due to equipment failures or atmospherics amounting to less than 5 percent of the time, a percentage of outages much smaller than that suffered by wire lines in the same area.[66] Beginning with these first relays linking Algiers and Tunis, Army tactical communications enjoyed the large facilities hitherto available only to administrative systems. From now on, military communications would make increasing use of radio relay, as the equipment took form in the AN/TRC types, commonly called antrac.

Along with these new developments in the communications of the ground troops in North Africa, there arose, in consequence of combat experience, changes and innovations in the signals of the Army Air Forces also. The airmen had spread their own radio nets over North Africa, paralleling Army nets. Like the ground forces, too, they used the SCR–299's for long distances (rather than SCR–188's, the older long-range set which the Signal Corps had originally designed to serve the Air Corps). Ground-air communications were indifferent at first. Visual signals—such as lights, pyrotechnics, or panels of colored cloth laid out on the ground—were considered unsatisfactory.[67] Air support for ground troops was not always obtained with ease. But the II Corps in the Tunisian fighting developed good co-ordination. During the fighting in central Tunisia, a direct wire line linked the corps command post switchboard with the 12th Air Support Command, so that the II Corps could get air support within thirty to sixty minutes.[68] One innovation in particular, which Colonel Tully described as highly satisfactory and effective, was the air-support party. An air-support party served with each division or combat team. Equipped with an SCR–299 and an SCR–522, it could communicate both with the ground forces and with any friendly aircraft within range.[69]

Fighter craft command radio now operated in the very high frequencies, using the VHF command set SCR–522. These new radios worked fairly well, within the limitations of the sets (not enough channels and trouble with noise and interfer-

[66] (1) Berg, Draft of Min of Conf, 12 Aug 43, *passim.* (2) Perkins, Rpt of Operations, *passim,* cited n. 65(2). (3) Jackson, Tactical Communication in World War II, Pt. I, pp. 142–43. (4) Page Interv cited n. 62(2).

[67] Incl 1, Information Relative to Signal Communications Based on Operations during the Tunisian Campaign, p. 1, with Ltr, Tully to CSigO, 1 May 43. SCIA File 23, Tully Rpts, 1.

[68] Jackson, Tactical Communication in World War II, Pt. I, pp. 104–05.

[69] Incl cited n. 67, pp. 1–2.

ence).[70] Allied aircraft were also equipped with IFF, for identification in search radar scopes. But that did not mean identification by troops unaccompanied by radar. Quite the opposite. Identification both up and down was an extremely sore point. United States aircraft attacked American troops all too often, and American troops fired on U. S. aircraft. One armored column in a few short hours was shot up twice by American planes, as well as twice by German craft, losing more men to the American attacks.[71] And the Signal Officer, Twelfth Air Force Support Command, reported, "We have lost more planes from our own antiaircraft fire than we have from enemy antiaircraft fire." [72] When the strangely new, twin-fuselage P–38's first appeared, they were shot at by Allied forces until the Air Support Command radioed to the ground forces that the P–38 did not look like any enemy aircraft, and would the troops please refrain from shooting at them.[73] The fact that the Germans had similar troubles hardly made amends. At radar stations, IFF was doing the job intended. Captain Bates, commanding an antiaircraft unit of the 68th Coast Artillery, told McCrary that his men, using the SCR–268, had had no trouble with IFF. "All friendly planes are equipped with IFF and it works quite well as far as we are concerned," Bates reported.[74]

[70] Ltr, Col Yeager to CG AAF, 12 Jun 43, sub: Rpt of visit of Col Yeager, Air Corps, to NATO, Ninth Air Force, and ETO, 6 Apr 43–7 Jun 43. SCIA File 75, Yeager Rpt.

[71] McCrary, Answers on Organization, No. 34, pp. 9–10 [p. 75] SCIA File 28, McCrary Rpts.

[72] Interv, McCrary with Pruitt, p. 2 [p. 140].

[73] Interv, McCrary with Maj Thomas, p. 2 [p. 123] SCIA File 28, McCrary Rpts.

[74] Interv, McCrary with Capt Bates, CO Battery B, 68th CA, p. 2 [p. 126]. SCIA File 28, McCrary Rpts.

Signal Corps Radars Meet the Test of War

American radar met the North African test well and the new American microwave sets presently proved to be as important a new development in combat signals as spiral-four cable and radio relay. Yet American radar in North Africa got off to a bad start. At first radar officers were few and radar in combat was not yet appreciated by the American troops. "Our commanding officers," subsequently commented one historian of the subject, "seemed not yet aware of the military capabilities of radar." [75] They tended to rely upon the British, possibly because of the Air Forces' marked preference for English sets and their operators. Yet the Signal Corps sets and their crews soon proved good enough to arouse the respect of the British, who had originally intended to employ only their own radars in North Africa.

"Planning for proper radar coverage caused us some headaches," General Matejka told members of the Army and Navy Staff College on 19 August 1943. This was because of the geographic split between the groups who planned and staged the invasion. At the start of the TORCH plan, AFHQ in London had decided to use British radar only. But the decision could not stand. Since the Western Task Force was staging in America, American radar would have to accompany it. Radar operations in North Africa, British and American, would have to be co-ordinated. They were. The combination worked "remarkably well"; so well, indeed, according to Matejka, that "the British in particular were pleasantly surprised at the results." [76] The Signal Corps

[75] Dr. Henry E. Guerlac, Hist Div OSRD, Radar, 1945, p. 1003 (Sec E, Ch. I, p. 21).

[76] Incl, Signal Communication Talk by Brig Gen Jerry V. Matejka cited n. 49(1).

was gratified, its faith in its sets and men sustained.

At the invasion, signal aircraft warning battalions had trouble getting ashore and into operation. In fact, they often did not have all their equipment. Weighing tons per set, the radars lay, inaccessible, in the bottoms of the convoy ships, and many were lost in the sinkings off Casablanca in mid-November.[77] The 561st Aircraft Warning Battalion had departed from America hastily organized and without having seen its equipment, which was left behind at the Brooklyn Army base.[78] When in some rare cases both the radar men and their equipment did get ashore, they sometimes found radar less highly rated than they had hoped. For example, the 560th Signal Aircraft Warning Battalion landed at Port-Lyautey, only to have its men drafted as stevedores. No doubt the need to unload the ships was more desperate than the need for air defense. At least the base commander in drafting the radar specialists made better use of the unit than did at first the commanding officer of Craw Field, who, in the words of the commander of the 560th Signal Aircraft Warning Battalion, "did not and would not understand our mission." All this so delayed the battalion's specialized business that not until 16 November, D plus 8, did the men set up their first radar, an American LW, the SCR–602, on a hill overlooking the airport. Not having enough SCR–602's, the battalion put to use a number of airborne ASV radars, SCR–521's, which, as might have been expected, proved unsatisfactory as ground search radars.[79]

Signal Corps ground radars for air defense first came into large-scale combat use in North Africa. Here the Allies encountered an enemy who was relatively well provided with aircraft and who was relatively stronger aloft than would be the case in subsequent campaigns. German Stukas and night bombers sorely harassed the invaders. The Allies at once set about employing radar on a huge scale, commensurate with the long lines they had to defend extending from Casablanca to Tunisia. They concentrated their sets in the eastern area toward Tunis, and the enemy's airfields there. American radars alone soon numbered in the hundreds, principally the SCR–268's and the 270's. By September 1943 there were 283 sets of 268's and the related 516's in the theater.[80] The SCR–268 won considerable appreciation from Coast Artillery units that used the radar to track aircraft and direct searchlights.[81]

To the Eastern and Center Task Force landings, the British brought their long-wave radars, COL's, MRU's, GCI's, and LW's. A few LW's (SCR–602) and GCI's (SCR–588B) came from America too. It was the LW type which was needed for the

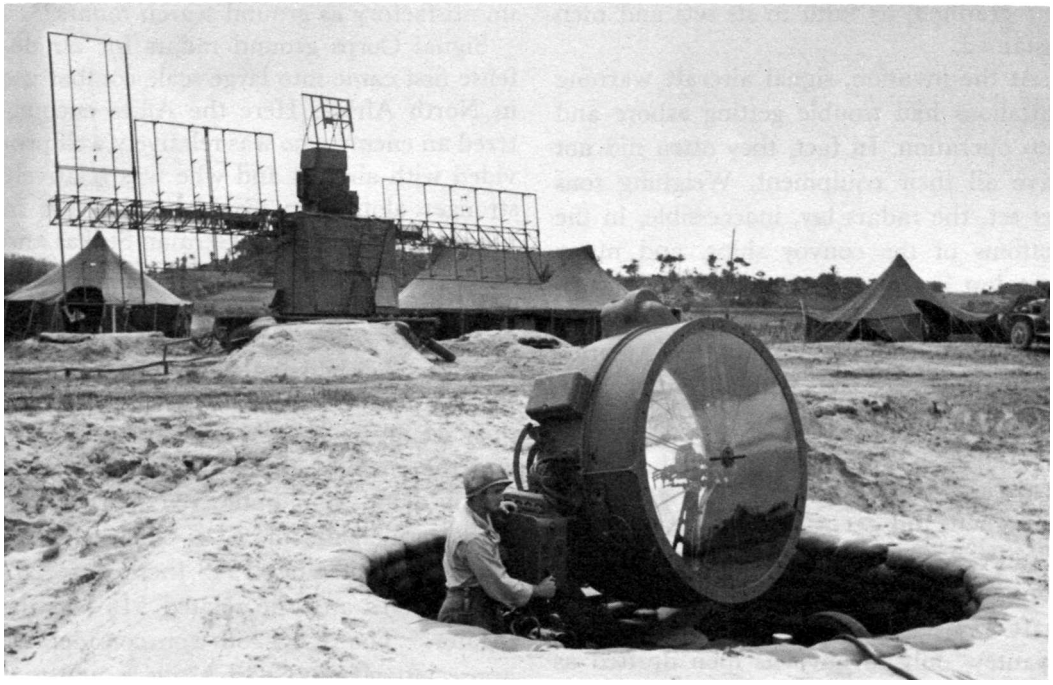
[77] Incl with Ltr, Yeager to CG AAF, 12 Jun 43, cited n. 70, Agenda A, p. 1.

[78] Memo, Matejka for CofS, 31 Jan 43, sub: Sig lessons of Opn TORCH, pp. 5–6. SCIA File 13, Matejka Rpts.

[79] Interv, SigC Hist Sec with Maj G. W. Johns (formerly CO, 560th Sig AW Bn, NATO), 5 Dec 42. This battalion, lacking suitable radios, used VHF SCR–522 airborne command sets, which had been supplied for ground communication with aircraft. But their range from the ground proved too limited, forty miles or less. In common with all units at the invasion, the 560th Signal Aircraft Warning Battalion suffered severely for want of transport, having only four jeeps and four ¼-ton trailers.

[80] 1st Ind, CSigO to CG APO 512, 6 Sep 43, on Ltr, Tully to CSigO, 12 Aug 43, sub: Power units PE–84. SCIA File 23, Tully Rpts, 1.

[81] Intervs, McCrary with Capt Stephens, CO Battery B, 213th CA, 25 Feb 43, p. 1, and with Capt Bates, p. 1 [pp. 31 and 125] SCIA File 28, McCrary Rpts.



THE SCR-268 SEARCHLIGHT CONTROL RADAR

assault phase—lightweight radars which men could quickly carry ashore and set up to watch for enemy raiders. Next, early warning radars with long range were needed to relieve ship-mounted air search sets. Finally, the GCI was wanted, to spot enemy bombers from the ground, enabling air defense control officers to coach AI-equipped night fighter pilots into positions where they could shoot down the enemy even in blackest night.[82] British equipment guarded the eastern sector well. One GCI station at Morris, east of Bône, claimed twenty-three enemy aircraft shot down positively and one probably during the first two weeks of December 1942. The Germans quickly learned to avoid this and any other area which enjoyed the protection afforded by the GCI-AI radar combination. In the vicinicy of Oran both British and American radars stood guard: nine SCR–270's, two MRU's, one COL, one British GCI, three SCR–516's, and one SCR–588B.[83] Presumably it was here that the British made a working acquaintance with American radar and got a much better impression than they had gathered from Watson-Watt's blistering report after his inspection of American radar on the North American continent some months earlier.

By the end of January 1943 an impressive array of radar sets was operating along the North African coast: British in the Eastern Task Force area; COL's at Algiers, Cap Gros, Cap Takouch, Aïn Taya; GCI's at Souk el Arba, Morris, Tébessa, Djidjelli, Philippeville; MRU's at La Calle, Emma-

[82] Memo, Matejka for CofS, 31 Jan 43, sub: Sig lessons of Opn TORCH, p. 6.

[83] Guerlac, Radar, p. 1004. (Sec E, Ch. I, p. 22).

pes, Philippeville; LW's at Cap Corbelin, Philippeville, Souk el Arba, Youks-les-Baines, Sétif; also three Royal Navy 271's, two at Algiers and one at Bône. American Signal Corps sets were spotted over the Center and Western Task Force areas: around Oran, SCR–270's at Falcon, Carbon, Ivi, Bocchus, Tenes (a number of British sets had at first operated at these sites, but they were being moved out); American LW's at Figalo and Tenes and an SCR–588 at Fleurus. Around Casablanca were four SCR–270's: at Bou Selham, Aïn Saierno, Marchand, and Ben Ahmed; two SCR–516's, at Mechra Bel Asire and Ben Ahmed. This total of 34 radars in operation by early 1943 was but a small beginning. Another 31 stations were already being erected and more were on the way, especially the new American microwave SCR–582's.[84]

Radar coverage of the skies gave troops everywhere considerable relief. A visiting scientist from the National Research and Defense Committee, Dr. Louis N. Ridenour, reported: "One of the chief surprises I had in North Africa was the worth of one piece of radar equipment." He meant any well-placed, well-maintained, and well-operated radar station. He cited in particular the British GCI set near Bône. Its crew had cooperated with British Beaufighters equipped with AI radar in setting the record of 23 enemy airplanes shot down in less than a fortnight (5–16 December). Their success, Ridenour emphasized, had caused "a very considerable reduction in the scale of night bombing attacks on Algiers and Eastward." But better radars were needed. The pilots of the Beaufighters, Ridenour added, were handicapped by their old type of long-wave radars, AI Mark IV sets, which could not track an enemy plane at low elevations because of interfering ground reflections. Already the German pilots were learning to fly low in order to evade detection and pursuit. What was sorely wanted now was the American microwave AI radar, the SCR–520, or its improved successor, the SCR–720, which did not suffer from ground reflections. General Eisenhower at once demanded one or two squadrons of planes so equipped. Consequently, the Army Air Forces chief, General Arnold, pressed General Olmstead on 24 February 1943 for quantities of the new microwave AI's, asking for 35 sets to be delivered in April and for 100 a month thereafter.[85]

Meanwhile, through the first months of 1943, eulogies were pouring out of North Africa touching the handful of SCR–582's there, the first American microwave radar sets to see action on the ground in World War II. Their capabilities were winning great favor. They were not intended for air defense but for surveillance and defense of coastal waters. Yet they proved so versatile against low-flying aircraft that they came into demand not only for fixed coastal defense but for mobile air search also. This radar was among the first applications of microwave developments which the Radiation Laboratory in Cambridge had developed under the Office of Scientific Research and Development. It was among the first microwave developments (including the SCR–547 range finder and SCR–584 gun

[84] Memo for Rcd, 3 Feb 43, sub: Breakdown of radiogram giving disposition of British and American radio locating stations in North Africa [Msg CM–IN 12940 (1–28–43) CG AAF]. SigC EO–4–9 (475), Equip and Movement Order NATO, 1942–43.

[85] Excerpts from Ridenour's Rpt, n.d., and a paraphrase of Msg 3728, Eisenhower to WD, n.d., both attached to Ltr, CG AAF to CSigO, 24 Feb 43, sub: Rqmts for SCR–720. AAG 413.44–S Radio.

layer) which the Signal Corps took over for Army ground use. The SCR–582 had been typed as a coastal defense radar, a search radar for use on the ground looking seaward.

Late in the hasty preparations for the North African invasion five sets of SCR–582 had been requested, with Coast Artillery crews.[86] They arrived late in January 1943, to become the first microwave radars to receive ground use, nearly a year after microwave ASV and AI radars first began to be employed in aircraft. And just as the airborne sets had at once proved the vast superiority of microwave radar aloft, so would this application prove its superiority on the ground. Though designed for the relatively humble functions of coast defense, the set received immediate attention from the Air Forces and also from those radar sophisticates, the British. Col. D. D. Graves, an AAF officer, said: "The performance of the SCR–582 was regarded very well. A number of British officers, who took a rather poor view of our other radar equipment, admitted that it is a very good set." [87]

One of the five sets was moved to Casablanca where its crew mounted it atop a grain elevator. Watching over the ocean, it could track all vessels within its range with great precision and was used chiefly to guide ships into the channel maintained through the mine field at the harbor entrance. The radar crews watched the vessels' progress on their oscilloscope and coached the skippers by radiotelephone.[88] The second 582 served similarly, overlooking the harbor of Oran. The remaining three sets were dispatched eastward toward Tunis, after being mounted in trucks and made mobile in shops of the Royal Navy. They served at Tabarka, Philippeville, and Bône, where they watched for enemy aircraft no less than for vessels. "The principal mission of these sets," General Matejka reported to General Olmstead, "is defense against minelaying by E-boats and enemy aircraft. A secondary mission is navigational aid for convoys moving in mine swept channels. They are also used to direct fighter planes to convoys which are being attacked by enemy aircraft or E-boats." [89]

The brightest feature of their performance was their freedom from ground and sea reflections, which had rendered all previous ground radars blind and helpless against low-flying aircraft. The ten-centimeter microwaves of the SCR–582 could detect airplanes right down to the surface of the earth or sea,[90] something which no

[86] Memo, Gen Handy, ACofS, for CG SOS, 17 Nov 42, sub: Radio sets SCR–582 for ETO. SigC 413.44 SCR–582, Nov 42–May 43 (RB–2021).

[87] Tab N, Comments and Observations on Radar Equipment, Incl with Ltr, O'Connell to CSigO, 9 Aug 43, sub: Rpt of Observations in NATO. SCIA File 113, O'Connell and Glasgow Rpts. By early June 1943 Allied radar coverage in NATO was thought by some to be equal to or better than that in the United Kingdom, with the laurels going to the SCR–582. Interv, SigC Hist Sec with Matejka, Apr 47.

[88] The crews turned out not to be Coast Artillery men, as originally intended. Neither Coast Artillery troops nor antiaircraft artillerymen could be spared. Actually, "odds and ends of signal personnel critically needed in other work manned the units and it paid off magnificent dividends in the air defense of NA." Interv with Matejka, Apr 47.

[89] (1) Incl, p. 2, with Ltr, CSigO AFHQ to CSigO, 6 Apr 43, sub: Opn of SCR–582 in NATO. SigC 413.44 SCR–582 No. 3, Nov 42–May 43 (RB–2021). (2) Guerlac, Radar, pp. 1005–06 (Sec E, Ch. I, pp. 22–23), pp. 613–14 (Sec C, Ch. VII, pp. 11–12).

[90] So Colonel Rives wrote back from North Africa in mid-1943: "Radio Set SCR–582 was reported as much better for low-flying aircraft than anything else used by either the British or the Americans. There has been no jamming of this equipment. SCR–582, when properly sited, will pick up low flying aircraft fifty feet above the surface positively at thirty miles and in some cases up to forty miles." Tab 2, Incl with Memo, Rives for CSigO, 21 Jul 43, sub: Observations in England and North Africa. SCIA File 84, Rives Rpts.

long-wave American or British search radar could ever do well, if at all. American microwave radar at last was stripping the enemy's aircraft of their last concealment, the dodge of flying under the radar beams.

In April 1943 a radar officer serving with the Coast Artillery Corps in North Africa wrote General Olmstead that the SCR–582 "is proving itself as one of the most versatile Radar sets in this Theater," and he listed some of the applications: detecting surface vessels, providing navigational assistance to ships, detecting low-flying aircraft, and providing GCI possibilites.[91] About 30 March one of the sets, located at Philippeville, detected eight enemy torpedo bombers attacking a convoy at night. The radar plots were used to direct rescue vessels to a troopship which had been torpedoed and was sinking. All persons were taken off safely, while eight enemy airplanes were shot down. Similarly, about 10 April, in another night action off Bône, an SCR–582 gave warning of enemy planes which were closing in upon a convoy. Royal Air Force planes at once flew out to drive off the invaders. One British plane was tracked by the radar operators as it crashed into the sea. The radar plot was used to direct a rescue launch to the scene.[92]

African operations emphasized mobility in ground radars. The SCR–582, developed as a fixed set, had been converted in North Africa to a truck mount. Its crew could put it into operation in an hour after reaching any location to which the truck could make its way. Then there were the LW types, which had mobility built into them from the start. Their designers had intended that they might be quickly assembled, moved about in components which a few men could lift, and set up for air defense in highly mobile warfare. These sets, too, were proving themselves, even in a somewhat indifferently good version copied from the British as SCR–602–T1. At least they were vastly lighter than other ground radars, though at a sacrifice of power and range.

Reports from home indicated that, of several other 602 types under development, the Signal Corps Radar Laboratory had the best set well in hand. It was type 8, which the Signal Corps had adapted from an early lightweight set of its own design, first installed in mid-1942 on a small vessel, the *Nordic,* for use in offshore air and sea defense. When civilian radar scientists, together with the British and the Air Forces representatives, tried type 8 at the Army Air Forces School of Applied Tactics (AAFSAT), Orlando, Florida, early in 1943, both the scientists and the British agreed that this was the best of the many SCR–602 types competing among the lightweights. Its range, the official report of the Chief Signal Officer announced, exceeded 110 miles and aroused enthusiasm in "even the greatest radar cynics." But the AAF was evidently less sure since it put in an order for only 200 sets of type 8, while asking for 200 sets of type 3, developed by the Bell Telephone Laboratories, and for 400 sets of type 7, offered by General Electric.

By June the British Air Ministry was

[91] Ltr, Capt J. G. Coultrup, CAC, to CSigO, 7 Apr 43, sub: Opn of SCR–582. SCIA File 49, Coultrup Rpts.

[92] Incl, App. 2, Rpt on Radar Maint for AA and CD in NATO, p. 29, with Ltr, Gen McNair to CGs Second and Third Armies *et al.,* 18 Aug 43, sub: Observations in North Africa, 11 May 43–23 Jul 43, inclusive. SCIA File 46, Misc Observers Rpts 1. I. A. Getting, Expert Consultant, OSW, wrote Colton on 16 June that "the SCR–582 in North Africa is operated in some cases for the British, in others for the Air Corps, and also by the Army Ground Forces." Ltr, Getting to Colton, 16 Jun 43. SigC 413.44 SCR–682, Oct 42–Sep 43 No. 1 (RB–2101).

waxing so enthusiastic over Signal Corps' type 8 that officials wrote General Colton seeking 200 sets, 50 from the 1943 production and 150 from the 1944 output. Congratulating the Signal Corps for devising what they called one of the most important developments in ground radar, they urged early production, adding that they believed the "other sets in the SCR–602 series are of secondary importance by comparison." [93]

"This Is a Signals War"

The prolonged North African campaign tested every phase of signal activity. Throughout the winter and spring of 1943 convoys, docking in North African ports, brought in ever more signalmen and more signal equipment, such as construction units [94] and huge wire stores to implement the A to H wire plan in order to provide dependable heavy-duty carrier telephone and telegraph between all the Army installations from Casablanca to Algiers and beyond.[95] "Beyond" in the last weeks of 1942 had meant Tunisia, which the Allies strained to penetrate ahead of the Germans. Late in November the 829th Signal Battalion was asked to send two SCR–299's with ten enlisted men and one officer to serve with the Twelfth Air Force. The officer was 2d Lt. Robert Philips. Subsequently, when he was repairing telephone lines with three enlisted men, two Junker 88's attacked. A 100-pound bomb exploded a few feet away, tore off Philips' right arm and badly wounded the three soldiers. Philips was able to jump into his truck and drive left-handed to a first-aid station six miles away to dispatch an ambulance for his injured men.[96]

Communications for the American armored units participating in the Allied BLADE force moving against Tunisia were furnished by detachments of the 141st Armored Signal Battalion. Two SCR–299's maintained contact with Algiers until the movement to the east opened the gap to 300 miles, whereupon they communicated with nearer British headquarters. Though the BLADE force failed to accomplish its objective, communications did not fail, thanks to the 299's.

Communications were now playing an increasing part in World War II. "This is a signals war," General Matejka made emphatic, in which "no question of command was ever raised without involving signals," a revelation which he believed was one of the large lessons learned from Operation TORCH.[97] Matejka also emphasized that here for the first time in warfare "There was complete integration of ground, air and

[93] (1) CSigO, Annual Report, 1943, p. 186. (2) Ltr, Tech Committee in AW to Dr. Bowles, 3 Mar 43, sub: Light transportable radar warning equip. SigC 413.44–12–i, Research Gen, proj. 405–E No. 6, Mar–May 43 (RB–1949). (3) Memo, Col M. E. Gross, AC, for Gen McClelland, Deputy ACofS, 2 Apr 43, sub: Light transportable radar equip. AAG 413.44–J Radar. (4) Ltr, R. B. Mansell, Air Vice Marshal RAF, to Colton, 12 Jun 43, sub: Radio set SCR–602–T–8, and Ltr, Colton to Mansell, 24 Jun 43. SigC 413.44 SCR–602 Apr 43, No. 3 (RB–2027).

[94] One of these units was the 27th Signal Construction Battalion which left the United States with 95 percent of its T/BA, but never saw any of it again. Interv, O'Connell with Col Moore, CO 27th Sig Const Bn, Tab M of rpt, Incl with Ltr, O'Connell to CSigO, 9 Aug 43, cited n. 87.

[95] By March 1943, no fewer than sixty-seven Signal Corps units were either in or on their way to North Africa. Memo, Col Lanahan for CSigO, 9 Mar 43, sub: Rpt on SigC matters in NATO. North Africa Folder 2, Sig C Hist Sec File.

[96] (1) Interv, SigC Hist Sec with Sweets, 29 Feb 44. (2) Ltr, Col J. S. Willis, Actg Dir of Sig Troops Div, to Comdt ESCS, 10 Feb 42, sub: Value of tng for self-defense. Hq File 353, 1942–43.

[97] Interv, SigC Hist Sec with Matejka, 19 Nov 43, SigC Hist Sec File.

naval action." The communications equipment which made integrated action possible became as important to the lives of soldiers as their food and weapons. Col. Grant Williams, after becoming Chief of Staff of the II Corps, reported to Col. Arthur A. McCrary in February that many sets had been cut from the 1st Armored Division's allotment in an economy drive some time earlier. He said, "I would like for the people who eliminated these sets from our T/BA to know that each set cut out has cost several lives and countless dollars in equipment." [98]

Commanders began to realize as never before the potentialities of mobile radio, radiotelephone, carrier telephone and teletype, to say nothing of the immense possibilities of radar, radio intelligence, radio countermeasures, propaganda, and so on. Commanders began to take for granted facilities undreamed of in any previous conflict. They expected to be able to communicate at any time with subordinates, even in moving vehicles widely scattered over a mobile front. They expected to be able to talk with headquarters however distant. In fact, they began to demand facilities not yet developed. The demand went as far down as up. Lt. Col. J. D. Calidonna, Signal Officer, 34th Division, reported in February that the Army needed communications down to the platoon and needed it badly.[99] The 536, smallest of the new SCR's, was not yet widely distributed. But the platoons were already beginning to get them. Captain R. W. Green, communication officer of the 18th Infantry Regiment, 1st Infantry Division, reported, also in February, that his men had a few 536's left over from the landing operation and were using them at platoon level "with excellent results." He added pointedly, "We never lose a unit we can communicate with." Battalion commanders also wanted them for communications between battalions and platoons.[100]

Some surprising signal developments grew out of the battle experience gained in North Africa. For example, armored divisions, which had expected to consume relatively little wire, expecting rather to rely heavily on their numerous radios, actually found themselves using wire in vast quantities, hardly less than the quantity consumed by an infantry division. "We need a lot more wire personnel and equipment within an armored division," Colonel Williams urged in February, acknowledging that the 19 wire men authorized for an armored division were proving ridiculously few. At the moment, he told Colonel McCrary, "We are actually using 2 officers and 40 men from our own division and have attached from Corps 1 officer and 14 men." [101]

During the battle through the first half of February, it proved fortunate that much wire was already in place in southern Tunisia, for Armored Force losses in radio were heavy. When the 141st lost an SCR–299 and two 193's in battle at Sidi bou Zid, the corps wire team, during the German breakthrough, handled communications for most of the units of the Armored Division on its two switchboards. Wire communications were in at all times except when the command posts were actually moving or when bombs tore out the lines. But these interruptions were brief. Switchboard posts, completely dug in, served to the last moments, maintaining communications and

[98] Interv, McCrary with Williams, 24–25 Feb 43, pp. 8–9 [pp. 13–14] SCIA File 28, McCrary Rpts.

[99] Interv, McCrary with Calidonna, 25 Feb 43, pp. 1–2 [pp. 130–313] SCIA File 28, McCrary Rpts.

[100] Interv, McCrary with Green, p. 3 [p. 27].

[101] Interv, McCrary with Williams.

serving also as information centers covering last-minute developments in the very teeth of German drives at Sbeitla, Feriana, Gafsa, and the Kasserine Pass.[102]

During the battles at the Kasserine Pass, Combat Command B was linked by radio with the 1st Armored Division headquarters at Haidra by means of SCR–299 teams from the 53rd, working from the Command back to the II Corps. Another 299 connected with the Twelfth Air Force. The 53d also maintained wire, radio, and messenger service from the II Corps headquarters to numerous points over the battle area. Throughout the Kasserine crisis, the II Corps commander, Lt. Gen. Lloyd R. Fredendall was able at all times to talk over the telephone to all of his key commanders and installations as far down as the combat teams and as far up as the British First Army and the Allied Forces Headquarters Advance Echelon in Constantine.[103]

In fast-moving situations, all manner of communications were used in all sorts of combinations: wire (telephone, telegraph, teletype), radio, visual means,[104] messengers, pigeons. They were often used in parallel, so that if one facility was knocked out, another would be standing by. Pigeons, for example, received considerable use in this theater of war. Before the birds can be used in any situation, their home loft must remain in one place at least a week before they will settle there, having become so familiar with the location that they return to it invariably. Three lofts of the North African Pigeon Platoon, part of the 829th Signal Service Battalion, were located early in 1943 at Constantine, Tébessa, and Sbeitla. Pigeons homing on a loft at Béja in northern Tunisia were employed for a period of seventeen days during campaigns in the vicinity. During this time birds that had been parceled out to front-line units brought back seventy-two important messages and many less urgent ones. In some cases they got the message through first, as upon the retaking of Gafsa in March during the southern Tunisia Campaign. The first complete report of the recapture reached corps headquarters carried by the pigeon "Yank" returning to the home loft near Tébessa, having made the 90-mile flight from Gafsa in 110 minutes. It was the first report to arrive because wire had not yet caught up with the advancing troops and because a radio net had not yet been established. Pigeons could be valuable during the periods of radio silence, especially if at the same time wire lines happened to be incomplete or out of action.[105]

In the campaign, Signal Corps units performed all manner of functions. The 141st Armored Signal Battalion, serving Armored Combat Commands A and B during the last ten days of January 1943, provided wire circuits to all division units, the usual job, of course, for division signal companies. At the same time the 1st Signal Company served the 16th and 26th Combat Teams. All in turn were linked to the II Corps command post some miles east of Tébessa through small improvised signal centers maintained by the 53d Signal Battalion at Maktar, Sbeitla, Feriana, and Gafsa, and all were tied together by parallel lines—an open-wire facility and a field wire line.

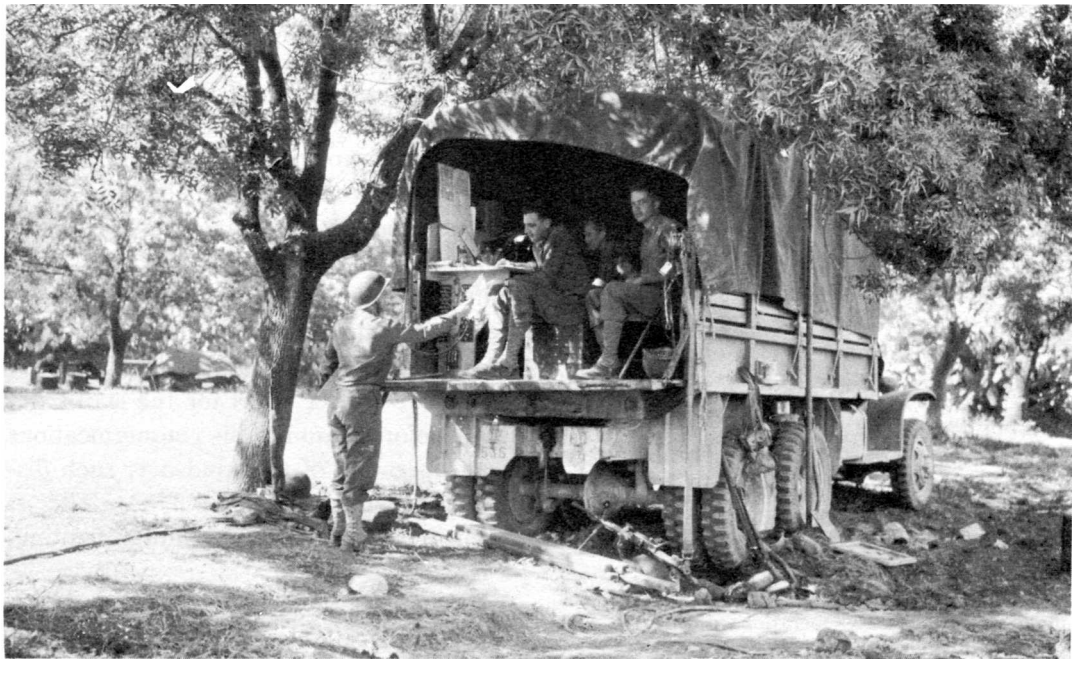
[102] Jackson, Tactical Communication in World War II, Pt. I, pp. 97–99.

[103] *Ibid.*, p. 100.

[104] Lt. L. N. Reiser, assistant communications officer, Division Artillery, 34th Division, reported on 26 February, "We have used signal lamps to a limited extent. . . . We have also used semaphores, but only when we don't have other means of communication." Interv, McCrary with Reiser, 26 Feb 43, p. 4 [p. 44] SCIA File 28, McCrary Rpts.

[105] Jackson, Tactical Communication in World War II, Pt. I, pp. 100, 133, 143, 164.

MEN OF THE 53D SIGNAL BATTALION *repaired wire lines (above) and operated Signal communications trucks for II Corps in North Africa (below).*



The 53d had built the open-wire line, some 220 miles, making use of existing French poles. They had also laid, by the first of February, some 360 miles of field wire in co-operation with the Air Support Command Signal Battalion. Attached to the 53d was a detachment from Company B of the 829th Signal Service Battalion with two SCR–299 crews and trucks serving the II Corps headquarters. Thus, providing communications for the II Corps was a large assignment, especially because of the unprecedented front over 140 miles wide and 90 deep.[106] Maneuver problems at home had never contemplated such distances, nor such conglomerations of patch-up facilities. For example, one teletypewriter circuit from the II Corps to a division command post ran for 113 miles over no less than five different wire segments, French, British, and American, open wire and cable.[107] Yet it all worked surprisingly well. Communications here in combat were better, said Maj. Gen. Orlando Ward, commanding the 1st Armored Division, than he had ever seen them in maneuvers.[108]

A glimpse of the busy life of Signal Corps officers in the field flashes from an on-the-spot account by Colonel Tully, II Corps signal officer. "We are in the midst of a very mobile, very fast moving operation with a very fluid front," he wrote early in 1943. He compared the Corps command post to a quarterback, well behind the line of scrimmage, directing the play on one end of the line and then suddenly shifting the play to the opposite end some dozens of miles away. As Tully dictated his account, it was late in the evening. The corps wire officer was busy shifting the wire circuits by making call after call to key points in order to assure telephone and telegraph service at the other end of the battle front. These services had to be arranged and ready within three hours. The corps radio officer was likewise busy at the phone arranging for emergency radio communications in areas where wire facilities had not yet been completely installed. "Corps radio, wire, teletypewriter and message center teams are moving at this moment," Tully wrote, "to the other end of the line, to an advance Corps signal center being established there from which we will give more detailed instructions to teams later tonight as the tactical plan unfolds." The message center operators were revising their messenger runs. The few open-wire commercial circuits in the area were being reassigned. "By midnight," Tully wrote on, "we hope to have both ends of the line well in hand." Success in tactical field communications, Tully believed, was apt to be a "by guess and by gosh" proposition, amid the general lack of advanced information. "Success is due mostly to a thorough anticipation or a damn good guess as to what somebody else will decide later," he concluded. "I am convinced by this time that successful communications depend upon getting the actual means of communication under way even before the staff has completed its plans. If the Signal Officer waits for the staff's decision before planning his communications in an operation of this kind over such distances, it might be too late." [109]

During the mid-February lull in fighting,

[106] (1) *Ibid.*, pp. 95–96. (2) History of the 53d Signal Battalion, p. 8.

[107] Incl 1, Information Relative to Signal Communication Based on Operations during the Tunisian Campaign, p. 3.

[108] Interv, McCrary with Tully, p. 3 [p. 112].

[109] Signal Corps Technical Information Letter, No. 17 (April, 1943), pp. 6–7, edited from Ltr, Tully to Gen Van Deusen, 1 Feb 43. SCIA File 23, Tully Rpts, 1.

Colonel McCrary, sent to survey the North African theater signal scene, found that the recent weeks of conflict baptizing American troops and equipment in battle had emphasized the need for extreme flexibility. Communication facilities must allow simultaneously the seeming incompatibles of rapid mobility over great distances and of close co-ordination among ground and ground-air teams. Field manuals had set the frontage of a battalion in full strength in a main attack at 500 to 1,000 yards. But here the yards stretched into miles. Divisions operated on fronts which ran to the tens of miles. The 34th Division front in northern Tunisia in February extended for 24 kilometers at the main line of resistance and for 40 kilometers at the outpost line. In the 1st Armored Division the gap between headquarters and the division's rear echelon varied from zero to 100 miles. "The situation here has not been like any we were taught at school," said Captain Green, communication officer of the 18th Infantry.[110]

Wire proved that it still had a vital place in modern mobile war. It was always used during contact with the enemy and movement under radio silence when, during halts, a line would be rushed from the division to the regiment. When not on the move, a division headquarters generally had one telephone and one telegraph channel by which to reach its regiments. If the situation were sufficiently stable, two telegraph channels would be set up along different routes. The 1st Armored Division put in circuits during nighttime, breaking them of course while an attack was in progress but re-establishing them as soon as possible afterwards.[111]

Radio proved itself, especially the big SCR–299. Everyone liked it. One British staff officer stated that "using a 299 after using any British R/T set is like driving a private car after handling a three-ton lorry." Maj. Gen. Charles W. Ryder told McCrary that the SCR–193 was "fine" and the 299 "mighty fine." [112] An odd SCR that became very popular in the North African theater was SCR–625, not a radio at all but a mine detector employing electronic circuits. It was used by everyone, not least by the Signal Corps men working on wire lines along roadsides which the Germans almost invariably mined.[113]

The Signal Corps men and signalmen proved themselves. Despite the handicaps which resulted from inadequate training and lack of familiarity with new equipment, they nonetheless learned how to make communication systems work, whatever the facilities and despite severe difficulties in supply and repair. They began to win high regard. "A commander and his staff are never niggardly about signal personnel after the first campaign." [114] High casualties sometimes added to the problem of getting enough such men and of getting trained replacements. Colonel Williams, speaking of an extreme case of battle disaster, said to McCrary after the Kasserine engagement, "We are going to have to do something

[110] (1) Jackson, Tactical Communication in World War II, Pt. I, p. 103. (2) Interv, McCrary with Maj Gen Charles W. Ryder, 26 Feb 43, p. 1, and with Green, p. 2 [pp. 5 and 26, respectively].

[111] Jackson, Tactical Communication in World War II, Pt. I, pp. 105–06.

[112] (1) *Ibid.*, p. 115. (2) Interv, McCrary with Ryder.

[113] Jackson, Tactical Communication in World War II, Pt. I, p. 147.

[114] Incl, Signal Communication Talk by Brig Gen Jerry V. Matejka to Members of the Army and Navy Staff College, 19 Aug 1943, with Ltr, Capt Walter to Col Mason, 7 Oct 43. SCIA File 13, Matejka Rpts.

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about our losses of communications personnel. In one battle, the 1st Armored Regiment lost every single communication officer and warrant officer except one, and all company communications officers and technical sergeants." [115]

New types of Signal Corps units proved themselves, too. Radio intelligence units, for example, had got off to a bad start at the invasion, having been employed as assault troops. The 128th Radio Intelligence Company was one of the first of its type to meet the test of war. During the Tunisia Campaign the men got busy with their intercept receivers and direction finders (all they had were the older, rather poor SCR–206's and 255's) and tracked the Germans "all over the place." They were the first to discover through their special skills that the Germans were withdrawing from Kasserine and thereafter on several occasions gave advance warning of enemy attacks. In this work and in the work of monitoring the radio procedure of American units and correcting abuses, they proved their worth.[116]

Combat photography came into its own, covering battle actions for the record, for study, and for publicity, and turning out such valuable training films, made and much used on the spot, as *Removing Mines and Booby Traps*. From March on the II Corps had a photographic detachment of three officers and fifteen men. Concomitantly with the campaigns ran training programs and in this work training film became extremely valuable. Weary men could hardly be expected to derive much benefit from classroom teaching, but they could relax before a movie screen and learn without exertion. By April a training film library was located in the Atlantic Base Section, Casablanca, and doing a land-office business supplying films. General Matejka wanted four more such units. At the same time, he was urgently seeking more Signal Corps photographers; in particular, he wanted the entire 163d Signal Photo Company.[117]

Quite aside from the strategic implications, the North African campaign was important as the first major testing ground for American forces in World War II. To the Signal Corps it was particularly significant because it provided a turning point in the military view of the importance of communications in the modern army. By the time the campaign ended in May 1943, the key part which communications had played in co-ordinating all the complex elements of the Allied Forces deployed on a wide front had been demonstrated. It had been demonstrated again and again, with forcefulness that drove home to everyone. Army officers who had not been signal-minded before became so now. The Signal Corps itself, after an unsure start, had gained further competence and confidence. These qualities, in the larger campaigns which lay ahead, would pay large dividends.

[115] (1) Jackson, Tactical Communication in World War II, Pt. I, pp. 122–23. (2) Interv, McCrary with Williams p. 2 [p. 7].

[116] (1) Jackson, Tactical Communication in World War II, Pt. I, pp. 83, 114, 161. (2) Intervs, McCrary with Capt H. F. Bearce, pp. 1–2, and with Tully, p. 3 [pp. 39–40, and 112, respectively] SCIA File 28, McCrary Rpts. (3) Ltr, Capt Shannon D. Brown, CO 128th RI Co to Sig Officer Hq II Corps, 12 May 43, sub: Opns. SCIA File 23, Tully Rpts. 1. Other Radio Intelligence units providing signal intelligence services in the North African campaign were the 117th, 122d, 123d, and 849th Companies. Hist Sig Sec, AFHQ, pp. 38–40.

[117] (1) Jackson, Tactical Communication in World War II, Pt. I, pp. 117, 145, 165. (2) Incl, Matejka, Answers to Questions, with Ltr, Matejka to CSigO, 18 Apr 43, sub: Questions desired answered by OCSigO, pp. 33, 35. SCIA File 13, Matejka Rpts.

CHAPTER XIII

Photo by U.S. Army Signal Corps (January 1942-Mid-1943)

North Africa provided the first major testing ground for numerous photographic services which constituted an important part of the Signal Corps' mission throughout World War II. The military value of photography had not been fully recognized in the prewar years. Policy planners gave little thought to its many uses and applications. The general evaluation seemed to be that photography was a luxury—nice enough if it could be arranged, but of little military value.[1] That conception changed rather rapidly in the emergency period, when Army training officers were suddenly confronted with the problem of converting thousands of selectees into an army. The Chief of Staff, General Marshall, became an advocate of the training film as a method of mass teaching and indoctrination. Other high-ranking officers soon recognized the versatility of photography as an aid in solving many an administrative or production problem, large and small. After Pearl Harbor photography could no longer be regarded as only a sidelight to the Signal Corps' larger responsibilities. Army regulations charged the Signal Corps with the provision of still and motion pictures for information, historical records, training, identification, photomail service, and other purposes. In addition the Signal Corps was responsible for providing combat photographic service for the Army Ground forces; for producing and distributing military training films, film strips, and orientation films for all agencies of the War Department; for custody of all foreign military and naval motion pictures; and for the development, co-ordination, standardization, procurement, storage, issue, and repair of all photographic supplies and equipment except for certain activities reserved to the Air Forces. A catchall requirement—responsibility for all photographic work for the Army not otherwise specifically assigned to other arms or branches—provided authority flexible enough to cover new requirements as they arose.[2]

Carrying out their allotted duties sent Signal Corps cameramen and technicians on a great variety of assignments, some of them glamorous and exciting, but many more of them tedious, dull, and exacting. They labored in V-mail stations in faraway corners of the world, in headquarters administrative stations in the United States, in training units in the field and at home, and in the major combat areas. Combat cameramen parachuted down behind enemy lines with the airborne troops, and

[1] Robert L. Eichberg and Jacqueline M. Quadow, Combat Photography (1945), SigC historical monograph F–2b, p. 18. SigC Hist Sec File.

[2] AR 105–5, 1 Dec 42; AR 105–255, 7 May 42.

A WOUNDED SIGNAL CORPS CAMERAMAN *waits to be taken to an aid station.*

landed in the first waves of the big invasions. They made a full pictorial record of the way the United States trained an army of eight million men, and of how those men lived, fought, and died on the African desert, in the mountains of Italy, on the Normandy beaches, in the Aleutian wastelands, and in the tropical jungles. Their hundreds of thousands of still photographs and their multimillions of feet of motion picture film provide an extremely valuable record for the deliberate scrutiny of student and historian.

In its more immediate uses in war, photography was of direct and incalculable worth to staff officers for strategic planning. In the supply field, pictures of equipment could reveal deficiencies, good or bad packaging, and so on. Photographs supplied legal evidence for use in war crimes trials. Photography had such a vital role in troop training that training officers called it their "secret weapon." It was invaluable in public relations, in building morale, and in hundreds of administrative jobs. Throughout the war, so frequently that it became almost as well known as a commercial trademark, this caption was seen: "Photo by U.S. Army Signal Corps."

Organization and Facilities

This full and effective photographic coverage of World War II was achieved despite the initial handicap of exceedingly meager resources in men and facilities which existed

within the Signal Corps when war began.[3] The Photographic Division of the Office of the Chief Signal Officer discharged its primary responsibilities through three widely separated and inadequately housed activities. They consisted of a photographic laboratory at the Army War College in Washington and two training film production laboratories, one at Fort Monmouth and the other at Wright Field. Each of the activities had a specialized function. The Signal Corps Photographic Laboratory at the Army War College was supposed to be the still picture center, although actually it performed a great variety of photographic duties. The Training Film Production Laboratory at Fort Monmouth specialized in producing training films for the various elements of the ground forces and the Training Film Production Laboratory at Wright Field produced training films exclusively for the Army Air Forces. Photographic training was conducted formally in a photographic school in the Signal Corps replacement training center at Fort Monmouth, but also informally on a learning-by-doing basis wherever technicians worked.[4]

Had these constituted the sole reservoir of photographic skills and facilities available to the Signal Corps, they would have been unable to keep up with the enormous expansion of Army-wide demands which followed the declaration of war. Fortunately, the Signal Corps was able to draw also upon the huge productive capacity and personnel resources of the motion picture industry. The benefits to the Army of the long-standing association between the industry and the Signal Corps had been amply demonstrated. Between 1930 and 1939 eight Signal Corps officers (including one from the Philippine Army) had received training in motion picture techniques in Hollywood without cost to the War Department. In 1940 the industry had accepted sponsorship of certain photographic units under the Affiliated Plan. In the same year, the industry had begun making training films for the War Department on a nonprofit basis. For the last two activities, the designated co-ordinating agency for the motion picture industry was the Research Council of the Academy of Motion Picture Arts and Sciences.[5] Although certain aspects of the arrangements with the Research Council were to come under Congressional scrutiny in 1943, there was no criticism in the early months of the war. On the other hand, there was widespread appreciation of the industry's assistance, expressed by Secretary of War Stimson and others.[6]

[3] For the account of Signal Corps photographic activities before 7 December 1941, see Terrett, *The Emergency*, pp. 78ff., 101ff., 223ff.

[4] Summary Report on Photographic Activities of the Signal Corps since 4 August 1941 in the Fields of Motion Pictures and Visual Aids, 26 Feb 43, pp. 1, 16, 28, 90–92, 284. SigC APS File. This 470-page, 13-section narrative report with some ninety exhibits was prepared by the Army Pictorial Service. It contains detailed information for the period covered. (Hereafter cited as APS Summary Rpt, with page number noted.)

[5] For detailed discussions concerning the arrangements with the Research Council, see (1) Terrett, *The Emergency*, pp. 225–27; (2) APS Summary Rpt, pp. 374–411; and (3) Senate Special Committee, 78th Cong, 1st Sess, *Hearings, Investigation of the National Defense Program*, Pt. 17, *Army Commissions and Military Activities of Motion Picture Personnel*, Jan–Apr 43, pp. 6878–93, 7100–16. (Hereafter cited as Truman Committee Rpt.)

[6] Attachment 2, Ltr, Y. Frank Freeman, Chairman of Motion Picture Producers Defense Cooperation Committee, to SW, 26 Nov 40, and Attachment 3, Ltr, SW to Freeman, 12 Dec 40, to Memo, Maj T. D. Hodge, Control Div OCSigO, for Deputy CSigO, 3 Feb 43, sub: Control Div SOS, tng film investigation rpts, interim 2 Oct 42, and Hollywood inspec 30 Oct 42. SigC EC 062.2 Tng Films, 1940–4–42. (2) Truman Committee Rpt, Exhibits 694–98, pp. 7106–16. (3) APS Summary Rpt, pp. 374–411.

The Signal Corps own production facilities expanded rapidly in the first year of war, but for some months the Army's photographic needs grew even faster. By midyear 1942 the widening scope of responsibilities had raised the Photographic Division of the Office of the Chief Signal Officer to the organizational level of a "service," designated the Army Pictorial Service (APS) on 17 June.[7]

Pearl Harbor brought to an abrupt close the debate over whether or not the Signal Corps should purchase the Paramount Studio at Astoria, Long Island, which was on the market. For months, Col. Melvin E. Gillette, commander of the Signal Corps Training Film Production Laboratory (SCTFPL) at Fort Monmouth, had argued for the purchase. It would provide an up-to-date plant where all training film production, processing, and distribution could be consolidated, leaving the Signal Corps Photographic Laboratory (SCPL) at Washington free to concentrate on still picture production.[8] On 12 December 1941 the Chief Signal Officer urged that the studio be bought without delay. By this time Paramount was less eager to sell, fearing to concentrate all its production on the west coast lest the Japanese attack that area. After some hesitation the firm consented and the property was acquired.

In February 1942 the War Department authorized the Chief Signal Officer to activate the plant as the Signal Corps Photographic Center (SCPC), an exempted activity under his control.[9] After alterations had been made to provide accommodations for troops, the Photographic Center opened in May, with Colonel Gillette in command. The modest Fort Monmouth Training Film Production Laboratory moved over to Long Island. The replacement training center's courses in still photography were transferred also and consolidated with the motion picture courses of the laboratory to form the Training Division of the new Signal Corps Photographic Center.[10] After six months of war the Signal Corps had an up-to-date plant for producing films and for training photographic technicians.

Once established, SCPC rapidly outgrew its quarters, a performance it was to repeat several times before the war ended. A requirement to rescore the Army's films in other languages made it necessary to seek more space, and resulted in the first expansion, the purchase of a building across the

[7] Memo, Col Fred G. Miller, Chief of Adm Div OCSigO, for Exec Officer, sub: Weekly prog rpt, 19 Jun 42, p. 3. Weekly Achievement Rpts 15 Jun–16 Jul 42. SigC Central Files.

The Army Pictorial Service became the Army Pictorial Division for a short time during 1942, then was redesignated the Army Pictorial Service, a name which it carried throughout the greater part of the war and which will be used throughout the remainder of this chapter. Under Col. Richard T. Schlosberg until mid-June 1942, when Col. J. T. Watson took temporary charge, the activity was commanded by Col. Kirke B. Lawton from July 1942 to July 1944. For a more detailed account of the Army Pictorial Service organization and activities, see James V. Clarke, Signal Corps Army Pictorial Service in World War II, 1 Sep 39–16 Aug 45 (1945), SigC historical monograph F–2a. SigC Hist Sec File

[8] (1) Memo, Gillette for O/C Photo Div OCSigO, 2 Oct 41, sub: Consolidation of motion picture production; (2) Memo, Gillette for Col Sadtler, Opns Br, OCSigO, 21 Nov 41, sub: SigC Hollywood office. SigC EO 062.2 Tng Films—Analysis of Rpt of TIG—Tng Film Production. (3) Terrett, *The Emergency*, pp. 228–30.

[9] Ltr, TAG to CG, Ft. Monmouth and CSigO, 18 Feb 42, sub: Designation and establishment of SCPC. AG 601.1 (2–4–42) MR–M–C.

[10] Colonel Gillette remained as commanding officer of SCPC until the early summer of 1943, when he was assigned to Europe and replaced at the Photographic Center by Lt. Col. Roland C. Barrett. Returning to the United States at the close of 1944, he was at Astoria briefly before secret orders took him to the Pacific until the close of the war with Japan. For the remainder of his life—only two years—he was on duty in Hawaii.

THE SIGNAL CORPS PHOTOGRAPHIC CENTER *at Astoria, Long Island.*

street from the studio.[11] For some time the Army had been exchanging master positives and duplicate negatives of training films with the British, and early in the summer the Deputy Chief Signal Officer, the Assistant Chief of Staff, G–2, and the Inter-American Defense Board outlined a program for extending this service by translating and rescoring an indefinite number of training films into Spanish, Portuguese, and Chinese. Later the service was made available to the Navy for rescoring its films in Spanish and further extended to include rescoring in the Russian, French, and Turkish languages as required.[12]

The task of putting Chinese words into the mouths of American drill sergeants for the enlightenment of Chinese troops had already begun at the Signal Corps Photographic Laboratory at the Army War College in Washington. When the Chinese Government asked for American military training films and the rescoring work began with the aid of translators provided by the Chinese Embassy, SCPL crowded the technicians and translators into its third-floor film strip and animation rooms. The laboratory had outgrown its facilities even before

[11] Ltrs, TAG to CSigO, 5 May 42 and 21 Jul 42, sub: Tng films for Latin American Armies. AG 413.56 (7–20–42) MT–B.

[12] In a year and a half the Signal Corps rescored 116 training films into Portuguese and 154 into Spanish, but disappointingly little use was made of them, and in April 1944 the program was given a very low priority. (1) Ltr, Col Lawton, Chief of APS, through Chief, for Liaison Br MIS, to Coordinator Inter-American Defense Bd, 25 Sep 43, sub: Spanish and Portuguese tng film production. SigC 062.2 Rescoring, 1943–44. (2) Ltr, SW to Secy of Navy, 17 Aug 42, sub: Rescoring Navy Dept tng films in Spanish. SigC APS Policy Book 2.

war came. Once overseas troop movements began, SCPL was snowed under with identification and passport pictures; in the early months of 1942 it was handling a daily load of 300 to 400 prints. No longer able to keep pace with the flood of news pictures, SCPL had some of them processed in a one-room laboratory, set up temporarily in the Munitions Building and operated by the Bureau of Public Relations. In June 1942 the major portion of the Army Pictorial Service, which had been quartered first in the Munitions Building and then in a temporary building, moved into the partly completed Pentagon. By December the still picture section and the still picture files joined the parent organization. In the first months of 1943 a still photographic sublaboratory was opened in the Pentagon. There the most urgent photographic work could be done, but the bulk of the still picture work was still handled by SCPL at the Army War College. The Army Pictorial Service also acquired in the Pentagon an auditorium seating 300 and four small projection rooms for official showings.[13]

While the Washington and Astoria plants took on new life and flourished,[14] the Training Film Production Laboratory at Wright Field was rapidly growing into an organization which in size, number of personnel, and facilities was comparable to a commercial studio.[15] The Army Air Forces, however, remained unsatisfied. What it really wanted was complete control of its own motion picture activities, as General Arnold made clear in June when he originated a recommendation to that effect. In a staff study on the subject, the AAF argued that giving it authority to make its own training films would avoid duplication of effort, delays, and confusions, and would result in better service.[16] Without waiting for approval the AAF organized the First Motion Picture Unit, which promptly set up for business in Hollywood.[17]

The Chief Signal Officer, commenting to General Somervell on the AAF staff study, reiterated the Signal Corps' desire to perform all the photographic services required of it by law or regulation, for the AAF as well as for other segments of the Army. He emphasized that no inherent difficulties existed that could not be solved by co-operation on both sides, but he indicated that in his opinion the AAF had not always provided such co-operation. The AAF, he said, had dealt directly with motion picture producers without going through channels, and had thus "jeopardized War Department relations within the motion picture industry." He cited as an example a training film on the subject of meteorology, to be made for the AAF by the Walt Disney Studios, which would cost five times the

[13] (1) Intervs with Col William W. Jervey, Chief of APS Div and Roland Barrett, Chief of Still Picture Br, APS, 5 Feb 48. SigC Hist Sec File. (2) Memo, Maj Lloyd Leman, OCSigO, for Col Richard T. Schlosberg, O/C Photo Div, 20 Feb 42. SigC 319.1 Rpts to Schlosberg and Lawton from Leman, 1941–43.

[14] By July 1942 SCPC had ten training film units in the field, four teams making film bulletins, one filming scenes for Special Services Branch, and one making propaganda pictures for the Bureau of Public Relations. Selective Service was providing numbers of first-class professional photographers, directors, script writers, and laboratory technicians, and as a result training films produced by SCPC were rapidly becoming more professional and effective. CSigO, Annual Report, 1942, p. 333.

[15] Intervs, SigC Hist Sec with Col A. E. Holland, 15 Mar 48 and 24 Sep 53.

[16] Incl 1, Tab A, Staff Study of Commanding General, Army Air Forces, with Memo, Olmstead for CG SOS, 11 Jun 42, sub: Staff study of CG AAF, referring to photo activities. SigC 062.2 Photo Activities 1942–43. OD–27.

[17] APS Summary Rpt, p. 444.

amount the Signal Corps paid for training reels produced by commercial studios. AAF photographic problems were not unique, he said, and what the AAF proposed would actually duplicate efforts, waste scarce materials, and cost more. The Chief Signal Officer countered Arnold's suggestion with one of his own—to eliminate Army-wide confusion generated by divided responsibility for photography by creating a War Department Photographic Service under the control of the Chief Signal Officer.[18]

To consider the issues raised by Arnold's proposal and Olmstead's counterproposal, Signal Corps and Army Air Forces representatives met in General Somervell's office on 16 June 1942 and brought forth an agreement that delineated the areas of responsibility between the two services. It was agreed that special Signal Corps photographic units would be organized as an integral part of the AAF, and under its command, to serve each unit of air force size or larger. A photographic laboratory, or laboratories, to operate under the AAF, but to be manned by the Signal Corps, would produce training films for the AAF. In brief, at the Wright Field Training Film Production Laboratory, the AAF would give the orders; the Signal Corps would continue to provide the money and the men to carry out the orders. For its part, the AAF agreed to assist the Signal Corps by providing technical assistance and equipment for air sequences in films which the Signal Corps might have to provide for other branches of the Army, and to conduct all transactions with motion picture production agencies through the Chief Signal Officer.[19]

The harmony created by this agreement did not last out the summer.[20] Bickering and friction between the two services continued during the late summer and autumn. It is difficult to escape the conclusion that the AAF did engage in an organized campaign to wrest control of AAF training films from the Signal Corps. Certainly the Signal Corps officers who served at the Wright Field laboratory and in the Washington headquarters at the time were convinced of it, and have put themselves on record to that effect.[21] At the end of the year, on the recommendation of Col. Kirke B. Lawton, the Chief Signal Officer withdrew signal personnel from the Wright Field Training Film Production Laboratory and left it wholly to the AAF. The Signal Corps retained only "such general technical control as for other technical services assigned to the Army Air Forces." [22] The Signal Corps personnel scattered; many of them went to Astoria and

[18] Memo, Olmstead for CG SOS, 11 Jun 42, sub: Staff study of CG AAF referring to photo activities, and Incl 2, Tab B, Specific Analysis of Proposal of CG AAF. SigC 062.2 Photo Activities 1942–43. OD–27.

[19] Memo, Somervell for CSigO, 19 Jun 42, sub: Photo activities (concurrence by CG AAF). Hq ASF File, SigC, SPCG.

[20] That it lasted at least two weeks is indicated by a memorandum to General Somervell from his chief of staff, dated 3 August 1942, informing him that "General Code reports that up until two o'clock Saturday there is complete harmony between the Army Air Forces and the Signal Corps on all fronts, including photographic. . . ." Memo, Gen Styer for Somervell, 3 Aug 42. Hq ASF CofS File.

[21] (1) Intervs with Lawton, 5, 8, 9 Mar 48. (2) Intervs with Holland, 15 Mar 48; 24 Sep 43. (3) Interv with Barrett, 5 Feb 48. (4) APS Summary Rpt, pp. 440–45.

[22] WD AGO Memo W105–5–42, 30 Oct 42. The Signal Corps' obligation extended to furnishing funds for AAF motion picture work, although the Chief Signal Officer had no knowledge of the details concerning the commitments or obligation of the funds secured for the AAF, and had no control over their expenditure. Clarke, Signal Corps Army Pictorial Service, pp. 28–30.

those who wished to remain at Wright Field were transferred to the AAF.

Training Cameramen

From the date of the first Selective Service induction until Pearl Harbor, the principal method of procuring Army photographers was to screen the ranks of the newly inducted men for those who had been professional photographers in civilian life and to bring them into the Signal Corps. This procedure was adequate for the time being, particularly since school facilities were too meager to absorb any large number of cameramen. By early 1942 any hope that Selective Service might bring in enough trained photographers to fill the wartime needs for combat cameramen had been dispelled.[23] Selective Service yielded few photographers, and of those few, not all came to the Signal Corps. Partly this was the result of the classification system used at the reception centers, but it was also true that the average age of competent professionals was so high as to eliminate most of them from the draft. Motion picture photographers and scenario writers were especially scarce.[24]

Lacking enough ready-trained men, the Signal Corps had to enlarge its facilities for training the unskilled. Until the Signal Corps Photographic Center was organized, the training facilities had been scanty indeed. By the end of June 1942 SCPC and its predecessor training activities at Fort Monmouth had trained and made available for assignment within the year 361 still and motion picture men.[25] Many more were needed. Qualified instructors were scarce, since even experts from the commercial field had to learn to adapt their skills to military use before they could teach others. There was a vast difference between commercial publicity pictures and tactical, logistical, and technical pictures for a heterogeneous audience—heterogeneous in the sense that the elements comprising the military machine all had specialized and dissimilar interests. Some of the techniques to be mastered were as simple as learning to load a camera in the dark. Others were so difficult and complex that only the battlefield could provide the final testing ground of proficiency. Meanwhile, men who had little enough skill with a camera at a field parade were hurried overseas to attempt combat photography because the calls for cameramen, as for other technicians, increased in direct ratio to the accelerated activation of troop units. The assignment system in effect in 1942 operated to the disadvantage of the combat units of the Army Ground Forces and the Army Air Forces. The commanding general of the Army Service Forces presented requisitions for replacement personnel for units under his control directly to the Office of the Chief Signal Officer. All other requisitions went through the AGF or the AAF directly to The Adjutant General. When photographic technicians graduated from the SCPC and were reported to the Adjutant General's Office as available for assignment, the Office of the Chief Signal Officer requisitions were chargeable against the men available. Thus the ASF requisitions were filled first; any photographers left over were assigned by the Adjutant General's Office against AGF and AAF requisitions. Since at that period there were never enough graduates to fill all needs, the Adjutant General's Office filled out the

[23] Maj Arthur L. Gaskill, Training the Army Cameramen, *Business Screen,* VII: 1 (December, 1945).

[24] OCSigO R&W Action 1, Schlosberg to CSigO, 27 Jan 42. SigC 352 Ft. Monmouth 1, Jan–May 42.

[25] CSigO, Annual Report, 1942, p. 323.

AGF and AAF requisitions with replacement center selectees. This procedure did nothing to assure that the best qualified photographers reached the combat organizations, a fact the Signal Corps pointed out repeatedly in its unsuccessful attempts to have the combat photographic units put on a priority basis.[26]

It was the goal of Col. Richard T. Schlosberg, chief of Army Pictorial Service at the time the SCPC was organized, to achieve a pool of 100 photographers to provide thoroughly trained men for emergency assignment to task forces. Instead the best some of them got were men who had crammed a 60-hour course into a single week. In some areas Army units could get no soldier photographers at all. A photographic center established at Cairo to serve the United States Army Forces in the Middle East had to be manned by civilians and supervised by an officer and two enlisted men of a radio team on detached service from Karachi.[27] Frequently it was necessary to place Signal Corps officers with no photographic background at all in command of photographic teams. The results were about as bad as might have been expected.

But after July 1942, when the officer situation in general became better, all officers assigned to photographic duties were given intensive training. First, they were sent to Washington to observe the methods of the Army Pictorial Service and the Bureau of Public Relations. Then, at the Signal Corps Photographic Center at Astoria, they received brief but remarkably effective instruction in news coverage. The New York press photographers co-operated with the administration at Astoria to solve the problem of injecting photographic news sense into the novice. The professional photographers of Acme Pictures, the Associated Press, International News Service, the *Daily Mirror, PM,* the *New York Times,* and the *New York World-Telegram* volunteered their services for this purpose. Students in the final stages of their training at Astoria and officers about to command photographic units all had the experience of working side by side with the professional press photographers on actual press assignments. Each professional took one officer or enlisted student along with him on assignments. The novice took pictures of his own and later compared his results with those of the professional, learning what was faulty in his own approach and what factors determined quality and made for general news interest. Above all, the student came out of this period of supervised practice with a better sense of composition and emphasis and with a better capacity for making split-second decisions. After graduates of this course reached theaters of operation, improvement in the quality of pictures was noticeable. Even so, these men were not polished professionals, and still lacked experience in combat photography.[28]

Motion picture training at Astoria began with an 8-week course which later was lengthened to 12 weeks and finally to 17 weeks. The training was intensely practical. It included a short period of instruction in the mechanical details of photographic

[26] (1) APS Summary Rpt, p. 287. (2) Capt Frederick Reinstein, Study of Signal Corps Enlisted Schooling, 1939–1944 (1945), SigC historical monograph C–8, p. 148. SigC Hist Sec File. (3) Palmer, Wiley, and Keast, *The Procurement and Training of Ground Combat Troops,* pp. 499–507.

[27] Ltr, CSigO USAFIME to CSigO, 20 Oct 42. SigC 413.53 Gen 1943.

[28] Capt William A. Wood, Historical Background of the Training Division of the Signal Corps Photographic Center, Astoria, L. I., 32 pp., *passim.* SigC Hist Sec File.

equipment. Next the student began to learn "story coverage," which SCPC considered to be the very heart of his training. After that the student made a series of phantom shots out of doors on a controlled problem, under close supervision. Then he was given live film to shoot. Supervision tapered off until he worked independently, but he received detailed criticism when his material was shown on the screen. The next phase covered simple daily assignments around New York. The student sized up his assignment, planned its coverage, and filmed the story. A critique preceded the next assignment. Instruction on 16-millimeter cameras and color film followed; then came more complicated assignments, editing, and finally working on the actual press assignments. Still picture instruction observed much the same routine, plus classes in darkroom and laboratory work. Little theory was involved and little training literature of any sort was used until late in the war.[29]

Throughout the specialized training, students continued their military training, with special attention to the aspects of field conditions they might encounter. They built hasty fortifications after long marches over difficult terrain, made overnight bivouacs, learned how to use and to protect their equipment under extremes of weather and temperature, and practiced shooting pictures from moving vehicles. They learned the techniques of setting up and using field processing laboratories. They spent a great deal of time mastering map reading, for combat photographers were usually strictly on their own at the front. Since combat photographers would carry weapons at all times, the men learned practical ways to accommodate themselves to the carbine, the 45-caliber automatic, and the Thompson submachine gun while packing and using their camera equipment.[30]

Another practical institution for training men in photographic work, a contribution of the Hollywood industry, was a school established by the Research Council in June 1942. There the studio employees who were selected for assignment to affiliated units received additional instruction in still and motion picture subjects. Fifty-nine of the industry's best men donated their services as instructors. The major studios of Hollywood, Culver City, and Burbank provided the facilities. The courses included work on the training and educational films which the Research Council was sponsoring for the Army.[31]

Combat Photography: Early Units and Problems

The Army originally conceived the role of photography in combat to be that of support for tactical units. Field photographic units were intended to fill in-the-field requests by unit commanders for pictures of terrain, weapons, and general intelligence information. Accordingly, war plans were drawn to provide each field army with a

[29] (1) *Ibid.*, pp. 15–23. (2) TM 1–219, Basic Photography, issued in July 1941, was the only manual available until May 1943. By mid-1945 twenty-one additional TM's on photographic subjects had been issued. Eichberg and Quadow, Combat Photography, App. B, Training Literature.

[30] Wood, Historical Background, p. 27. For more detailed accounts of photographic training, see Wood, *passim*, and the following Signal Corps historical monographs: (1) Reinstein, Study of Signal Corps Enlisted Schooling, 1939–1944, pp. 124–52; (2) Eichberg and Quadow, Combat Photography, pp. 6–22.

[31] (1) Ruth F. Sadler, History of the Signal Corps Affiliated Plan (1944), SigC historical monograph C–4, p. 101. SigC Hist Sec File. (2) APS Summary Rpt, pp. 403–407. (3) Intervs, SigC Hist Sec with Col Lawton, Chief of Fiscal Div OCSigO, 5, 8, 9 Mar 48. SigC Hist Sec File.

signal photographic company as a part of its organic complement. These companies contained assignment units for distribution to elements down to and including the division. Gradually the concept of the role of combat photography broadened to include information on personnel, matériel, conditions, and technique for staff agencies of the theater and of the War Department; news films and pictures for release to the public; historical records; and other assigned projects. Thus not all overseas photography was necessarily combat photography in the strictest sense. This was an important distinction not always thoroughly understood.[32]

At the beginning of 1942 only two Signal Corps Photographic Companies had been activated, the 161st and the 162d, both in the continental United States, except for two detachments which had been sent to Hawaii. Before the end of January a team from each company sailed for Northern Ireland. Thereafter, as other detachments were sent out, the 162d was quickly denuded of practically all of its skilled men. The photographic companies were under the jurisdiction of the Army commanders, Army corps, and G–3 until March 1942, when they became a part of the newly organized Army Ground Forces, which trained them and directed their operations in the field. Special photographic units and teams were composed of the best men available, selected from the photographic companies, the Signal Corps Photographic Center, and Signal Corps mobile photographic laboratory units.[33]

Panama, Puerto Rico, and Trinidad each received a team from the 162d. A detachment left for Newfoundland. Other units moved out to Iceland and to China. Usually the groups consisted of a lieutenant and six enlisted men—one still picture and two motion picture cameramen, two chauffeurs, and a clerk.[34] Such a detachment sailed with the first large convoy to reach Melbourne. This group, in charge of 1st Lt. W. L. Van Ness, then went on to New Caledonia, arriving in March just in time to photograph for G–2 the dramatic but bloodless revolt of the citizens against the Free French Commission.[35] On 10 April the 163d Signal Corps Photographic Company was activated at Fort Sam Houston, Texas.[36] In May a ten-man combat camera unit which had been recruited and organized through the Research Council in Hollywood received a month's training with the 162d, and was then transferred with an administrative cadre to Camp Crowder to form the 164th Signal Photographic Company.

In early August this detachment of experienced motion picture and still cameramen sailed for the United Kingdom. There they joined the rapidly expanding Army Pictorial Service organization in London, whose nucleus was the pioneer unit of the 162d Signal Photographic Company originally landed in Northern Ireland in January. In June this unit had transferred to

[32] (1) FM 11–22, Signal Operations in the Corps and Army. (2) WD Pamphlet 11–2, Standing Operating Procedure for Signal Photographic Units in Theaters of Operation. (3) WD Pamphlet 11–5, Combat Photography.

[33] APS Summary Rpt, pp. 351–53.

[34] (1) Ltr, CG GHQ, US Army to TAG, 23 Dec 41, sub: Division photographic assignment units, and 2d Ind, CSigO to TAG, 5 Jan 42. SigC OT 320.3 Aircraft Warning Service. (2) Memo, Lt Col R. T. Schlosberg, Chief of APS, for CSigO, 22 Apr 42. SigC 413.53 Gen, 1943.

[35] Interv, SigC Hist Sec with 1st Lt. W. L. Van Ness, APS OCSigO, 15 Aug 43. SigC Hist Sec File.

[36] AG 320.2 (3–2–42) MR–M–C, 20 Mar 42, sub: Activation 163d Sig Photo Co.

London to set up the APS Laboratory in the basement of a bombed-out building.[37]

From that headquarters the men covered spot news and newsreel assignments in England, Ireland, and Scotland. Early in September, S. Sgt. Waldo V. Thrasher photographed the Dieppé raid. Since that was entirely a British engagement, the British naturally wanted complete control of the sole Signal Corps cameraman's coverage of it. Later, however, Thrasher's material was made into a special newsreel, released through the Allied pool to all newsreel companies. The excellence of Thrasher's pictures won him a commendation from Vice Adm. Lord Louis Mountbatten, who had led the raid.[38]

Photographic Coverage in North Africa

Meanwhile, all planning in late 1942 was concentrated upon the imminent invasion of North Africa. On 17 September the Chief of Staff approved the Chief Signal Officer's plan for still and motion picture coverage, designating Col. Darryl Zanuck as the War Department representative to co-ordinate all photographic phases of the entire operation. Two groups of photographers were to be provided, Group A to accompany the Western Task Force, and Group B to be attached to Allied Force Headquarters. Each group would consist of a field grade officer, two noncommissioned officers, and four camera teams, each made up of one officer and three motion picture and two still cameramen.[39]

Maj. Anatole Litvak, on duty with Special Services, was detailed for 90 days to command Group A. Lt. Elton P. Lord of the 163d Signal Photographic Company, Fort Sam Houston, began interviewing photographic personnel from his own organization, from the Signal Corps Photographic Laboratory at Astoria, and from Camp Crowder, to select men for the camera crews. On 26 September the selected men assembled at A. P. Hill Military Reservation, Virginia, to begin their preliminary training and receive instructions for their mission. Meanwhile, the Chief of Staff had directed General Eisenhower to select eight officers and thirty enlisted photographers from photographic units in the United Kingdom for immediate amphibious training so that Colonel Zanuck might organize them into special photographic detachments to cover the assault landings and land action in North Africa for AFHQ.[40]

Early in October Zanuck arrived in London, bringing with him a ton of photographic equipment by air priority shipment.[41] There was much to be done. Zanuck would be attached to AFHQ as nominal commander of Group B. With the assistance of Lt. Col. William W. Jervey, director of the Army Pictorial Service on General Rum-

[37] For detailed account of the APS mission and organization in ETOUSA, see U. S. Forces, ETO, Sig Sec, History of the Signal Corps, ETO. 314. Military Histories, Vol. 2. Kansas City Rcd Center (C 2946). Additional accounts will be found in George Raynor Thompson and Dixie R. Harris, The Signal Corps: The Outcome, a forthcoming volume in this series.

[38] (1) Memo, Stoner for Lawton, 5 Oct 42, sub: SigC coverage, Dieppé raid. SigC AC 333.1 Trip, Stoner (ETO), Oct 42. SPSAC 5440. (2) Interv, SigC Hist Sec with 1st Lt Waldo Thrasher, 15 Apr 44. SigC Hist Sec File.

[39] Memo, CSigO for CofS, 17 Sep 42, sub: Plan for still and motion picture coverage of a typical opn involving two or more theaters, and Incl 1, Detailed Plans for Group A and B. SigC 062.2 Photo Coverage of Task Force Activities, 1942. OD–20.

[40] Msg, Marshall to USFOR, London, CM-OUT 10219 (9–30–42) R–1410. SigC 062.2 Photo Coverage of Task Force Activities, 1942. OD–20.

[41] Memo, CSigO for CofS, 30 Sep 42, sub: Air priority. File cited n. 40.

bough's staff,[42] and Capt. William H. Rivers, who was slated to accompany Zanuck to North Africa for an assignment to AFHQ as photographic officer, plans quickly took form. They provided for two combat assignment units from the 162d Signal Photographic Company to accompany the troops embarking from Great Britain. In addition, Zanuck selected several individual photographers, cameramen, and directors from the United States for special missions, to be distributed at various places throughout the invasion groups.[43]

From the Army Pictorial Service Laboratory in London, Sergeant Thrasher and Cpl. Earl Zeigler, a still photographer, were assigned to General Eisenhower's headquarters and moved to Gibraltar early in October. They set up photographic facilities in the signal center deep within the Rock. As staff photographers, Zeigler and Thrasher had a vantage point for the many important events that followed in the next few weeks. They made the first photographs ever taken inside the fortress of Gibraltar; they photographed the first Flying Fortresses and the first P–38's to land on the Rock; the first paratroopers to land there; pictures of General Eisenhower and his staff when they arrived; and, most significant of all, the takeoff on D Day for the invasion of North Africa.[44]

On 5 November Colonel Zanuck accompanied General Eisenhower and his staff who crowded into six Flying Fortresses and headed for Gibraltar to await D Day. On 8 November 1942 the battle for North Africa began, and the signal center in the fortress tunnel, the hub of a giant communications network, became the scene of frenzied activity.

Photographers went ashore with the first assault waves. Some of the cameramen came in under fire from enemy batteries in the early dawn of 8 November, literally tossed on to the shore by waves which rolled eight to twelve feet high along the coast. Lieutenant Lord, for example, commanding a group which came ashore at Fedala with the Western Task Force, was in a Higgins boat which overturned in the heavy surf. Lord swam in, bearing his equipment on his back, but salt water and sand seeped into his camera, and it stopped functioning after only twenty feet or so of film had been run through. Another cameraman was the fourth American to step ashore at Safi from the destroyer *Bernadou*. Still another attached himself to an infantry group detailed to knock out a machine gun nest. One was caught behind Fort du Blondin in a barrage laid down by the United States Navy. By that time it was light enough to take pictures, and he photographed the taking of the fort.[45] Photographing their way eastward, the cameramen joined Colonel Zanuck in Algiers and turned over their pictures of the amphibious invasion. All together, Zanuck sent 5,000 feet of war film back to London.

Zanuck's mission was twofold in that he was charged not only with initial co-ordination of photographic coverage of the invasion, but also with gathering material for the second film of the War Department historical series, *At the Front in North Africa*. Although he had authority to distribute his men as he wished, the scarcity of photogra-

[42] Chief Signal Officer, ETOUSA.

[43] Sig Sec AFHQ, History of the Signal Section, Allied Force Headquarters, 24 July 1942–10 November 1945 (1945), p. 8, and App. F, Historical Report of the Photographic Division. SigC Hist Sec File, A47–200, Drawer 15.

[44] Interv with Thrasher, 15 Apr 44.

[45] Ltr, Lord to Schlosberg, 21 Apr 43. SigC AS 062.2 Prod, 1942–46, Theaters of Opn.

SIGNAL CORPS CAMERAMEN *film an action scene in North Africa.*

phers was a thing that could not be overcome by directives. He dropped his cameramen off in pairs along the 600-mile front as the Allied drive toward Tunis began; thus the entire front had equal, if sparse, coverage. From Algiers through Bougie, Djidjelli, Phillipeville, Bône, Souk Ahras, Chardimon, Souk el Arba, Béja, Medjez el Bab, Tébourba, and close to Tunis the cameramen moved with the major fighting units. The Allied drive stalled short of Tunis in December. Zanuck drove back to Bône, then flew to Algiers, arriving on 5 December. In conference with Army Pictorial Service officers stationed there, he mapped out plans for future photographic coverage of the campaign, then went on to Oran, where he collected more film footage, then back to Gibraltar, and on to the United States to edit the picture. His comment foreshadowed the lack of enthusiasm with which *At the Front in North Africa* was received: "I don't suppose our war scenes will look as savage and realistic as those we usually make on the back lot, but then you can't have everything." [46]

Problems of Organization

North Africa provided a testing ground for photographers no less than for other Signal Corps specialists. In the weeks and months that followed, cameramen learned much and applied the lessons so well that eventually the Signal Corps combat photographers earned hearty praise on almost

[46] Day by Day Recollections, a 64-page report submitted to the CSigO by Zanuck, 18 Dec 42. SigC AS 062.2 Notes of Col. Darryl Zanuck, N. A. Mission, 1942.

every front.[47] There were, however, certain elements inherent in the organization and operations of photographic companies that needed changing, as the first months of combat indicated.

As it existed in 1942, a Signal Corps photographic company was composed of four elements, or general assignment units, as they were called. The type A camera unit took still and silent motion pictures of military operations in combat areas for news use. The type B, or newsreel unit, with the same mission, was equipped with a single-system, sound-recording, motion picture camera for recording interviews, sound effects, and so on. Then there were two laboratory units, A and B. The first was designed to operate at or near corps headquarters in the forward areas to provide camera and developing service for military intelligence, supply, and like purposes, while the type B laboratory unit provided similar service near army headquarters in forward areas. Neither developed news pictures, but sent them to the rear area laboratories by the fastest means.[48] Wherever military laboratories for processing film were not available, it was rushed to the Signal Corps Photographic Laboratory at Washington or to the Signal Corps Photographic Center on Long Island. Commercial laboratory facilities were used in some theaters where they were available.

When Colonel Zanuck surveyed photographic needs and operations in the United Kingdom in the summer of 1942 he became convinced that such companies could not perform satisfactorily. Better results, he believed, could be accomplished by a few photographic technicians organized into units consisting of not more than five still and five motion picture cameramen dispersed to areas of action with full authority to carry out their particular missions. He had recommended the organization of such units for immediate dispatch to England, and for use in other theaters as well.[49] His experience in filming *At the Front in North Africa* had demonstrated the advantages of flexibility in the deployment of photographic troops. The tables of organization for photographic companies remained fixed during the first year of the war, however, and it was not until well into 1943 that a move for a more flexible photographic troop structure gained impetus.

In the meantime, in actual practice company strength was scattered far and wide in small teams and detachments as needed. The cameramen found almost immediately that in combat they could not work advantageously in larger groups. For one thing, they duplicated coverage; for another, it was a useless risk of life. Photographic officers in North Africa therefore split their detachments into teams of one still and one motion picture technician, two men to a jeep when they could get such a vehicle. For mobility in covering a battle, jeeps were far superior to panel trucks and carryalls. Weapons carriers proved to be the ideal supply vehicles.

The cameramen found that when commanders were co-operative and briefed them on where and when a battle might be expected, they could often set up their equipment in what they hoped would be an advantageous spot and wait for the fight-

[47] For examples of Signal Corps still photographs from the North African campaign, see *The War Against Germany and Italy: Mediterranean and Adjacent Areas,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1951), pp. 1–93.

[48] Memo, Col Gillette, AFHQ, OCSigO, for Chief of APS OCSigO, 6 Oct 43. SigC 413.53 Gen, 1 May 43–31 Oct 43, Pt. 2.

[49] Ltr, Zanuck to CSigO, 29 Jun 42. SigC AS 333.1 Rpts of Inspec Trips (Zanuck, May–Jun 42).

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ing to come to them. They learned not to move with convoys, which were favorite targets for strafing, but to stand off to one side and photograph the strafing. In mountainous regions where vehicular travel was impossible, they scaled cliffs or followed goat trails for miles to get their pictures, often shooting their way out of tight spots with guns, not cameras.

They learned by experience what was needed in the way of equipment, and calls began to come into the Army Pictorial Service from all areas for more Eyemos, Bell and Howell 16-millimeters, Speed Graphics, and especially Leica or Contax cameras. Lacking the ideal, they improvised. "To give us 50 feet of extra film and to make a long shot and a close-up possible when time is so valuable, we have taped two B&H 16's together with the three-inch lens on top and the one-inch lens on the bottom. . . . This makes loading with the mags possible and the extra 50 feet is a Godsend." With a one-inch lens they had to get in the middle of a battle to picture it, but with the larger lens they were able to film it from the fringes. Tank action was particularly difficult to picture effectively because of the distances between tanks, which ranged from 2,000 to 5,000 feet.[50]

In contrast to the U.S. Army's photographic organization, the German Army's photographic troops operating in North Africa were in reality propaganda groups which operated in teams of one still and one motion picture photographer, a radio commentator, one or more reporters, and so on. Much of the action recorded was staged behind the lines. German soldiers in captured uniforms might enact the parts of Allied troops, and stock scenes be released in lieu of fresh battle coverage. The false impressions which such scenes created usually caused only amusement when shown to the troops, although there were times when they drew bitter comments; for example, when pictures playing up assured supply lines were shown to soldiers on short rations. Nevertheless, there were at least two features of the enemy photographic organization which appealed to American cameramen. The most pleasing element was the prominence accorded the German photographers, who, regardless of their rank, were in command of their groups during operations and who were completely free to photograph any scene or object they desired. Also, German photographers seldom remained long on one assignment under the theory that a fresh viewpoint resulted in better pictures, and some U. S. Army photographers held this same view. Moreover, under the German scheme for portraying the war, it was easier for an inexperienced photographer just out of training school to turn in acceptable material than it would have been had he been required to record authentic combat action.[51]

The United States Army expected more from its cameramen but gave them less freedom of action. Many U. S. cameramen found that more spectacular scenes occurred in training areas than in actual combat, where too often a photographic vantage point was occupied by the enemy and infantrymen were forced to hide and dodge behind bits of cover, advancing as they could, man by man. Dispersion was a

[50] Ltr, Lt Lord, 2625th Sig Sv Regt, to Col Schlosberg, APS OCSigO, 21 Apr 43, no sub. SigC AS 062.2 Theater of Opns, 1942–Feb 46.

[51] Mil Attaché Rpt from Cairo No. 4544, 16 Jul 43. I. G. No. 6585.

safer if not photogenic tactic. Soldiers no longer made massed charges as they had in the days of San Juan Hill. Like Colonel Zanuck, who had voiced misgivings as to how *At the Front in North Africa* would be received, many cameramen overseas learned that filming a staged battle not only brought fewer harrowing experiences but it produced a picture which would probably have more reality on the screen than the real thing. The Army's combat pictures had not caught the elusive something which General Marshall had wanted when he had sought Colonel Zanuck's advice on how to make training films more realistic. Genuine war scenes were not the answer.

Problems of Command

Like other specialists, photographic technicians assigned to troops were subject to the orders of field commanders. Understandably, photographic coverage of the war occupied a very secondary place in the interest of commanders charged with combat responsibilities. The Chief Signal Officer observed that "the provision of combat films for publicity and staff study purposes was seriously impaired by the fact that signal photographic companies, when transferred overseas, passed to the complete control of theater commanders." [52] Until the value of photography in tactical operations was proved, commanders tended to regard cameramen purely as publicity agents, and assigned them to the staff public relations officer. Hence, complaints were heard that the cameramen lacked news sense, and were too often dominated by public relations officers intent on making news of the commanding general instead of the war.

Much of the difficulty lay in the fact that the duties of photographic officers had not been spelled out clearly for their own information, or for that of the commanders under whom they served.[53] Both needed to know why the pictures were being made, what should be photographed, what use would be made of the pictures, how they should be shipped, and so on. A direct flow of information back and forth between the Army Pictorial Service and camera units overseas could have eliminated many difficulties, but there were many intervening headquarters between Washington and the combat cameraman, and "channels" were unknown quantities which the cameramen dreaded. "The channels in between would naturally get it all screwed up," voiced a common attitude. A young photographic officer at an overseas headquarters wrote to the APS in Washington to say: "Before I left the U.S.A., . . . I had heard the term, but that was all. . . . If you can give me some good straight dope on what Washington expects us to do, you can bet I'll appreciate it." [54]

The Army Pictorial Service headquarters in Washington also believed that the unsatisfactory performance of cameramen overseas could be attributed in part to a lack of both the general and specific direction necessary to do a good job. APS was much concerned over the relatively poor showing its combat cameramen were making. Over a 40-day period in early 1943, APS had received from theaters of operation some 95,000 feet of 35-mm. and 37,000 feet of 16-mm. film, of which only 10 percent was considered to be of sufficient in-

[52] Ltr, CSigO to CG SOS, 7 Jan 43, sub: Proper photo coverage of activities within theaters of opns. SigC 062.2 Photo Activities, 1942–43. OD–27.

[53] Ltr, Zanuck to Lawton, 5 Sep 42. SigC AS 413.53 Alaskan Dept, 1942–44.

[54] Ltr, Charlie Dourro, APS Officer USAFFE to "Charlie" (probably Col Charles S. Stodter, APS) 14 Mar 43. SigC 413.53 Gen, 1943.

terest to warrant requests for prints. APS contended that the specialized nature of photographic activities called for "specific continuity of directions, clearly defined coverage, proper transportation for camera crews and equipment, and advance information on important and outstanding events to be covered." [55] It recommended that specific channels of command in theaters of operation be established, specifically that a qualified ranking officer be assigned to the general staff of theater commanders, charged with responsibility for photographic activities in that theater.[56] This recommendation bore fruit a few weeks later when the War Department directed the overseas commanders to designate a staff officer, to be assigned to the staff of the theater commander and charged specifically with the staff functions connected with photographic activities.[57]

In addition to establishing a more clearly defined chain of command in overseas theaters, the APS believed that it was necessary to bring specialist training of photographic companies, units, and individuals to a higher standard through joint action by the Army Ground Forces and the Army Pictorial Service. The specialist training which the Signal Corps gave at Astoria, argued APS, ought to be co-ordinated with the later mobilization training which the AGF gave photographic companies. Methods, courses, and doctrine should be consistent. When ordered to theaters of operation, instructor teams should accompany the Signal photographic companies to train secondary personnel and replacements.[58]

Desirable as it might be, such a program even if accepted by AGF could not be expected to produce results immediately. In the long-range applications, many of the APS recommendations were accepted eventually, with good results. Meanwhile for some time there continued to trickle in reports such as the one General Somervell passed along to the Signal Corps in August 1943. It stated that at one base, out of 4,000 pictures, more than 2,500 were of the commander "eating lunch, picking roses . . . or what have you"; the rest of the 4,000 pictured the public relations officer.[59] Maj. Gen. Harry C. Ingles placed that complaint in proper perspective. If that were true, he said, "it calls for the reprimand of the commanding general, as he certainly has the authority to stop this practice any time he sees fit." Nearly all commanders and their staffs were ignorant of the function a photographic section was to perform, as established by law and regulations, said Ingles, adding that he knew of but one directive that had ever been issued controlling photographic activities, and that one he himself had issued when he was chief of staff of the Caribbean Defense Command. "I do not believe that either you or I, or anyone else in Washington can satisfactorily decide what pictures should be taken in England, Africa, Sicily, Middle East, Persian Gulf or India . . . the respective commanding generals have ample staff machinery to do this, but they turn the matter over to a public relations officer, and he interprets his duty to be the collection of all possible pictures for publicity purposes." [60]

[55] Staff Study, Field Photography, prepared by APS, 22 Apr 43. SigC 062.2 Policy, Combat Photography, 1942–44.

[56] *Ibid.*, p. 12.

[57] AG 210.31 (4–29–3) OB–S–D–M, 6 May 43, sub: Fld Photography.

[58] Staff Study, Field Photography, pp. 3–11.

[59] Memo, Somervell for Ingles, 25 Aug 43. Hq ASF SigC File.

[60] Memo, Ingles for Somervell, 27 Aug 43. SigC AS 319.1 Rpts Photo Activities, 1942–44.

This problem, like others, yielded to time and experience. The greatest single improvement in this matter came as a result of the appointment of the staff photographic officers mentioned above.

Photographic Security

A problem which affected the operations of combat cameramen overseas concerned security. In the field, before exposed film was processed, it was automatically regarded as "confidential," unless it was known to contain shots of material which would warrant a higher classification. After film was processed, prints were sent to Washington, where, a month after Pearl Harbor, the Secretary of War had established the War Department Photonews Board. Its duties included the review of newsreels and stills from all war theaters, and the selection of materials, subject to the approval of the Bureau of Public Relations, for release to the public. Still pictures were classified overseas at the point where they were processed.[61]

The cameramen's difficulties with security reached further back in the chain of operations. It was not always possible to reconcile photographic objectives with the security provisions imposed by commanders. The Army Ground Forces wanted pictures with training value. To have training value, they must show precise situations. If they showed precise situations, they told too much.[62]

More and more secret equipment was being placed in the hands of troops and the cameramen had no way of knowing what was secret and what was not. Often unit commanders themselves did not know. A tank spitting fire at the enemy on unrecognizable terrain was a good combat shot, and from the cameraman's point of view there was nothing about such a scene that could give aid or comfort to the enemy. But Dr. Vannevar Bush, Director of the Office of Scientific Research and Development, pointed accusingly to just such a picture which had appeared in a large daily newspaper early in the war. It revealed, he said, that infra-red equipment was being used and anyone familiar with the uses of infra-red might deduce from the position of the equipment quite a little as to what was under way on a classified Army project.[63]

If pictures were innocent, often the captions told too much. There were many ways in which pictures could violate security. For example, *At the Front in North Africa* contained a scene which showed a burning plane. A label on the cap of the fuel tank revealed the brands of German and Italian gasoline which might safely be used in it, thus giving an inkling of the nature of the plane's engine. As this was a German plane, the scene might be shown, but had it been an Allied aircraft, the danger of publishing the picture is obvious.[64]

The stress on maintaining military secrecy made commanders nervous about photographic activities. Their tendency was to restrain cameramen from taking any pictures which might conceivably violate security. Often the signal officer on a commander's staff was not without blame in restricting the photographic unit's activities. The cameramen bewailed the restrictions,

[61] Eichberg and Quadow, Combat Photography, p. 68.

[62] Ltr, CG AGF to CG SOS, 21 Oct 42, sub: Combat photography for AGF, and 1st Ind, Hq SOS Tng Div to CSigO, 24 Oct 42. SigC APS Policy Book 2.

[63] Ltr, Dir of OSRD to ACofS WDGS, 1 Dec 42. SigC 062.1 Photos.

[64] Ltr, R. C. Champlin, Ethyl Corp., N. Y., to Lawton, 7 May 43. SigC Proj. 3800, 3801, 3802.

contending that the classification of the pictures later could govern their use. Indeed, the War Department pointed out to theater commanders that the act of photographing did not, of itself, violate any military safeguards as long as the release of pictures was controlled by the War Department Photonews Board and by the G–2 sections in the field and in the War Department General Staff.[65] Nevertheless, restrictions continued to harass both the cameramen and the Army Pictorial Service, which received less coverage than it expected and chafed at delays in receiving the amount that did come in. Overseas clearances were delayed. In joint action with the British, where British troops, equipment, and censorship were involved, these difficulties multiplied.[66]

This conflict between full, factual pictorial presentation and the necessary demands for reasonable security was never completely resolved, but as cameramen gained experience and began receiving better supervision, the problem grew less acute.

Field Units in Mid-1943

By mid-1943, six photographic companies had been activated,[67] with three more scheduled for activation before the end of the calendar year. The 161st Signal Photographic Company was on duty in the Southwest Pacific theater, and also had units in Iceland, Ireland, China, and Hawaii. In North Africa there were ten units, five each from the 162d and the 163d Signal Photographic Companies. Large detachments of the 162d were on duty at various points in England. In addition the 162d had units serving in Hawaii, Ireland, Newfoundland, Greenland, Panama, Puerto Rico, and Trinidad. One unit of the 164th was in Alaska, but the rest of the company, along with the 165th and most of the 164th was training in the United States. The 196th, composed of four units derived from the 161st, was on duty at the Desert Training Center with the Second Army.[68]

Thus although the number of photographic companies in being had increased threefold during the first eighteen months of war, there were still not enough to fill the need for them. The simple fact was that there were not enough photographic technicians, and therefore not enough photographic companies.[69] Moreover, it could be expected that, as the number of campaigns increased, the need not only for combat coverage but also for photographic coverage of base activities would multiply. As the fiscal year ended, plans were in progress to organize "commando" photographic units—units which would approximate Colonel Zanuck's teams assigned to the North African operations.[70]

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[65] Ltr, TAG to All Comdrs in Theaters of Opns, 30 Jun 42, sub: Motion picture and still photography in theaters of opn. AG 004.5 (6–1–42) MB-F-PS-M.

[66] (1) Memo, CSigO for TAG, 3 Dec 42. SigC 062.2 Policy, Combat Photography, 1942–44. (2) SigC 062.1 Photo Security, *passim*.

[67] The 161st, 162d, 163d, 164th, 165th, and 196th Signal Photographic Companies. APS Summary Rpt, pp. 350–51.

[68] (1) *Ibid.* (2) Staff Study, Field Photography.

[69] Eichberg and Quadow, Combat Photography, p. 163.

[70] (1) Memo, Lawton for Dir of Planning, OCSigO, 11 Jan 43. SigC 413.53 Gen, 1943. (2) OCSigO R&W Action 1, Capt B. Miggins, APD, for Dir of APD OCSigO, 19 Jan 43, sub: Proposed plan opn of commando photographic units. SigC 062.2 Policy, Combat Photography, 1943–44.

The Widening Range of Photographic Activity

The expansion of facilities for photographic work in the first year of war merely reflected the widening scope of the Signal Corps' responsibilities in the various phases of photography. Some of these responsibilities—for example, the provision of training films, still and motion pictures for public relations purposes, and identification photographs—were not new, but were greatly expanded because of the rapid expansion of the Army. Others, such as the provision of orientation films and films of the historical series, constituted new applications and extensions of basic responsibilities. Still others were wholly new—services never supplied before, but now deemed necessary. One of the most important of these was a photographic mail service.

V-Mail

Inaugurated in the summer of 1942, as personal mail and war supplies competed for cargo space in ships and airplanes, V-mail provided a welcome means of reducing personal correspondence to a minimum bulk without restricting the volume of the letters. For some years microfilming had been used extensively for reducing voluminous office and library files to small rolls of film in order to save storage space. In the spring of 1941 the British adopted the technique for their "Airgraph" photographic mail system, developed by the Eastman Kodak Company and used by both the British public and its armed forces. The U.S. Army postal service, deeply interested, asked the Signal Corps to prepare a plan for a similar system for use of the American Army. By the summer of 1942 a plan drawn up by Maj. Kenneth B. Lambert had been approved, funds had been allocated, and the services concerned were ready to launch the project. It was a responsibility shared by the United States Post Office Department, which handled domestic distribution of incoming mail, and by the Army and Navy postal services, which transported mail between military and naval units and the U.S. postal service. The Signal Corps was assigned responsibility for the microfilming and developing processes and for establishing photographic mail stations.[71]

Originally it was anticipated that each processing station would be operated by the Signal Corps. But after all the possibilities, including a plan for complete commercial operation, had been explored, a compromise was settled upon. Where conditions permitted, stations would be operated under contract with the Eastman Kodak Company of the United States or with the British firm, Kodak, Limited. The Signal Corps would supply the service in active theaters and in other areas where the employment of civilians was not feasible.

The first Signal Photo Mail Company was activated on 1 July 1942. Already detachments of men trained at the plant of the Eastman Kodak Company had scattered over the globe, just as other Signal Corps technicians had done. One detachment had embarked for Suva in the Fiji Islands to organize the service in the South Pacific Area. One went north to Iceland, another to India, and still others moved out to serve the troops in Africa. The Eastman Kodak Company continued to train Signal Corps men in this specialty until autumn, when the Signal Corps established an Official Photo Mail Station in the Pentagon and thereafter conducted its own training.

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[71] WD Cir 219, 7 Jul 42.

V-mail service grew rapidly. From 35,000 letters sent overseas from the United States in June 1942, the number increased to 11,935,000 within a year.[72] The number processed overseas for transmittal to the United States showed a corresponding increase—from 18,000 in June 1942 to 7,673,000 in June 1943. The total peak volume was handled in April 1944—63,638,405 letters.[73] Within the first year the number of stations increased from 1 (opened in June 1942) to 8 contract and 6 Signal Corps stations. By the end of the war 9 contract and 19 Signal Corps stations had been activated.[74] Outgoing letters could be fed into the recording machines at an average rate of 1,200 per hour. Not only did V-mail move rapidly but it saved an enormous amount of space and weight. The weight of 150,000 ordinary one-sheet letters was estimated to be 2,575 pounds. Recorded on film they weighed only 45 pounds. One 100-foot roll of 16-mm. film, weighing less than seven ounces and occupying only 16 cubic inches of space, carried 1,800 letters.[75]

Procurement of Photographic Supplies

As its range of photographic services widened, the Army's requirements for photographic equipment and supplies became greater. Actually, prewar procurement planning had almost overlooked the problems of photographic supply. As a result, the war was nearly over before complete and accurate requirement data were compiled. Although standard commercial products were used almost exclusively, there was seldom an adequate supply of even these on dealers' shelves. For many months private owners were being urged to sell appropriate items to the Signal Corps. Persons from forty-four states made offers and more than 1,000 purchase orders were placed early in the war for privately owned cameras, such as Mitchell, Bell and Howell, Akeley, and Eyemo 35-mm. motion picture cameras; Cine-Kodak Special and Filmo 16-mm. cameras; and still picture cameras such as Speed Graphic; also for tripods, exposure meters, range finders, pack adapters, and so on.[76]

[72] Hq ASF, Statistical Review of World War II, p. 151.

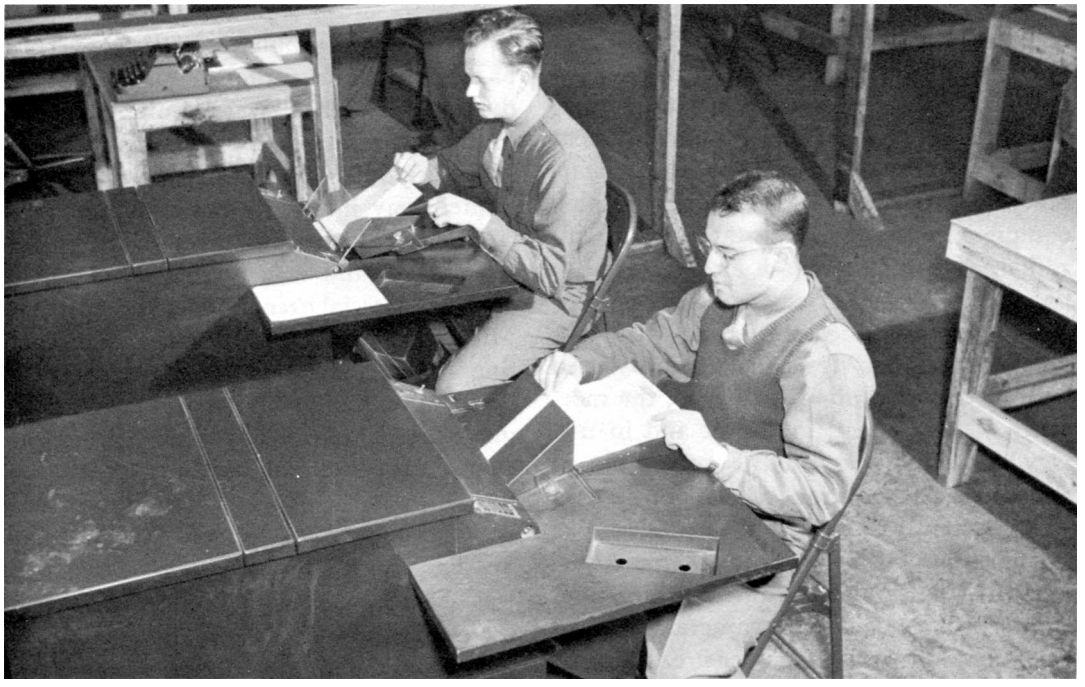
[73] Mary E. Boswell, A Study of Signal Corps Contributions to V-Mail through 1943, Supplement, December 1943 to August 1945, SigC historical monograph F–5, Fig. 5, Volume of V-Mail Microfilmed Since Inception, p. 18. SigC Hist Sec File.

These figures, compiled by Army Postal Service, are the number of V-mail letters handled by the Army in microfilm form. They do not necessarily represent letters to and from Army personnel solely, since V-mail service was available to certain civilians and to Allied forces receiving mail through APO facilities. Also, since the Army and Navy co-operated in the service, a substantial number of Navy letters were handled by the Army, and appear on Army records, while likewise a number of Army letters handled by the Navy appear on Navy records. Photomail Data, Oct 45, compiled in Opns Br, Army Postal Service.

[74] Signal Corps stations overseas were deactivated as the need for each individual station diminished. At one time or another stations were in existence at Abadan, Algiers, Brisbane, Calcutta, Casablanca, Guadalcanal, Karachi, Leghorn, Leyte, Marseille, Naples, Narsarssuak, Oran, Paris, Port Moresby, Reykjavik, Saipan, Suva, and Tontouti. Mary E. Boswell, A Study of Signal Corps Contributions to V-Mail through 1943, SigC historical monograph F–4, Fig. 1, p. 9. SigC Hist Sec File.

[75] For a detailed account of V-mail operations throughout the war, refer to Signal Corps historical monographs F–4, by Mary E. Boswell. A Study of Signal Corps Contributions to V-Mail through December, 1943, and F–5, Supplement cited n. 73.

[76] (1) James J. Cerruti, Historical Narrative of the Philadelphia Signal Corps Procurement District (1945), III, 677–79. SigC Hist Sec File. (2) I. D. Adams, Prod Div, Philadelphia SigC Proc Dist, Industrial Summary: Signal Corps Procurement of Photographic Equipment, 31 Jan 46, pp. 6ff. SigC Hist Sec File.



V-MAIL BEING PROCESSED *by members of a Signal Photo Mail detachment in Iceland in October 1942.*

The Speed Graphic was a good fair-weather camera, although with its open range finder and exposed cut-film and film-pack holders, it became water soaked very easily in heavy rains and then failed to function. The Army Pictorial Service was working with manufacturers on the design of a small, still picture camera with interchangeable short and long focal lenses, which combat photographers had found to be essential for the best results, although immediate requirements necessitated the use of any suitable substitute, such as the Leica and the Contax cameras. These made 1½ by 1-inch pictures on 35-mm. film, supplied in cartridges of 18 or 36 exposures, black and white or color.[77] Although most of the calls from the field were for standard commercial equipment, occasionally there was a request for a unique item, as, for example, a camera for use behind the enemy's lines to photograph documents for G–2, one small enough so that the cameraman might "stick it underneath his shirt, with his shirt-tail hanging out so it can't be seen." [78] Not only equipment but stocks of sensitized paper and photographic film were scarce. Film was officially classified as a scarce commod-

[77] (1) OCSigO R&W Action 1, Dir of APS to Dir of Planning, 11 Jan 43, sub: Camera. SigC AS 413.53 Theaters of Opns, Pt. I, 1943–44. (2) Clarke, Signal Corps Army Pictorial Service in World War II, p. 14.

[78] Incl, Extract of Telephone Conversation, 29 Jul 44, to Memo, CSigO for Dir of R&D ASF, 11 Aug 44, sub: Authorization. SigC AS 413.53 Theaters of Opns, Pt. 1, 1943–44.

ity and as such it was controlled and allocated by the War Production Board.[79]

But whatever the item or its nature, before it could be issued to troops in quantity it had to find a place on tables of equipment through the usual tortuous route of concurrence and approval. Tables of photographic equipment were as rigid as tables of organization, and troop strength alone proved to be a poor basis for issue, particularly for such items as projectors, because the dispersion of troops upset calculations based entirely on troop numbers.[80] Also, the mortality of equipment, in transit and in use, was higher than expected. For example, in the field the delicate mechanism of a camera was constantly subjected to excessive dust or moisture. Jolting over rough roads jarred small parts loose or broke them. Lens turrets became bent when cameramen dived into ditches or foxholes under fire. Cameras were too few to permit sending them to base signal repair shops, and there their low priority would shove them aside. The small repair sections of the photographic and service companies were therefore obliged to maintain not only the company's photographic equipment but also that of other arms—the Engineer Corps, Ordnance, Military Police, and so on. And the repairmen had to do what they could without spare parts, for which tables of allowances made no provision. These and minor commercial accessories were scarce. Without spare parts, cannibalization was often practiced in order to keep the photographic service going, but it was neither an economical nor a practical solution to the repair problem.[81]

A factor in the shortage of photographic equipment and supplies was the conversion of many manufacturing plants to the production of other war equipment. For example, Eastman stopped making cameras in 1941–1942, and began again only in a limited way in 1943. Ansco stopped soon after Pearl Harbor and throughout the better part of the war produced no photographic material except paper and film. The Mitchell camera people began making spotting sets and resumed the manufacture of cameras only after an expansion had been made in their plant. The big Bell and Howell plant was devoted largely to orders from the Army Air Forces and the Navy. Lens-making facilities were particularly small, and late in 1942 the Army-Navy Lens Board was set up to effect a fair distribution of the small supply.[82]

None of the limited funds available to the Signal Corps for equipment research in the prewar period had been devoted to photographic equipment. There were too many other more important or more pressing needs. By early 1943 it was evident that standard commercial cameras and photographic equipment designed for civilian use could not be expected to perform satisfactorily all the specialized tasks of military combat photography. In March 1943 General Somervell specifically charged the APS with research responsibility for photographic equipment.[83] On 11 April the APS

[79] CSigO, Annual Report, 1943, p. 472.

[80] SigC AS 413.53 Gen Miscellaneous, Photo, *passim*.

[81] SigC AS 413.53 Theater of Opns, Pt. I, Jan 43–Sep 44, and Pt. II, May 43–Oct 43, *passim*.

[82] Interv SigC Hist Sec with Harold Lang, Rqmts Div P&D Sv OCSigO, 8 Mar 46.

[83] ASF Adm Memo S–21, 21 Mar 43, APS. Cy in SigC DS (Gen Harrison) Proc, APS. This file is one of more than a hundred personal file folders maintained by General William H. Harrison, not Dewey decimal numbered, in the Adjutant General's Office Departmental Records Branch. Hereafter referred to as SigC DS (Harrison) with file subject cited.

directed the Signal Corps Photographic Center to establish the Pictorial Engineering and Research Laboratory (PERL) at Astoria.[84] Its responsibilities would include conducting tests and experiments on all types of photographic material, preparing and revising specifications for new and existing equipment, submitting military characteristics for, and standardizing, photographic equipment and supplies, and preparing the necessary instruction publications and manuals.

PERL began operations in one small office room at the Center. Its staff of three officers and two secretarial assistants concentrated at first on making procurement tests of equipment and on writing procurement specifications and technical literature. This first organized attempt to test and procure photographic equipment for purely military uses soon branched out into studies of maintenance problems, incidence of failure, and the procurement of replacement parts. Thereafter, throughout the war, the Signal Corps possessed a laboratory devoted to the specialized job of research into photographic equipment problems—a laboratory that eventually became a major center of research and development in this field.[85]

Although general responsibility for procurement of photographic supplies rested with APS, the procurement districts of the Signal Supply Service handled the actual contracting. APS's contracting activities extended only to the purchase of still and motion pictures and raw film stock.[86]

Still Pictures

The production of the Army's official still photographs constituted an important portion of the work of the APS. This duty, like the others, increased enormously during the first eighteen months of war, although the staff to accomplish it did not swell proportionately. For example, the figures for Signal Corps Photographic Laboratory personnel—civilian, enlisted, and officer—stood at 157 on 30 June 1942, and at 222 on 31 May 1943.[87] Included in these figures were the enlisted men of Company B of the 846th Signal Service Photographic Battalion, which had been activated at Astoria on 11 September 1942 to perform various headquarters photographic duties.[88]

Before war struck, the volume of still photographs coming in to the still photograph library had shown a decided upward trend. As Army inductees poured into training camps all over the country, newspapers and magazines clamored for pictures showing how the men lived and trained. These pictures swelled the files of the still photograph library. The first pictures received in World War II were of the Japanese attack at Pearl Harbor, and showed the bomb damage to Hickam Field and a small Japanese one-man submarine that was washed up on the shore.[89]

[84] Ltr, Col Lawton, Deputy Chief of APS, to CO SCPC, 11 Apr 43, sub: PERL. SigC 413.53 Gen 1943.

[85] Maj Lloyd T. Goldsmith [Dir of PERL Div SCPC] "Pictorial Engineering and Research," *Business Screen,* VII: I (December, 1945). Typical PERL projects included adaptation of motion picture camera PH–330, which became a basic piece of Signal Corps equipment and which accounted for 90 percent of all combat footage shot during the war, and the development of the new, lightweight combat camera, PH–530/PF.

[86] Memo, Exec Officer OCSigO for Chief of APS, 22 Apr 43, sub: Proc of photo supplies and equip, still and motion pictures. SigC DS (Harrison) Proc, APS.

[87] CSigO, Annual Report, 1943, p. 486.

[88] (1) APS Summary Rpt, p. 118. (2) Signal Corps Information Letter, No. 13 (December, 1942), p. 19.

[89] Maj Frank Muto [SCPC], "Still Pictures," *Business Screen,* VII: I (December, 1945).

Thereafter the volume of overseas pictures increased steadily. By the close of the fiscal year on 30 June 1942, the still library had received 16,000 new negatives. The number nearly doubled during the next twelve months as the tempo of the conflict quickened; 28,000 new negatives for the twelve months ending 30 June 1943.[90] By then the library's collection numbered altogether about 190,000 negatives. So many pictures were coming in from overseas that the Still Picture Library Branch established a temporary overseas picture file for official reference use, to serve until the pictures could be classified and filed in the permanent collection. Putting captions on pictures and issuing them promptly to the appropriate service—AGF, AAF, or ASF—required a great deal of routine work, but it was important that prints be furnished for technical study and training to Army activities all over the country. An additional service that the Still Picture Branch instituted at this period was a critique on the news value and technical quality of the negatives received from overseas. This was of great value to the cameramen overseas, who as often as not had no opportunity to see their own pictures or to learn what their mistakes or successes might be.[91]

When in mid-1942 the corps areas (later called service commands) were authorized to establish photographic laboratories and sublaboratories to provide photographic developing and printing facilities at posts, camps, and stations, the Still Picture Branch of APS acquired an additional duty—staff supervision of the laboratories.[92] It was a job that quickly grew to major proportions, for 123 new still laboratories were established before the end of June 1943. APS arranged to admit a limited number of service command photographers to the Signal Corps Photographic Center at Astoria for advanced training and instituted a still photographic laboratories production report, which showed the number of pictures made and the material used, in order to be able to estimate future equipment and supply requirements.[93]

Meanwhile, the Signal Corps' own Photographic Laboratory, particularly the new sublaboratory for still pictures in the Pentagon, acquired new and improved equipment to help handle the work load expeditiously. The Casablanca conference in January 1943 furnished an opportunity to demonstrate this fact. The Still Picture Section received 226 4 x 5 negatives, two reels of 35-mm. negatives, and 85 kodachromes of President Roosevelt, Prime Minister Churchill, and other notables at Casablanca. The laboratory's technicians developed the negatives and delivered 900 prints to the Bureau of Public Relations for release, all within the record time of seven hours.[94] Publicity pictures of special events like this spotlighted the work of the laboratory, but it was the thousands of day-to-day, routine tasks that spelled the real measure of accomplishment.

Distribution of Training Films

The Signal Corps distributed the Army's training films, film strips, and film bulletins

[90] CSigO, Annual Report, 1943, pp. 478–79.

[91] *Ibid.*

[92] Still Picture Branch later became Field Activities Division. See Chart 330, Functional Organization Charts, 31 Jul 42. SigC Hist Sec File.

[93] (1) Signal Corps Information Letter, No. 7 (June, 1942), p. 51. (2) CSigO, Annual Report, 1943, pp. 338, 478–79.

[94] Signal Corps Information Letter, No. 17 (April, 1943), p. 46.

through a system of central film libraries in the corps areas and sublibraries in designated posts, camps, and stations.[95] When a new training film was approved by the initiating agency for distribution, the Chief Signal Officer consulted the appropriate training division to find out exactly how and where the film would be used, where it would be shown, and the number of troops for whom it was intended. On the basis of this information the Signal Corps printed the required number of copies of the film and distributed them to the libraries through its Film Distribution Branch.[96]

At the onset of war the Signal Corps had been drawn into the twilight zone between two disparate but closely related functions: that of providing training films, a supply function, and that of the use of films, a command function. The training film was a relatively new device and very little use had been made of it either inside or outside the military establishment. Therefore the War Department felt that some agency had to be designated to demonstrate how motion pictures could be used in training. Soon after Pearl Harbor the Signal Corps had been instructed to furnish personnel to demonstrate effective techniques in the use of visual training aids.

Although a great deal was accomplished during the first year of war, a joint survey conducted by the Control Divisions of the SOS and the Office of the Chief Signal Officer in late 1942 indicated that training films still were not being used as effectively as they should have been. There were several reasons. Neither the APS, nor the Training Division, SOS, nor the corps areas had enough officers to assign a sufficient number to the work of promoting the Army's training films. Usually an officer assigned to a film library had other duties as well. FM 21–6, which listed the available films, was published only twice a year and fell badly behind schedule at that, so that the lists it contained were seldom up to date. There was also an acute shortage of projectors, which were controlled items and as such issued only on priorities. Film libraries had no such priorities. Furthermore, there was no relationship between the issue of films and the means for showing them. Projectors were issued according to the tables of basic allowances, whereas the distribution of films and film strips to libraries was covered by AR 105–260.[97]

In March 1943, therefore, the War Department transferred to the service commands Signal Corps' responsibility to provide consultant and advisory services on the utilization of training films.[98] This responsibility included operating the film libraries, which by this time numbered some 200, supplemented by at least 100 auxiliaries attached to post libraries at the larger installations.

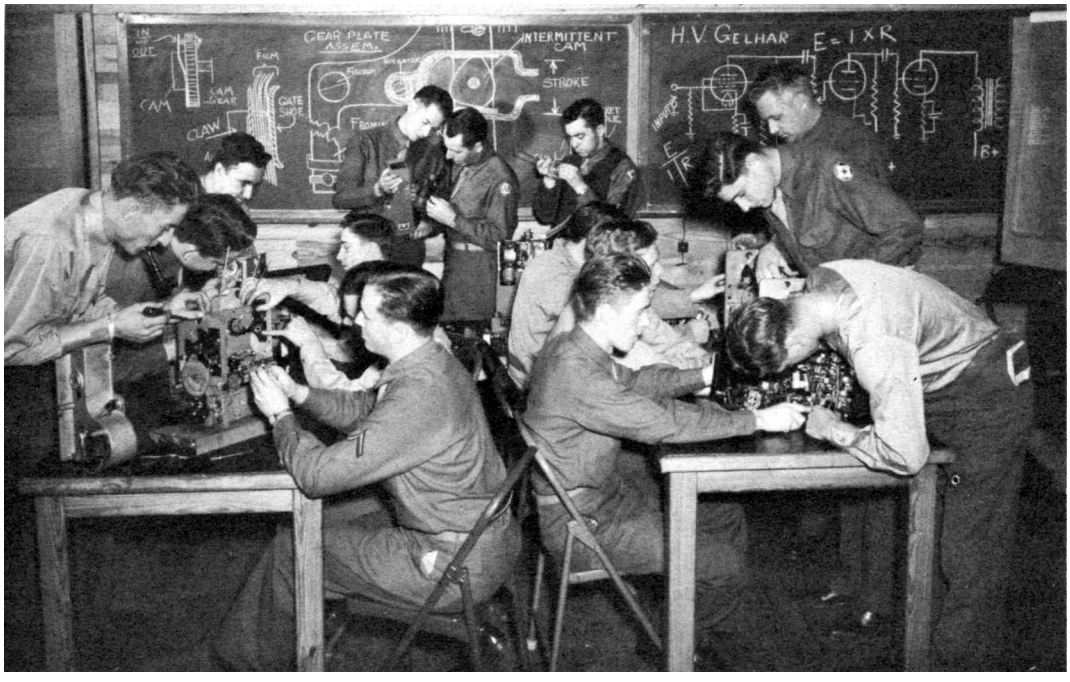
During the following months the APS and SOS kept a constant check on the op-

[95] Except for the AAF, which distributed its own training films. Special Services Division, SOS, distributed Army orientation films and informational films, and the War Department Bureau of Public Relations distributed films designed to promote industrial morale. APS Summary Rpt, p. 362.

[96] So designated as of 31 May 1943. It was originally activated 20 December 1941, as the Visual Aids Section, and redesignated the Film Distribution and Utilization Branch on 17 June 1942.

[97] Survey of Distribution of Training Films and Film Strips, Control Div SOS and Control Div OCSigO, 26 Nov 42–8 Dec 42. SigC EC 062.2 Tng Films, 1942–43.

[98] WD ASF Memo S105–14–43, 22 Mar 43, sub: Tng film program.



A CLASS IN PROJECTOR REPAIR

erations in the service commands.[99] A visual aid co-ordinator in the Eighth Service Command made an intensive study of conditions in that command. By May 1943 the APS was ready with recommendations which it presented to representatives of the nine service commands, the AAF, and the AGF at a two-day conference held at Toledo, Ohio, 28–29 May. The recommendations were aimed at two principal objectives—to arouse in service command officers a greater sense of responsibility for the proper utilization of training films, and to set up a uniform system of procedures in film libraries.[100] At the same time APS moved to reorganize its own distribution facilities in order to provide better and faster service. The new arrangement, effective 1 July 1943, consolidated distribution operations in the Signal Corps Photographic Center. The Film Distribution Branch of APS in Washington was responsible for staff supervision and policy matters only.

Orientation Films

Orientation films were training films of a special category. When war came the Bureau of Public Relations, War Department General Staff, had a corps of speakers busy traveling over the country delivering lec-

[99] (1) Memo, Chief of APS for CG AGF, 22 Apr 43, sub: Inspec of photo activities; (2) Memo, Col D. E. Liston, SOS, for Dir of Tng SOS, 14 May 43, sub: Inspec of tng film activities at Third, Fourth, and Eighth Sv Comds. SigC DS (Harrison) APS, Fld Instls.

[100] Summary of Recommendations, contained in *Get 'Em Into Action!*, booklet prepared for Toledo conference. Copy in Harrison Files, DRB AGO.

tures to troops on the general theme of why they were being called upon to fight. The background of world events which led to war was a fascinating subject to historians and students of world politics, but to soldiers bone-tired from their initial encounters with basic training it proved baffling, bewildering, or just boring. In any event, lectures were too slow, too limited, to meet the demand for mass indoctrination.

The Chief of Staff, General Marshall, already enthusiastic about the technique of training through the medium of motion pictures, was eager to extend the project to include orientation films for troops. On 9 December 1941 Brig. Gen. F. H. Osborne, Chief of the Morale Branch of the War Department (later designated Special Services), called Colonel Schlosberg of the Army Pictorial Service to discuss the matter with him, and Schlosberg agreed to try to find a qualified person from the motion picture industry to be commissioned in the Signal Corps to direct a series of orientation films.[101]

Frank Capra, a successful Hollywood producer-director, agreed to undertake the work. Capra was commissioned as a major in the Signal Corps on 14 February 1942 and placed on duty in the Morale Branch as chief of its film production section.[102] By the end of April Hollywood writers under Capra's guidance had completed a series of scripts based primarily upon the Bureau of Public Relations lectures. About 80 percent of the film footage was obtained from newsreels and other library sources; the remainder comprised animated maps and staged scenes. Film from the files of Fox Movietone, Pathé News, the Allied embassies, the Museum of Modern Art, impounded enemy film, and privately owned collections went into the making of these reels.[103]

Prelude to War, the first of the *Why We Fight* series (in French and Spanish versions also), was issued in October. Others followed at intervals throughout the war: *The Nazis Strike* (in French also), *Divide and Conquer, Battle of Britain, Battle of Russia, Battle of China,* and *War Comes to America.*[104] On 6 June, at the direction of the Commanding General, Services of Supply, the 834th Signal Service Photographic Detachment, a highly efficient unit comprising initially eight officers and thirty-five enlisted men drawn from the various technical fields of the motion picture industry on the west coast, was activated especially for the purpose of producing the orientation films in the *Why We Fight* series. This detachment, commanded by Capra, operated at first, not under the Chief Signal Officer, but under the jurisdiction and direct control of the Chief of Special Services, the Signal Corps' responsibility being limited to supplying the technicians and to assisting upon request.[105] On 1 September 1943 the memorandum assigning the 834th Signal Service Photographic Detachment to Special Services was rescinded, and thereafter the Signal Corps produced films for the Special Services Division upon its request in the same manner as

[101] APS Summary Rpt, p. 412ff.

[102] One of the three sections of the Information Division, headed by Col. E. L. Munson, who was to become the chief of the Army Pictorial Service in the Office of the Chief Signal Officer in July 1944.

[103] Memo, Chief of Spec Sv SOS for Chief of Adm Sv, 23 Apr 42, sub: Orientation films. SigC APS Policy Book 2.

[104] (1) WD Cir 368, Sec. IV, 9 Nov 42. (2) Clarke, Signal Corps Pictorial Service in World War II, pp. 221–24.

[105] Memo, CG SOS for CSigO, 2 May 42, sub: Establishment of SigC detachment under jurisdiction and direct control of Chief of Special Svs. ASF Control Div File, Sig Officer, Office of Chief.

for other agencies in the Army Service Forces or for the Army Ground Forces.[106]

The orientation films were highly successful, and were shown not only to soldiers, but at special showings to other groups including some of the individuals who had been leading participants in the events portrayed.[107] Capra's group soon undertook a second series, closely related to the orientation films, the *Know Your Enemies* and *Know Your Allies* series. John Gunther, William L. Shirer, John Whittaker, Leonard Spigelglass, and Eric Knight wrote the scripts for *Know Your Enemy Japan, Know Your Enemy Germany,* and *Know Your Ally Britain.* The last-named film was so effective from the British point of view that Prime Minister Winston Churchill had it shown in all the British theaters.[108] All together, Capra produced seventeen excellent feature films, at the rate of one about every two months, during the approximately three years he was assigned to this work.[109]

The Historical Series

The first of the War Department historical record series of feature films, designed to be shown to the civilian public, was *Report from the Aleutians.*[110] In mid-summer of 1942 Colonel Zanuck flew to Umnak, the springboard for launching aerial and ground action against the Japanese on Kiska. His mission was to plan the coverage and make the arrangements for the film. The work of completing the film he left to the direction of Lt. John Huston, assisted by Lts. Jules Buck and Rey Scott and two enlisted men. One of the greatest obstacles to filming action in the Aleutians was the weather. Before leaving Umnak, Zanuck made one unsuccessful flight over enemy-held territory, an experience duplicated several times by Scott and Buck before they succeeded in getting over Kiska on a clear day.[111]

The Aleutians picture, which ran to some 1,680 feet of 16-mm. and 4,200 feet of 35-mm. film, was shown officially just as the cameramen made it. But before its release for public showing some of the scenes had to be deleted for security reasons.[112] Scenes of the landing on Adak had been returned to the United States for editing before the Japanese were believed to be aware of the occupation of the island by United States forces, the Canadian customs officials having agreed to pass the shipments of film without examination of the packages.[113]

The *Report,* in technicolor, recorded in unforgettable detail how American men occupied Adak, the American outpost farthest out and closest to the enemy, barren of life, except for its grotesque scavenger ravens. It showed what ingenuity had gone into the conversion of Adak for use as a military post—a lagoon became a steel-surfaced airfield in eleven days, ready for American

[106] Memo, CG ASF for CSigO, 4 Aug 43, sub: Proc of films for Spec Svs Div. ASF CofS File, Sig Officer, Office of Chief.

[107] Speech, Gen Marshall, Lessons of History, Princeton University, 17 Nov 49.

[108] *Ibid.*

[109] Clarke, Signal Corps Army Pictorial Service in World War II, p. 221ff.

[110] Ltr, CSigO to CO Western Br, SCPC, 19 Dec 42, sub: War Department Historical Record Series. SigC Proj. 3800, 3801, 3802.

[111] (1) Ltr, Zanuck to CSigO, 5 Aug 42, sub: Photo survey of Alaska and Aleutian Islands, and establishment of a SigC APS unit within the ADC; (2) Memo, CSigO for TAG, 14 Sep 42; (3) Ltr, Zanuck to Olmstead, 25 Aug 42. SigC AS 413.53 Alaskan Dept, 1942–44.

[112] SigC Projs. 3800, 3801, 3802, *passim.*

[113] (1) Ltr, Scott to Schlosberg, 16 Sep 42; (2) Ltr, Actg Commissioner of Customs, Treasury Dept, to Maj Lambert, APS OCSigO, 3 Sep 42. SigC AS 413.53 Alaskan Dept, 1942–44.

bombers to take off to raid Kiska. It showed how weather dictated the terms of life and action and how it affected the labors of the two photographers who landed there in a slashing rainstorm. It showed the daily bombing missions against the enemy; bombers landing in blinding spray on a field flooded with a foot of water; returning with wings made filigree by flak and with holes in their sides large enough for a man to put his head through; a crash landing, with the ambulance crew going into action; a funeral, bleak scene in a bleak land; Sunday church services in the open. The exact details of a bombing mission were filmed: briefing and loading, the flight to Kiska, the formation of the bombing run that permits exact bombing, the attempts of the enemy to throw the planes out of their run, three bombing flights at different altitudes above Kiska with the cameraman's plane rocking with the impact of antiaircraft fire, and the safe return of all nine bombers after the destruction of Kiska's hangars. These were the elements of *Report from the Aleutians.* Absorbing as the best fictional dramas, this picture carried exact information and the cameramen had caught the very texture of war.

The second of the series, *At the Front in North Africa,* was not so well received. It was compiled from combat film footage taken by groups of Signal Corps photographers under Colonel Zanuck's direction during the first weeks of the North African campaign. At best, it could show only a fraction of the effort expended in a campaign, and for that reason was open to charges of superficial or inaccurate coverage.[114] It incorporated no dramatized material; no studio effects were employed to enhance its appeal. Its war scenes were real, but they did not look real to the public. A British film being shown at about the same time contained studio-filmed scenes of night attacks, and scenes patched together from captured enemy reels which had no connection with the subject campaign. These professional tricks resulted in a more dramatic picture. The policy of the War Department, however, was to use no such studio aids unless the artificial or re-enacted scenes be edited in such a manner as to segregate the staged from the actual scenes, with explanatory titles defining clearly the line of demarcation. The Signal Corps believed that such explanations would detract from the continuity of a film to such an extent as to be unworkable and therefore held to the policy of showing only authentic scenes.[115]

Throughout the war campaign reports and historical films were made available through the Office of War Information and the War Activities Committee of the Motion Picture Industry for showing in commercial theaters. *Eve of Battle,* the story of the invasion of Europe, was an example of this sort of film. It was shown throughout the country within a few days after D Day in Normandy. A general letdown in war production in the summer of 1944 was met by the release of the film, *This War Speeds Up. The Liberation of Rome,* released about the middle of 1944, also received wide public showing. *The Enemy Strikes* followed the German counteroffensive in December 1944.[116]

[114] Ltr, Brig Gen Richard B. Moran, Sig Officer Fifth Army, to CSigO, 27 Jul 44. SigC AS 062.2 North African Theater of Opns, Pt. I.

[115] Memo, Code for Chief of APS ASF, 25 Mar 43, sub: Combat films. SigC 062.2 Policy, Combat Photography, 1942–44.

[116] Clarke, Signal Corps Army Pictorial Service, pp. 213–14.

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Industrial Incentive Films

Still another film series, which the Signal Corps produced for the Office of the Under Secretary of War, was intended as an aid to stimulate war production. In February 1942 the Labor Consultant to the Under Secretary of War had suggested that a film be prepared which would dramatize the Army's desperate need for equipment and the responsibilities which the war placed upon "our soldiers of production." Capt. Richard W. Maibaum of the Army Pictorial Service prepared the script and served as technical adviser to 20th Century-Fox during its production. Before the end of June this picture, *The Arm Behind the Army,* had had more than 700 showings to an estimated one million workers assembled in factories, union halls, and at plant and community rallies. It had won general commendation from workers and management officials alike. Under Secretary of War Patterson was deeply impressed by it. He considered it a "highly successful dramatization of the Army's production message," and requested General Somervell to direct the Signal Corps to produce one such film every month.[117]

To comply with the directive, a special subsection was set up within the Army Pictorial Service, eventually becoming the Special Projects Branch. Three more films were produced before the end of the year: *Combat Report,* made by Pathé, and *Firepower* and *Attack Signal,* both by 20th Century-Fox. The Signal Corps Photographic Center dubbed in Spanish and Portuguese titles for South Central American audiences, and the Office of War Information distributed prints of the films in Allied and neutral countries through its Overseas Film Division.[118] Navy representatives saw *Combat Report,* and requested the Signal Corps to change the title to read "Produced by the Signal Corps for the Army and Navy." This was done, and thereafter each film in the series contained at least a few shots of the Navy in action.[119]

The Training Film Program

The biggest of all the wartime photographic chores centered around the training film program. In the broad sense, almost every sort of film, except those designed purely for entertainment, could be considered to be a training film. A narrower concept limited the definition to a film that presented a portion of the established curriculum of a service school. In that sense, providing training films for the various arms and services had been an accepted part of the Signal Corps' duties for many years. Even before Pearl Harbor the demand for training films was paralleling the growth of the armed forces. After war came the rate of demand rose faster than the rate of growth of the Army, because mass training of large numbers of men could be accomplished most effectively through the medium of films. For fiscal year 1942 the sum of $4,928,810 was appropriated for Army Pictorial Service, of which $1,784,894 was for motion picture production and $1,304,710 for motion picture distribution, chiefly of training films. More than four times that sum, $20,382,210, was appropriated for the next fiscal year, 1943, and half went for training films and for training of officer and

[117] (1) Memo, Patterson for Somervell, 7 May 42, sub: Motion picture rqmts of USW. APS Summary Rpt, pp. 306–307. (2) CSigO, Annual Report, 1942, p. 336.

[118] APS Summary Rpt, pp. 307ff.

[119] Clarke, Signal Corps Army Pictorial Service, p. 212.

enlisted personnel in photographic specialist courses.[120]

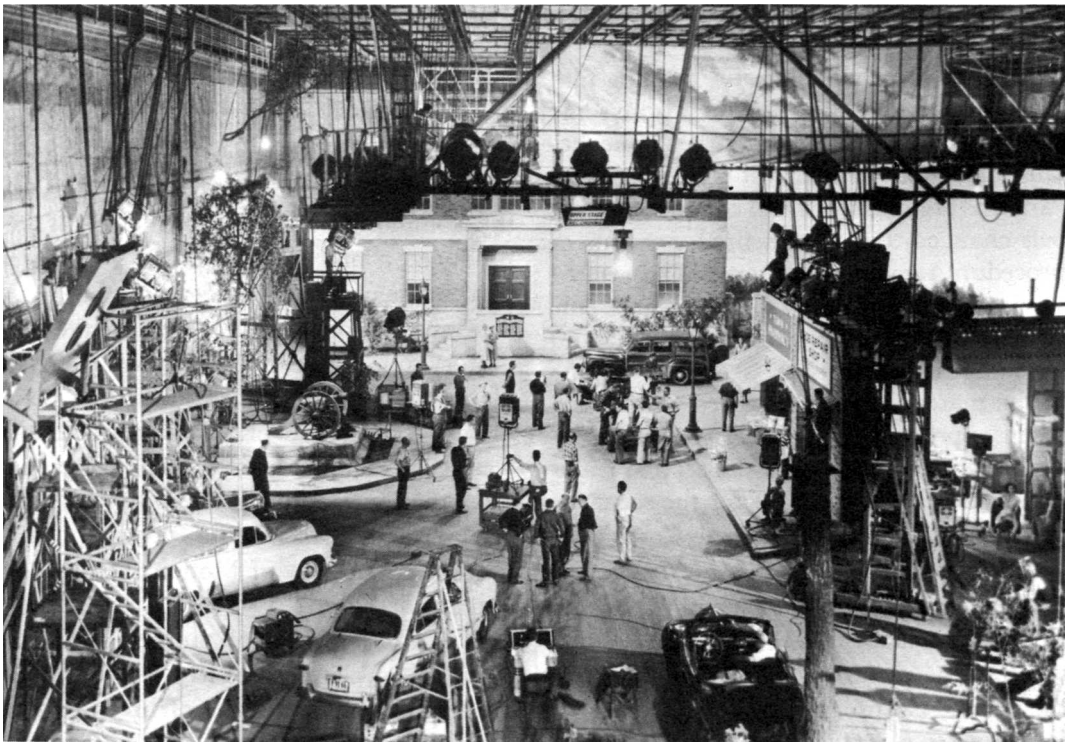
The actual production of a training film was always the result of a request from some arm or service. Throughout 1942 the details incidental to approval of film projects varied as organizations and command channels changed, but the essential elements of procedure remained the same. The arm or service decided what part of its school curriculum should be presented on film, and prepared a picture plan, a general outline of the material to be presented. This plan, when approved by the chief of the appropriate service (by way of the service training division) was the basis for the scenario, prepared either by the Signal Corps (for SOS) or by the service itself (for the AGF). The Army Pictorial Service within the Office of the Chief Signal Officer determined whether the picture would be produced at the Signal Corps Photographic Center or by the west coast film industry. Technical advisers assigned by the requesting arm or service assisted in the actual production in either case. When the finished film was approved and accepted by the requesting service, the Signal Corps distributed it as instructed by the service.[121]

To the extent possible with the facilities available, the Signal Corps had always produced training films in its own film laboratories, but until the middle of 1942, when the SCPC became operative, the facilities had simply not been adequate to cope with the volume of requests. Thereafter SCPC produced a progressively larger and larger percentage of films. The demand, however, continued to outrun the ability of the laboratory to produce the films, and the Signal Corps continued to place contracts for commercial production of such films with the west coast film industry. Until December 1942 the contracting agency with which the Signal Corps dealt was the Research Council of the Academy of Motion Picture Arts and Sciences.

It was this aspect of the Signal Corps' contractual relationships which received the most attention in a series of investigations during the latter half of 1942. They culminated in hearings before a special committee of the United States Senate which was investigating the entire national defense program. In August 1942 this committee, headed by Senator Harry S. Truman, presented the War Department with a list of questions pertaining to the Signal Corps' training film program. Rumors had reached the committee that the Research Council was assuming a dominant role in the training film program to the exclusion of small producers who were not members of the council; that the operation of the Affiliated Plan put Hollywood's favorite sons into safe berths at Astoria for the duration of the war; and that Colonel Zanuck, by virtue of his three positions as chairman of the Research Council, as an official of 20th Century-Fox, and as a Signal Corps officer

[120] CSigO, Annual Report, 1943, p. 496.

[121] (1) APS Summary Rpt, pp. 298–300, 335–36. (2) Jacqueline M. Quadow, Training Films in the Second World War (1944), SigC historical monograph F–1, pp. 48–56. SigC Hist Sec File. (3) Attachment 4, Interim Report on Training Films, Control Div, SOS, 2 Oct 42, to Memo, Maj Thos. D. Hodge, Control Div OCSigO, for Deputy CSigO, 3 Feb 43, sub: Control Div SOS, tng film investigation rpts (Interim, 2 Oct 42), and Hollywood inspec (30 Oct 42). Hereafter cited as Hodge Memo. SigC EC 062.2 Tng Films 1940–4–42. (4) ASF Manual M4, Military Training (April 1945), pp. 31–34. DRB AGO. Training films for the AAF, a Signal Corps responsibility until late 1942, were handled in much the same manner, the TFPL at Wright Field being the producing agency.



A MOTION PICTURE SET AT SCPC

on active duty, was exerting undue influence.[122]

The questionnaire, recognized as the harbinger of a Congressional investigation, touched off a series of independent investigations of the photographic program by the Services of Supply. The first was conducted by Lt. Col. A. M. Sims of the Control Division, SOS, in and about Washington during August and September. It culminated in a seventeen-page Interim Report on 2 October. The report charged that production of urgently needed training films had been "exasperatingly slow"; it protested against cumbersome procedures, disputes between those responsible for training film doctrine and those responsible for production, lack of definite assignment of duties among Army elements participating in the program, and the lack of production scheduling. It charged that "contractual arrangements with Hollywood" had made the Army "peculiarly impotent" in obtaining the kinds of films required, and that proper controls over the expenditure of federal funds had been lacking.[123]

The report listed ten recommendations, six of them directed toward the Signal Corps. Most of these actually related to staff supervision and co-ordination of training film activities, which were not the responsi-

[122] (1) Memo, Col Lawton for CSigO, 27 Aug 42, sub: Photo activities. SigC 062.2 Photo Activities. OD–27. (2) Intervs, SigC Hist Sec with Lawton, 5, 8, 9 Mar 48. SigC Hist Sec File.

[123] Hodge Memo.

bility of the Signal Corps, but of the Training Division, SOS, as the Director of Training, General Huebner, and the Deputy Director, Colonel Weible, quickly pointed out.[124] Weible said, "The writer was apparently not entirely conversant with the responsibilities or authority of an operating agency as contrasted with a staff unit. This has resulted in unfair criticism of the Signal Corps." Huebner also remarked that most of the criticisms submitted had been appreciated prior to receipt of the report, and that steps had already been taken to remedy them. One of the steps involved a directive to all the preparing arms and services to submit a complete list of all approved projects and a list of projects for which approval would be requested during the fiscal year 1942–43. This would permit the Signal Corps to be given a production schedule, with priorities set up, on which an orderly production program could be based.[125]

The Army Ground Forces, commenting on the Interim Report, not only reflected the opinion that the report had been written under a misconception of responsibilities amid a confusion of terms, but also noted that many of the statistics it contained were erroneous, and the allegations incomplete and misleading. For example, although the report alleged that only three training films had been completed and distributed for the Army Ground Forces and the Services of Supply between 1 January and 15 September 1942, AGF asserted that actually seventy-five had been released for the Ground Forces alone, and probably as many more for the SOS. AGF also pointed out that the regulations covering the production of training films were inadequate and obsolete and urged the revision of AR 105–260.[126]

Following the submission of the Interim Report, Colonel Sims, accompanied by three officers from his division, and by Lt. Col. Charles T. Lanham, chief of the Visual Aid Section, AGF, and Col. Kirke B. Lawton, chief of the Army Pictorial Service, departed for Hollywood to investigate training film activities in that area. On 30 October the Sims investigators submitted their final report to General Somervell who immediately sent a copy of it to The Inspector General for further investigation. At the same time he directed the Chief Signal Officer to comply with the dozen recommendations embodied in the final report, aimed at Signal Corps relations and operating procedures with the Research Council.[127]

General Olmstead at once began reorganizing APS procedures to comply with the pertinent recommendations. The effect was to decentralize operations and to give the Signal Corps Photographic Center at Astoria a good deal more authority. He gave the SCPC responsibility for scheduling and producing all training films whether produced there or in Hollywood. He converted the Liaison Office in Hollywood into an operating office, as the Western Branch of the SCPC, in quarters separate from those of the Research Council. He also directed the SCPC to prepare a production plan for

[124] Attachment 6, Memo, Weible for Control Div SOS, 29 Oct 42, sub: Comments on rpt on tng films made by Control Div SOS, 2 Oct 42, and Attachment 7, Memo, Dir of Tng SOS, 29 Oct 42, sub: Tng aid program in SOS, to Hodge Memo.

[125] Attachment 7, Memo, Dir of Tng SOS, 29 Oct 42, to Hodge Memo.

[126] Attachment 8, 1st Ind, Hq AGF to CG SOS, 5 Nov 42 (without basic ltr); Attachment 13, 1st Ind, Hq AGF to CG SOS, 9 Nov 42 (without basic ltr), to Hodge Memo.

[127] Attachment 9, Inspection of Training Film Operations in Hollywood, California; Attachment 10, Memo Gen Styer, CofS SOS, for Dir of Tng SOS, 30 Oct 42, sub: Tng films; Attachment 14, Memo, CG SOS for CSigO, 1 Nov 42, sub: Tng films, to Hodge Memo.

training films, in the form of a report to the Commanding General, SOS, establishing the relationships of the Signal Corps with motion picture companies, writers, producers, and directors, and to prepare standards by which to examine budget estimates.[128]

The second significant feature of Olmstead's reorganization involved the breaking off of the long-standing arrangements between the Signal Corps and the Research Council. The Research Council was permitted to finish the work it had in progress, but all new production projects would be handled by the Western Branch of SCPC on a contract basis worked out with the individual studios. Production costs were to be figured exactly—that is, as exactly as they could be, considering the unknown contingencies that could arise in producing a film. The possibility that some of the producers might not continue the practice of making films on the basis of "out-of-pocket" costs, as they had been doing, induced General Olmstead to retain the Research Council in an advisory capacity in dealing with the companies it represented, although it would no longer handle War Department funds.[129]

The ink was barely dry on the directives establishing the new procedures when further administrative changes erupted. Early in 1943, before the Inspector General's Department had completed its investigation of the Army's photographic program, the Truman Committee followed up its questionnaire of the preceding August by beginning hearings at Washington on the activities of the Army Pictorial Service. The early questioning took place during General Somervell's absence overseas, and moved his chief of staff, Brig. Gen. Wilhelm D. Styer, to recommend to him upon his return that a change be made in the supervision of the Army Pictorial Service. Specifically, he recommended that steps be taken "to effect any reorganization" of this "large and important activity . . . very much in the spotlight." He suggested that "some very capable officer" be selected to supervise the organization, and noted that Brig. Gen. William H. Harrison could be made available for the post.[130]

A few days later General Somervell received a preliminary report of The Inspector General's investigation and sent it to the Chief of Staff, U. S. Army, with his recommendations for reorganizing photographic activities. The Inspector General's report, like those of the Control Division, disclosed overlapping and a lack of co-ordination in the motion picture activities of the Army as a whole. It listed eleven agencies engaged in producing motion pictures, all competing for scarce materials and skilled manpower. Actually, this number was in error, since three of the organizations listed were AAF units, responsible for their own training film production under War Department order, and of the remaining eight, only two were engaged in activities which duplicated or overlapped those of the APS.[131]

The report recommended that a central and unified photographic organization—such as the Chief Signal Officer had pressed for—be set up, but that it be separate from

[128] Attachment 29, Ltr, CSigO to O/C SCPC, 9 Nov 42, sub: Prod of tng films, to Hodge Memo.

[129] Attachment 30, 1st Ind, Lawton to CG SOS, 18 Nov 42, sub: Tng film prod; Attachment 31, Memo, Lawton for CG SOS, 18 Nov 42, sub: Prod of tng films, to Hodge Memo.

[130] Memo, Styer for Somervell, 26 Feb 43. ASF CofS File, Feb 43.

[131] Attachment 1, Analysis of Report of Inspector General, 5 March 1943, to Memo, Harrison for Lawton, 29 Apr 43, sub: Photo investigating rpts. SigC EC 062.2 Tng Film—Analysis of Rpt of IG—Tng film prod.

the Signal Corps. Noting that the Signal Corps had already revised its procedures for the commercial production of films, the report recommended that these new procedures be continued. It was full of criticisms of past performances by the Signal Corps, other elements of the Army, the Navy, and civilian government agencies, but since most of these had already been corrected by the agencies concerned, the report probably merited the term "anti-climactic," which the Acting Chief Signal Officer, General Colton, applied to it.[132]

General Somervell's recommendations to the Chief of Staff for reorganizing the Army Pictorial Service followed those of The Inspector General's report. Although they embodied the Chief Signal Officer's own ideas for centralizing control of Army photography in one agency, Somervell proposed to withdraw control of the activity and lodge it in his own office, under an officer of his own choosing. At the same time he proposed to leave the Chief Signal Officer with the responsibility for the details of administration. Somervell's recommendations also provided for the organization of an Army Pictorial Board, to be composed of the chief of APS, as chairman, and representatives of the AAF, AGF, SOS, Bureau of Public Relations, and Special Services Division. Its function would be to establish photographic policies for the Army and to co-ordinate programs.[133]

Within a few days the G–4 Section of the General Staff offered a substitute plan. It provided for a board under the chairmanship of the Assistant Chief of Staff, G–4, and recommended that no further action be taken toward reorganizing the Army Pictorial Service pending the completion of The Inspector General's investigation. General Somervell took issue with the G–4 proposal to defer the reorganization he had recommended. "It is sheer sophistry to state that facts are not known and are controversial. The subject matter is under investigation by the Truman Committee, and it is highly desirable that the War Department not be kicked into taking some action." [134] The upshot of the matter was that, although he was denied authority to reorganize the whole program, on 13 March Somervell named General Harrison to take charge of the APS, under Somervell's direct supervision. Two days later the Secretary of War issued an order setting up the Army Pictorial Board recommended by G–4 to integrate photographic policies and activities generally.[135]

Within a month the Truman Committee resumed its inquiry into Army photographic affairs. It heard Under Secretary of War Patterson, General Harrison, Colonel Lawton, and a number of other officers. No new evidence was brought out, although much of the questioning concerned past relations with the Research Council. Testimony confirmed the practical impossibility of comparing costs of training films produced commercially with the cost of those produced at Astoria, where topflight directors and other

[132] Incl 3, Inspector General's Report, 5 March 1943, and Exhibit 9, 3d Ind, Actg CSigO to CG ASF, 29 Mar 43, to Memo, Col Lawton, Deputy Chief of APS, for Chief of APS, 19 Apr 43, sub: Recommendations and actions—photo investigating rpts. SigC EC 062.2 Tng Films, 1942–43.

[133] (1) Memo, Somervell for CofS U. S. Army, 1 Mar 43; (2) Memo, CSigO for CG SOS, 1 Mar 43, sub: Photo activities of Army. ASF CofS File, APS.

[134] (1) Memo, Styer for Somervell, 6 Mar 43; (2) Memo, Somervell for Deputy CofS U. S. Army, 8 Mar 43. ASF CofS File, APS.

[135] (1) Memo, Styer for Deputy CofS and others, 13 Mar 43. ASF CofS File, APS. (2) AG Memo W210–4–43, 15 Mar 43.

specialists who received enormous salaries in civil life had been acquired through the draft. Comparative costs were discussed, but the figures had little meaning. At no time, however, did the committee or the men it heard intimate that Hollywood had produced inferior films or that it had overcharged for its services. To the contrary, suspicion seemed rooted in the fact that the Research Council had not charged as much as it might have.[136]

Many of the committee's questions centered around Colonel Zanuck and his status and duties as an officer. The matter had also figured prominently in The Inspector General's report, which had devoted one entire section to the Zanuck matter. Essentially, the criticism was based upon the fact that from the time Colonel Zanuck was called to active duty in early 1942 until August 1942, he had continued to hold his position as chairman of the Research Council and his corporate connection with 20th Century-Fox Film Corporation, although he had drawn no salary as an Army officer and although his status had been known and approved by the Chief Signal Officer. There was no suggestion that Colonel Zanuck had in any way influenced the selection of military personnel, or the business relations of the companies doing business with the Signal Corps, by virtue of his position with the Research Council. On the contrary, as Secretary Patterson testified, there had been wide agreement that Zanuck's expert services had been of immense value to the War Department, both before and after Pearl Harbor. The chairman of the committee suggested that he might well have performed the same services as a civilian, but Secretary Patterson pointed out that Zanuck's duties in the combat areas could not have been performed by a civilian.[137]

The hearings came to a close. No formal report of findings was made, and on the whole the committee seemed satisfied that the matter might well be dropped. As to the Zanuck affair, a spokesman for the committee told the Deputy Chief Signal Officer that the committee members were completely satisfied, did not care to interview Colonel Zanuck, and were "sorry that they had bothered the Signal Corps in the first place." [138] Chief of Staff Marshall personally wrote the Truman Committee, giving Colonel Zanuck "a fine boost" and expressing himself as believing that Zanuck had received unjust treatment.[139] On 1 June 1943 the War Department approved Zanuck's request for relief from active duty.

Early in July General Somervell relinquished his direct control of the Army Pictorial Service and it reverted to its original status as a part of the Office of the Chief Signal Officer, with Colonel Lawton again in charge.[140] There had been no understanding that the transfer out of Signal Corps was temporary, but it can be inferred that Somervell had made the arrangement for at least two reasons. For one thing, he may have been convinced that the move would forestall further criticism from government investigating committees. Furthermore, Secretary Patterson testified before the Truman Committee that the organizational level which the Signal Corps occupied did not give it the necessary authority to deal decisively with other services on the same or higher echelons.[141] In the case of day-to-day opera-

[136] Truman Committee Rpt, pp. 6895ff.

[137] *Ibid.*, pp. 7042–45.

[138] Log entry, 24 Mar 43, p. 88. Deputy CSigO Folder, 1942–45. SigC Hist Sec File.

[139] *Ibid.*, 26 Apr 43, p. 89.

[140] ASF Memo S–37, 30 Jun 43.

[141] Truman Committee Rpt, p. 7049.

tions, this argument would seem to have little weight, but when fundamental policy decisions involving other services were at stake it assumed validity. It was particuarly pertinent because General Olmstead was out of the country during most of the period, on an overseas inspection trip involving important supply matters. In other words, this was a situation where "big brother" could command attention more effectively.

During the three months General Harrison as chief was responsible only to General Somervell, Harrison applied himself intensively to the problems of APS. Reporting to the new Chief Signal Officer on 2 July, Harrison outlined what he had accomplished. "Internal administration of the Army Pictorial Service and responsibilities of the individual groups have been spelled out," he said. He mentioned also the revision of distribution and library service which had taken place under his direction, the beginning of a program for improvement of overseas operations, the setting up of a long-range program for improvement of V-mail operations, a review of the status of items of equipment and supply and steps taken to expedite procurement, and a review of training films scheduled by AGF and ASF to determine their essentiality.[142] Harrison concluded by saying that he believed APS was "now on a going basis," that the staff was capable, and, in effect, that all that was required was to continue the present policies.

Summary: The Status of APS at Mid-Year 1943

The administrative upheaval that followed the various investigations of late 1942 and early 1943 neither wrecked the Army Pictorial Service nor altered its basic design very drastically. Nevertheless, it served to focus attention upon weaknesses and deficiencies which in the year that followed were corrected to bring the Army's photographic service to a high peak of efficiency. The strong, centralized control of Army photography was still lacking, but APS officers were beginning to achieve the desired results by closer co-operative relations between initiating and producing agencies. Several of the measures taken in 1942 were definitely helpful to the Signal Corps—for example, the SOS directives of October and December which required all services to prepare lists of their film projects, with priorities desired, and estimates of the time each would require, so that the Signal Corps could establish reasonably accurate production schedules. The same directives forbade all services except the Signal Corps to enter upon negotiations with any commercial motion picture producer.[143] Decentralization of production scheduling from the APS headquarters within the Office of the Chief Signal Officer to the SCPC at Astoria was a step toward better control of production. The SCPC soon established a series of status reports and a system of rigidly controlled fiscal and accounting policies which also served to regulate training film activities. Several of the reforms accomplished during General Harrison's tenure, especially the consolidation and standardization of distribution and use procedures, were definitely beneficial.

[142] Memo, Harrison for Ingles, 2 Jul 43, sub: APS. SigC DS (Harrison) APS.

[143] Memo, Huebner for Chiefs of SOS, 24 Oct 42, sub: Tng film program, and Memo, Huebner for all Chiefs of SOS, 24 Dec 42, sub: Tng film program of Army. ASF CofS File, APS. The corresponding directive from AGF to all its preparing agencies was issued 6 November 1942. Quadow, Training Films in the Second World War, p. 56.

Most of the difficulties that beset the Army's training film program in the first eighteen months of war were the result of two factors common to many other Army activities. First of all, the demand was too big and came too suddenly to be absorbed without some mistakes and frictions. In the second place, both the using and producing agencies lacked experience. Men from the commercial field were new to Army doctrine and procedures and to the use of films as training aids. Instructors and educator-advisers knew the effectiveness of visual aids but did not know the techniques needed to create effectiveness. Old line Regular Army officers knew what they wanted their men to do and to learn but did not know the limitations and the possibilities of films as training aids.[144] By mid-1943 requesting agencies had learned from experience a great deal about the intricacies of training films and the Signal Corps' problems in producing them and were co-operating at every step, to the mutual benefit of all concerned.

The period of greatest productivity in the Army Pictorial Service still lay ahead, particularly in the field of combat photography.[145] Nevertheless, already a substantial record of achievement could be pointed out. During the fiscal year 1943, approximately 135,000 16-mm. prints and 24,000 35-mm. prints of training films were made available to film libraries in the United States and overseas. There were 200,000 bookings of forty-four subjects filmed for the Corps of Engineers alone. Some 655,600 still picture prints were distributed for technical and publicity use.[146]

The APS had grown from 154 officers, 531 enlisted men, and 667 civilians, at the end of June 1942, to 414 officers, 909 enlisted men, and 1,661 civilian employees by the end of June 1943. Appropriations for the photographic service had increased during the same period from less than five million dollars to more than twenty million dollars. V-mail costs alone now amounted to almost four million dollars, and within the year 273 enlisted men and 33 officers had received training in the operation of stations at the Official Photo Mail Station at Washington.[147] During the calendar year 1942 the School at the SCPC graduated 525 men, and, in 1943, 101 officers and 652 enlisted men. The Army Pictorial Service was well on its way toward the fine record of accomplishment with which it was widely credited at the end of the war.[148]

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[144] Quadow, Training Films in the Second World War, pp. 40–42.

[145] For experiences of Signal Corps photographers in overseas campaigns of 1943–45, refer to Thompson and Harris, The Signal Corps: The Outcome.

[146] CSigO, Annual Report, 1943, pp. 474, 478.

[147] *Ibid.*, pp. 478, 480–82, 485–86.

[148] For an account of APS activities in the latter half of 1943, and in 1944–45, see Thompson and Harris, The Signal Corps: The Outcome.

CHAPTER XIV

Global Communications

(Late 1942–Mid-1943)

The Design for ACAN

During World War II American and Allied command became as wide as the world and required signals on a global scale. Global communication suggests messages circling the world, clicking neatly through automatic apparatus in well-organized and well-equipped signal centers, replies to inquiries returning in an unbelievably short space of time. It is that. But military communication during World War II involved much more than that. Its modes varied from manual telegraph to automatic teletype. Its safeguarding required the utmost in codes, ciphers, and cipher machines. Its nets serving the Army's administrative and tactical communications fanned out from Washington in all directions to reach to the Army unit farthest out, sometimes a unit no larger than a single soldier dropped in a remote spot to observe and to report. The very smoothness with which the vast system worked tended to divert attention from it and from its vital purpose, except among the Signal Corps men who planned, engineered, installed, and operated it. They could say, and did, with justifiable satisfaction, that "although Congress can make a general, it takes communications to make him a commander." With this General of the Army Omar N. Bradley agreed.[1]

From Washington, the heart of the Army Command and Administrative Network (ACAN), direct wire and radio circuits enabled the Army's command headquarters to communicate quickly and, if need be, secretly, with all the major field commands, whether continental or overseas. Through the terminals of the primary command circuits it was possible to relay messages to subordinate administrative networks, to connecting tactical networks, and to the Army Airways Communications System, which constituted an independent net serving solely the needs of the Army's airways. After Signal Corps men established Army communications in an area, they strove to maintain the link back to Washington, no matter how far the troops penetrated or how many headquarters intervened.

Such was the basic intent underlying the orderly design of the Army's communications system. Essential elements of the design were dependability, flexibility, security, and speed. It was flexibility that permitted the small peacetime system to expand to war size without change in the basic pattern.

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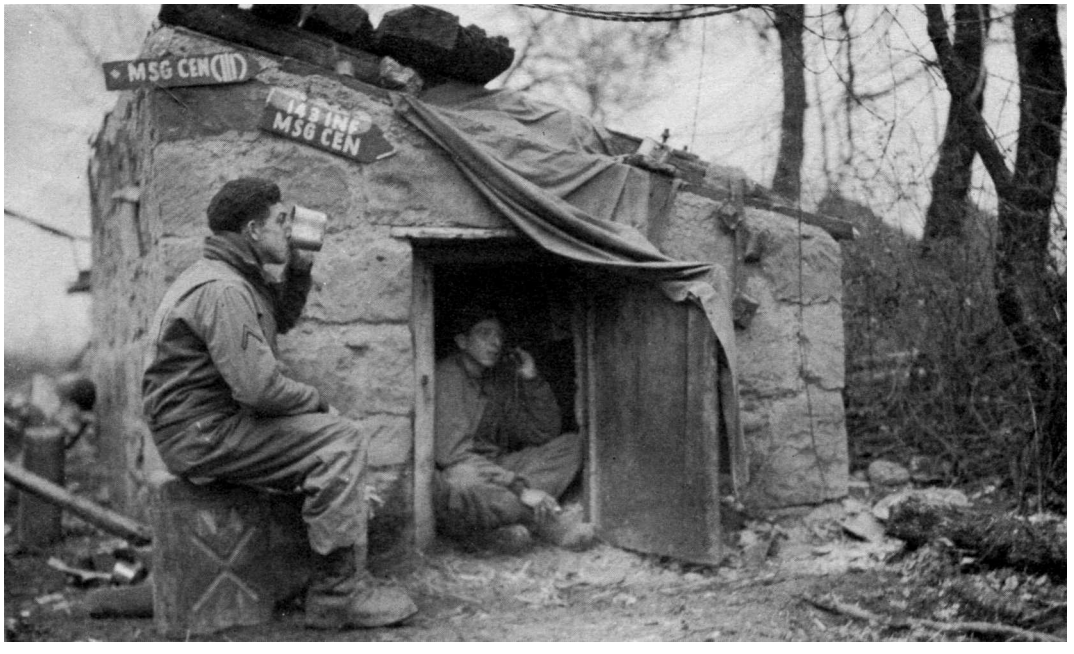
[1] Omar N. Bradley, *A Soldier's Story* (New York: Henry Holt and Company, 1951), p. 474.



SIGNAL COMMUNICATIONS FROM FORWARD TO REAR AREAS *provided the link necessary to successful command.*

Throughout the war the hub of the pattern turned on the War Department Signal Center (designated as the Message Center prior to mid-1942) in Washington. Its radio station bore the appropriate letters WAR. Thence the command network of radio and wire circuits radiated out like the spokes of a wheel to all the main headquarters of the field forces in the United States and overseas, to which new circuits were added as need arose. Then, from the outer terminals of the spokes, which in turn became the hubs, each of a separate wheel, other circuits in like fashion fanned out to field headquarters and supply areas, to tactical units right up to the front lines, even to Army transports plying the seas. Nor was ACAN limited to Army facilities. It had connections with the Navy's circuits and with the civil systems of Allied and neutral lands. And of course it utilized large portions of the private communication systems at home. Truly a gigantic communications network served the United States Army in World War II, its administrative and technical operation directed by the Signal Corps from Washington.[2]

The great civilian communications systems of America, severely taxed though they were with the transmitting of war-related civilian communications, solidly buttressed the Army's administrative signals. ACAN supplemented its own radio and wire design wherever possible with facilities leased from the Bell System, RCA Communications, Inc., Postal Telegraph and Cable Company, Mackay Radio and Telegraph Company, Western Union Telegraph Company, Press Wireless, Globe Wireless, and so on. For example, the Signal Corps had leased the entire communication system of Globe Wireless in order to supplement its own installations within the United States and in Hawaii. It had leased, effective 1 August 1942, Mackay and RCA stations near Chicago, New Orleans, Seattle, and Los Angeles.

What commercial facilities the Signal Corps did not put to use or lease for outright Army operation it included in plans for use in an emergency, in order to provide secondary circuits upon which the Army could fall back in the event that existing nets suffered damage. Thus the Signal Corps had arranged early in the war to operate the facilities of RCA and Mackay in order to provide emergency communications between WAR and the more important corps area headquarters. This was accomplished by means of control circuits which linked the War Department Signal Center and Governors Island with the stations of those companies in New York. Early in October 1942 the Signal Corps had drawn up a plan to consolidate both military and commercial facilities in the San Francisco area. The plan provided for normal, and for first- and second-alternate operation. A similar plan was implemented in the Washington area.[3] Yet, valuable though these civil facilities proved in wartime, they could not provide one of the essentials of the ACAN design, namely, that

[2] (1) Mary E. Boswell, The 17th Signal Service Company, A Component of the War Department Signal Center from World War I through World War II (1945), SigC historical monograph E–5a, *passim*. SigC Hist Sec File. (2) CSigO, Annual Report, 1943, pp. 408ff.

[3] (1) Pauline M. Oakes, The Army Command and Administrative Communications Systems, Pt. II, Signal Corps Domestic Communications Network as Extended to Overseas Terminals FY 1941–15 August 1945 (1945), SigC historical monograph E–5b, pp. 5–6. SigC Hist Sec File. (2) Memo, Col Hatch for Exec Control Div, 8 Oct 42, sub: Weekly digest of prog and problems. SigC AC 319.1 Digest, 30 Jul 42–1 Dec 44.

degree of security and secrecy which must safeguard military messages.

Security was the reef which eventually wrecked one leased experiment, an innovation called the Army Full Period Telephone Network. This was a top command domestic net intended to serve the highest Army commanders at Washington and elsewhere throughout the country when urgency demanded overriding priority of communication. Early in 1942 the sudden need for military telephone service had so overtaxed commercial long-distance trunk lines, including the long- and short-haul circuits which the Signal Corps had leased, that delays of hours in getting a telephone call through sometimes occurred. In February 1942 the Signal Corps had begun organizing the Army Full Period Network. By 1943 the system sprawled along some 32,000 circuit miles and interlaced staff offices in Washington with military commands the country over, with connections to Montreal and to points in Alaska. Heavily used and somewhat abused for the year and a half that it existed, Army's Full Period Telephone Network helped greatly to alleviate a severe military telephone problem at home during the early months of the war. It got out of hand eventually through wide and undiscriminating use by subordinate commanders. The voice scramblers employed in the net did not provide as much security as the users were prone to assume.[4]

Security, like flexibility, always remained an important element in the ACAN design. Wire therefore remained preferable to radio and, thanks to the large existing commercial wire nets within the country, ACAN traffic at home moved increasingly over wire circuits, as its radio channels within the states were gradually closed down in order to cheat the enemy of opportunities to eavesdrop.[5]

But radio remained essential to link WAR directly with overseas terminals. By the beginning of 1943 the circuit to Fort Shafter in Hawaii was converted to landline operation as far as San Francisco and to radiotype from that point. Army communication links eastward were building up heavily. Several efficient radio channels to London had come into operation. The War Department Signal Center utilized two commercial transatlantic cable circuits to the British Isles as well. Radio channels now reached from WAR directly to Algiers, to Cairo, to Casablanca, to Accra on the Gold Coast of Africa, and to Asmara,

[4] (1) Mary-louise Melia, Signal Corps Fixed Communications in World War II: Special Assignments and Techniques (1945), SigC historical monograph E–10, pp. 78–85. SigC Hist Sec File. (2) AG Ltr to CG's AGF, AAF, SOS, 1 Apr 42, sub: Army Full Period Telephone Network. AG 676.1 (3–31–42) MC–M. (3) Memo, CSigO for ACofS for Opns SOS, 10 Nov 42, sub: Army Full Period Telephone Network. SigC 676.1 Gen 6, Oct–Nov 42. (4) Ltr, Col Marriner, Dir of Com AAF, to CSigO, 11 Dec 42, sub: Request for private line to Orlando, Fla., and 1st Ind, CSigO to CG AAF, 19 Dec 42. SigC 676.1 Gen 7, Dec. 42.

Throughout 1942 home telephone facilities for the military expanded endlessly. During the one month of September there was a net gain of 95 rented systems put into service, representing 7,206 stations and 1,033 lines. In addition to these rentals, 16 new systems were installed, adding another 277 trunk lines. Memo, Col Parker for Dir of Army Com Sv, 30 Sep 42, sub: Weekly digest of prog and problems, 23–30 Sep, inclusive, Item III, 3. SigC 319.1 Drawer 483, AC 133, Weekly Digest of Prog and Problems, Rpts from Divs, 7–30–42 to 12–30–42.

[5] (1) Oakes, Army Command and Administrative Communications System, Pt. II, p. 32. During 1943 the landline teletypewriter network of the domestic ACAN system replaced the Army Administrative Radio Net at home. (2) Army Forces Staff College Lecture C–1, Employment of Communications in the Army, Pt. I, Tab 9, p. 2. SigC OP 352 (11.02) Armed Forces Staff College Rpts, 1948–49.

well down the east coast, opposite southern Arabia. Not only did WAR personnel transmit and receive, encode and decode, military messages moving directly to and from such distant terminals, but the station served also as the relay point for radio traffic between other ACAN stations which did not have direct connections. Relaying was often necessary because the demands for direct point-to-point circuits were always greater than the possibilities of providing them. For example, messages between Miami and the Caribbean area flashed first into WAR and from WAR to the destination: to Miami by way of a link from Washington to Atlanta, extended on to Miami through the facilities of the subordinate network; and to the Caribbean area by the direct channel between WAR and Panama or between WAR and Puerto Rico, which had forked connections to Trinidad.[6]

Centering also at the War Department Signal Center was a smaller local network made up of wire circuits which during 1942 linked the Signal Center, located in the old Munitions Building in Washington, with various tributary terminals, with the transmitting station at Fort Myer, Virginia, and with the receiving station at Battery Cove, Virginia, several miles to the south. But these transmitting and receiving locations soon became inadequate for the expansion required to handle the growing volume of messages. A 450-acre reservation was accordingly acquired at La Plata, Maryland, and the Battery Cove receivers were relocated there. The Battery Cove plant was then utilized as a second transmitter site complementing the Fort Myer installation. Each was capable of independent operation and included transmitters ranging from 1 to 40 kilowatts in power. By 1943 an ultra-high frequency radio system provided the control circuits between the Signal Center, newly relocated in the Pentagon, and the remote transmitting and receiving stations.[7]

Networks whose spokes radiated over the continents and spanned the seas were becoming commonplace. In the autumn of 1942 WAR added a novel spoke to the wheel—a channel to Radio Station WTE. This was a terminal which moved hither and yon over the United States aboard the President's private train. Signal Corps soldiers from WAR had installed the equipment in a railroad car. As President Roosevelt traveled across the country in the fall of 1942, inspecting Army camps and installations the length and breadth of the land, for the first time in the nation's history a President could communicate almost instantly with the White House through official communication channels. WTE had access to WAR circuits at any time, whether in motion or at stops, through any one of six War Department net stations with which it maintained schedules. It had access to the

[6] (1) Memos, Chief of ACD, for Control Div, 12–26 Nov and 3–31 Dec, sub: Weekly digest of prog and problems, *passim*. SigC AC 319.1 Digest, 30 Jul 42–1 Dec 44. (2) Ltr, CG AAF to CSigO, 19 Dec 42. SigC 676.1 Gen 7, Dec 42. (3) 1st Ind, CSigO to CG Caribbean Defense Comd, 6 Mar 43, on Ltr, CG Caribbean Defense Comd to CSigO, 28 Jan 43, sub: Establishment of supply and water transportation radio net in Caribbean area. SigC AC 665.2 Army Adm Net.

[7] The cutover of all radio channels from the Munitions Building to the new Pentagon location was accomplished smoothly on 12 and 13 January 1943. (1) OCSigO R&W Action 1, Maj T. H. Mitchell, Traffic Br OCSigO, to Chief of Traffic Br, 19 Jan 43. SigC AC 319.1 Prog Rpts Traffic Operational Engineering, 5 Jan 43–9 Nov 43. The cutover to La Plata was begun on 30 June and completed by 2 July 1943. (2) CSigO, Annual Report, 1943, pp. 424–25. (3) Memo, Gen Stoner, Chief of Army Com Sv, for Control Div, 17 Jul 43, sub: Digest of prog and problems. SigC AC 319.1 Digest, 30 Jul 42–1 Dec 44.

White House by way of a private loop from WAR and with Army commands anywhere in the world through the ACAN network radiating from WAR.

The White House station, in turn, served as the hub of a unique ultrahigh frequency network embracing, at first, five fixed and thirty-one mobile terminals. The fixed equipment was placed at strategically located points in the city of Washington. The mobile sets were installed in automobiles used by the President, the Secret Service, the Military Police, and the White House signal detachment (under Col. William A. Beasley). The Engineer Corps used one car in this radio net. Subsequently the White House network added other fixed stations, such as a terminal at Lee, Massachusetts, the temporary home of Queen Wilhelmina of the Netherlands, to whom was extended the protection of the United States Secret Service. Still other terminals sprang up along the routes which the President traveled frequently as he went back and forth between the White House, his home at Hyde Park, Warm Springs, and his Shangri-la on Catoctin Mountain in Maryland. At the main terminals of the White House network, private (PBX) telephone networks supplemented the radio system. Thus, the President was never out of touch either with the White House or with WAR, no matter how far afield he traveled.[8]

ACAN installations were extending widely as they kept up with the spreading theaters of the war. Army's radio channels and wire circuits rapidly increased to the east and the west, ultimately linking together completely around the world. Before the end of 1942 some forty-six overseas radio and cable links had come into use between the Signal Center in Washington and the primary terminals alone.[9] As American soldiers occupied lands where electrical communication was mediocre at best, or nonexistent, they nevertheless demanded good communications service immediately because they scarcely knew how to live without it. This the Signal Corps tried to provide, whether in the active theaters, or in quiet areas which soon might acquire greater strategic importance, or in areas which the war might bypass altogether. In 1942 the path the conflagration would take had not been well marked. Therefore, universally good service was the only safe objective. But there were many obstacles to achieving it, such as the shortage of equipment, the effects of latitude and ionospheric conditions on radio operation, and the lack of skilled manpower.

In peacetime the demand for fixed radio station equipment had been fairly stable. Until the nation's manufacturing capacity could be increased, it could not produce enough big transmitters, power units, antenna equipment, and associated items to enable the Signal Corps to provide point-to-point service throughout the world. While manufacturers tooled up quickly for greater production, the Signal Corps used commercial standard equipment in its expansion. Although some of the items were not entirely satisfactory, they served, with modifications, to place vital circuits in operation. Meanwhile, until commercial equipment could become available in quan-

[8] (1) Oakes, Army Command and Administrative Communications System, Pt. II, pp. 113–14. (2) Maj George J. McNally, "WTE Calling," *Signals*, 7:4 (March–April 1953), 20ff. (3) Signal Corps Technical and Tactical Training Aid (January–February 1953), p. 39. SigC Hist Sec File.

[9] Draft of Memo, CSigO for AWS Comdrs, 2 Nov 42, sub: Responsibility in connection with fixed com systems. SigC 676.1 Gen 6, Oct–Nov 42.

tity, the Signal Corps plugged the gap in supply with three million dollars' worth of equipment obtained from amateur radio operators. By the end of the war, the Signal Corps' administrative network, the world-wide fixed ACAN facilities, would build up to a value of 163 million dollars, three times the cost—an estimated 57 million dollars—of the entire international plant of all American commercial communication companies.[10]

An initial obstacle encountered in providing satisfactory world-wide radio service was magnetic absorption in the polar regions, which reduced the reliability of direct channels between WAR and some of the more strategic ACAN stations overseas. There then was no known means of overcoming this effect. But the polar regions could be bypassed. Therefore, the Signal Corps designed a belt line of communications circuits which circled the world in the vicinity of the equator. The eastward equatorial route from WAR sped by way of Asmara in Eritrea, Africa, New Delhi in India, Brisbane in Australia (later Manila was substituted when the Philippines were retaken), and San Francisco, thence back to WAR by landline. Terminals at strategic points to the north and south tapped into the equatorial belt line with secondary circuits. Thus from any point served by Army circuits, messages could be sent to any other point around the world. If ionospheric conditions in one direction were bad, traffic could readily be routed in the opposite direction to reach its destination. This around-the-world belt line was a happy solution which not only evaded the difficulty of communicating by radio over the polar regions but also facilitated communication in the event of failures or interference anywhere.[11]

Radio circuits were unpredictable at best. The British in Libya had found that at times units forty to sixty miles apart could not communicate with each other by radio, regardless of the power output they used, yet each could communicate with London. Therefore, while the condition lasted, traffic between the nearby points had been relayed through London facilities.[12] Similarly, in the continental United States, there were times when an antenna built and beamed for communication with Chicago, for example, transmitted a stronger signal to San Francisco. The operators confessed they did not know why it was so, but they found by experimenting that when signals were bad over authorized channels they could often be bettered by an unorthodox hookup. The improvement might last from minutes to weeks and months.

To correct situations of this sort was just a part of the radio operator's job, and therein lay another of the obstacles to providing good communications service on the fixed networks: the length of time required to convert a recruit into an accurate, speedy, sensitive technician capable of coping with such happenings. Training time could not be avoided or reduced. But might it not be possible to substitute automatic equipment? Indeed, the Signal Corps had already begun searching for a means of transmission that would reduce the requirements for skilled technicians. The use of Boehme high-speed equipment was the first step, but

[10] Maj Gen Frank E. Stoner, Chief of ACD OCSigO, speech before the American SigC Association, New York, 27 Feb 46. SigC Hist Sec File.

[11] Oakes, Army Command and Administrative Communications System, Pt. II, pp. 116ff.

[12] Sig Intel Sv Memo, Communications and the Staff, 1942. SigC Hist Sec File.

that was only partly an automatic process. Radiotype, another experiment in "semi-automatic" equipment, proved to be not completely satisfactory. ACAN combined, discarded, and improvised until a rapid, secure automatic system suitable for military use on the command network was achieved. This system, radioteletype, involving automatic teletype and tape relay, was incorporated in the ACAN design as quickly as possible, beginning in early 1943.[13]

In theory the Signal Corps was the sole provider of administrative military communications service. But the wide expansion of communications facilities, which the increase in the Army during the first year of the war made necessary, was not accomplished without duplication, overlapping, and division of authority. Crisscrossing the orderly design of the Signal Corps' ACAN by late 1942 were numerous independent military networks. There were the Army Air Forces Ferrying Command Network; the Air Service Command Teletypewriter Network; the Army Air Forces Statistical Control Network; the Intelligence Network; the Second Air Force Tactical Network; and the telephone and telegraph full period private line service (Army Full Period Telephone Network) of the Eastern and Western Defense Commands, the First and the Fourth Air Forces, and the Third Army. Within the Signal Corps itself was an independent system, the Storage and Issue Teletypewriter Network. In addition, the Army was consuming a vast amount of commercial circuit and channel time on a toll basis by telephone, telegraph, and TWX (Teletypewriter Exchange). The Office of the Chief of Ordnance alone was receiving and dispatching almost ten million words of message matter a month and its long-distance telephone conversations were consuming almost 1,500 hours monthly. Not all the communication arrangements were efficient. For a while the chief of one service was paying, in effect, $608 for each message which passed between his office at Washington and a field office in San Francisco, so light was the traffic on his private line in comparison with the rental cost of the circuit.[14]

Early in the war there was no central authority in the Army to co-ordinate and control leased facilities. Eventually, more than seventy-five communication installations were integrated into one network. But this integration affected only a fraction of all the domestic Army circuits. Not until late in the summer of 1943 was action taken to centralize appropriately in the Signal Corps the control of the many independent military communication systems, and then the War Department applied only a halfhearted remedy, dividing responsibility between the Chief Signal Officer on the one hand and corps area commanders on the other.[15]

This dual control was the best that could be achieved. Also, by then there developed pressure for new communications networks, such as an antisubmarine network, and an administrative communications system to be used entirely by the Army Air Forces, aside from the Army Airways Communica-

[13] See above, pp. 218–24. See also Army Forces Staff College Lecture C–1, Pt. I, p. 3.

[14] (1) Oakes, Army Command and Administrative Communications System, Pt. II, pp. 12–13. (2) Interim Rpt compiled by Lt Col Fred A. Ironsides, Jr., ASF, 23 Sep 43. SigC AC 676.1 Gen 1942–45. (3) Gen Stoner, ACSigO, speech before the Federal Communications Bar Association, Washington, 11 Jan 46. SigC Hist Sec File.

[15] (1) WD Cir 222, 21 Sep 43. (2) Maj Gen Harry C. Ingles, CSigO, address before conference of CGs of Sv Comds, Jul 43. SigC Hist Sec File. (3) Oakes, Army Command and Administrative Communications System, Pt. II, pp. 11, 13–14

tions System, which everyone conceded to be a necessary exception to the orderly communications design. At places the AACS paralleled the ACAN; at others it diverged as it followed the routes of the Air Transport Command. But the priority of the traffic it carried was such as to preclude the integration of its channels with those of the ACAN even where the circuits ran parallel. The AACS was in reality a tactical network which crossed many a jurisdictional boundary. Where the routes converged and traffic was light, the trend was to integrate the administrative into the airways system rather than the other way around. Often Signal Corps men operated administrative channels in the AACS stations; sometimes they operated the AACS tactical circuits too, although officially that was the function of the AAF. Similar co-ordination existed between the Army and the Navy where circuits ran parallel or where joint facilities existed. And paralleling circuits, in these circumstances, did not usually mean duplication. If traffic volume warranted two circuits in the same area, as it frequently did, it appeared preferable in many respects for each service to operate its own circuit. Eventually considerable standardization was achieved between the systems of the Signal Corps, the Army Air Forces, and the Navy.[16]

Speaking in mid-1943 of the relation between the AACS and ACAN, General Stoner, Chief of Signal Corps' Army Communications Division, said "It is all on a cooperative basis. Everything that has been done has been done on a cooperative basis." But co-operation sometimes failed. In military situations Stoner had no doubt that coordination should be attained by command.[17]

Organizing and Implementing ACAN

ACAN took form out of the trials and troubles of the early days of the war. Maj. Gen. George V. Strong, Assistant Chief of Staff G–2, testifying in mid-1943 before a board of officers investigating Army signals, recalled: "In March, 1942, I was directed by the Chief of Staff to look into the Signal Corps and straighten out the matter of Army Communications, where there was a terrific backlog of messages." The Chief of Staff and his staff officers, Strong noted, were encountering delays of hours and days in getting messages to field commanders and in receiving answers. "I called down General Stoner," he said, "who at that time was in charge of the War Department Message Center, and gave him a very specific mission. . . . I told him what was required and I wanted his recommendations as to how that was to be accomplished. He gave me a set of recommendations and on those, we got out a plan for the development of Army Communications." [18]

Thereafter, the Chief Signal Officer's responsibility for providing communications channels for the Army, including those for the expanding air routes, was lodged in the Army Communications Division, which in July 1943 became the Army Communications Service. Upon General Stoner, who remained the efficient chief of the activity throughout the war, the huge task devolved. The division had but one purpose—to ex-

[16] (1) Gen Stoner, Army Communications, seminar of the Army Industrial College, Dept of Research, 24 Sep 45. SigC Hist Sec File. (2) Oakes, Army Command and Administrative Communications System, Pt. II, pp. 14–17.

[17] Proceedings of Board To Investigate Communications, Tab O, pp. 2–3. AG 311 (5–10–43) (1) Bulky Pkg Army RG 207.03, Job A50–55.

[18] *Ibid.*, Tab U, p. 1.

tend the Army's wire and radio networks to service all the elements of the Army, wherever they might be, down to the point where the tactical communications troops of the ground and air forces took over. From that point on, communications became the responsibility of the field commanders under whom Signal Corps units served.

Signal Corps' Army Communications Division early in the winter of 1942–43 consisted of three units, each concerned with one of the three main essentials of military communications service: (1) the installation of the fixed wire and radio plants, (2) the movement of message traffic over the networks, and (3) the safeguarding of the content of military communications transmitted by either military or commercial means. These functions were the responsibilities, respectively, of the plant, the traffic, and the security units, headed in that order by Colonel Parker, Colonel French, and Col. Frank W. Bullock.

On 1 January 1943 the Office of the Chief Engineer, Signal Corps, came into being to assist in determining policies and formulating plans to co-ordinate the operations of these units. The Chief Engineer, Col. William C. Henry, concerned himself with plans for extending ACAN, for installing and maintaining the AACS, for providing submarine cable facilities, for manufacturing and supplying equipment for the overseas and the domestic stations of the networks, and for constructing wire and pole lines in deserts, tropical jungles, and the frozen north where a permanent Army telephone line was being built along the route of the new Alcan Highway. Equipment was scarce, so scarce that Colonel Henry had to dismantle some domestic stations and rearrange facilities in order to provide essential items overseas. For example, Boehme high-speed telegraph equipment was removed from installations in the Fourth, Fifth, and Eighth Service Commands, not because those areas did not need it, but because the needs of task forces were greater. Yet it was difficult to retrench anywhere, in view of increased demands everywhere, unless the post commanders and field signal officers co-operated. Securing agreement in such instances became another task for the new engineering unit.[19]

The equipment situation was tight—tighter than officers overseas realized. Far removed from the administrative problems at home, they knew only how meager was their supply of even the bare essentials for good communications, and they chafed at the delays in receiving what they desired. Colonel Grable, in the Southwest Pacific, nettled by his unfilled requisitions, wrote to Colonel Parker in Washington: "We have no civilian corporations across the street that we can run to in case of emergency."[20] But all the manufacturers together could not immediately produce the vast quantities of equipment needed.

Plant

In 1943 as troops moved out to overseas bases and theaters in ever greater numbers, the Army Communications Division faced tasks unprecedented in communications history. For a while the War Department gave thought to a plan for unifying the control of administrative and airways circuit in a more powerful "Army Communications

[19] (1) CSigO, Annual Report, 1943, pp. 409–10. (2) Progress and Problems Renort, Airways and Fixed Radio Br Plant Div OCSigO, 16 Sep 42. SigC 319.1 Digest of Prog and Problems 1, 1942.

[20] Ltr, Grable, Hq USASOS SWPA, to Parker, 10 Dec 42. SigC AC 333.1 Inspec Trip to South and SWPA Area, Maj A. E. Wharton, 1942.

Command." [21] The plan was not adopted. But a reorganization of Colonel Parker's Plant Branch did take place.[22] The branch had encountered much woe in carrying out its mission of getting fixed-station equipment to overseas destinations. The usual supply agencies were swamped by the task of sending large quantities of T/BA signal equipment to troops and could not be expected to give special attention to assembling the conglomeration of material required for fixed stations. In many areas even the commonest items of hardware were unobtainable, and shipments accordingly had to include everything that would be needed, down to the last bolt and nut. Moreover, field offices often requisitioned materials which did not accord with the engineering plans, or which could not be used with the power available, or which duplicated that being supplied by Plant. By instituting a careful review of such requests with an eye to conserving critical materials,[23] Plant had been able to reduce the items on some requisitions from Australia, the Fiji Islands, and New Caledonia by as much as 75 percent.[24] Further, special shipments, some large and some small, often became hopelessly hidden in transportation snarls unless they received special handling. It therefore fell to the lot of Plant Branch to follow through on fixed-station supply and eventually on entire engineering projects, from inception to completion.[25] All this meant expansion and reshaping of the Plant Branch.

Another circumstance which compelled a reorganization of the Plant Branch was its responsibility, recently restated, to supply, install, and maintain point-to-point and air-navigational communications equipment for the vast chain of navigational and communication stations which constituted the AACS, whose extent would soon exceed ACAN itself. A special part of this special system for the Air Forces pertained to meteorology. As air routes circled the earth, weather stations from the icecap of Greenland to the jungles of the tropics provided the meteorological data required for safe flying over the globe. All this particularized work to be done for the Army Air Forces made it desirable to detach the plant organization from the Office of the Chief Signal Officer and move it to Philadelphia, where it was established by February 1943 as the Plant Engineering Agency (PEA), an exempt installation—under the direct control of the Chief Signal Officer and still supervised in its operations by General Stoner.[26]

Philadelphia was selected for several reasons. There PEA would be near the big

[21] Activities of the Dir of Planning, OCSigO, 11 Nov 42. SigC 319.1 OD–1 Daily Rpt.

[22] The plant organization changed names three times in one year. During 1942, it was at first called the Plant Division, then the Plant Branch, and in February 1943 it became the Plant Engineering Agency. At the end of June 1942 the staff numbered 40 officers and 160 civilians. A year later these numbers increased to 160 and 540, respectively. CSigO, Annual Report, 1943, pp. 427–28.

[23] (1) 7th Ind, CG ATC to CG AAF, 23 Oct 42; 8th Ind, CG AAF to CG ATC (without basic ltr). SigC 413.35 Teletalk 1, Oct 42. (2) Ltr, Parker to Dir of ACD OCSigO, 20 Mar 43, sub: Com Engineering and Supply to Theaters of Opns, and 1st Ind, CSigO to PEA, 30 Mar 43. SigC 676.1 Gen 3, Mar 43.

[24] Report of Progress and Problems, Plant Br, 30 Dec 42. SigC 319.1 Digest of Prog and Problems 1, 1942.

[25] OCSigO R&W Action 1, Plant Br to ACD, 27 Oct 42. SigC 322.08 PEA 1.

[26] (1) See above, p. 287. (2) OCSigO Memo, 25 Nov 42; (3) Memo, CSigO for BOWD, 23 Dec 42, sub: Establishment of PEA in Philadelphia. SigC 300 Gen 1. (4) CSigO, Annual Report, 1943, p. 57. (5) Memo, Stoner for Control Div, 2 Feb 43, sub: Digest of Prog and Problems. SigC AC 319.1 Digest, 30 Jul 42–1 Dec 44.

Philadelphia Signal Depot and eastern manufacturing sources. Better co-ordination toward filling requisitions might be expected. Further, the Directorate of Communications of the Army Air Forces had proposed to establish an office in Philadelphia and, for that reason especially, the city had seemed the logical place for the headquarters of the Signal Corps' AACS activity. Ironically, after the Signal Corps had committed its Plant Engineering Agency to Philadelphia, the AAF decided to transfer its Air Transport Command headquarters with the attendant AACS to Asheville, North Carolina.[27] This example of poor co-operation separated the PEA and its working partner, the Technical Division of the AACS, by some 600 miles. The transaction of PEA-AACS business required the writing of four to five hundred letters a day.

The Signal Corps wrote a strong complaint, which General Somervell vigorously endorsed and sent on to General Arnold, asking that the Technical Division be moved back to Philadelphia. "That shows you," Stoner told a board of General Staff officers who investigated Army communications in the spring of 1943 that "without any control from the top . . . these three networks [ACAN, AACS, and the Air Transport Command net] can just be operated any way they want." [28] He regretted that the co-ordinated operation of the several almost independent networks in the Army had to depend upon voluntary co-operation. "There is no command control [of Army communications] at the top," he lamented. General Stoner preferred a strong over-all control of Army signals, a Signal Corps aspiration which was never attained during World War II.[29]

From its Philadelphia office the PEA operated through four field headquarters serving the four wings of the Air Transport Command at Presque Isle (Maine), Miami, Seattle, and San Francisco.[30] Procedures were experimental and experience led to changes. At first the radio engineering work for all installation projects was done at Philadelphia. A request from the Air Forces in the field for a certain type of AACS installation went to the headquarters of the Air Transport Command at Asheville for approval. Then PEA received the approved request with a directive to install the equipment. The engineers at Philadelphia usually lacked knowledge of local conditions at the site, such as its altitude, its accessibility, its position in relation to the power supply, mineral deposits in the ground which might affect operation, and so on. Maps, if available at all, were often inaccurate and incomplete. The best the engineers could do in their ivory towers at home was to produce some sort of drawing, which did not always fit the far-off situation. The Army Communications Service, hoping to correct this defect, soon redistributed PEA's engineering personnel to sector headquarters, and even farther out, to the regions into which the sectors were subdivided. With closer co-operation accomplished in the field, guesswork was reduced and delays were shortened. Plant assembly points, to be estab-

[27] OCSigO R&W Action 1, Parker to ACD, 30 Dec 42. SigC 322.08 PEA 1.

[28] Proceedings of Board To Investigate Communications, Tab O, p. 4.

[29] *Ibid.*, Tab O, p. 3. For a discussion of the problem of control over Army signals, see below, Ch. XVI, *passim*.

[30] (1) Memo, CSigO for CG SOS, 23 Nov 42, sub: ACS, and 1st Ind, CG SOS to CSigO, 28 Nov 42; (2) Memo, CSigO for BOWD, 23 Dec 42, sub: Establishment of PEA in Philadelphia. SigC 300 Gen 1. (3) AG Ltr, 21 Apr 43. AG 320.2 (14 Apr 43) OB–I–SPMOU–M. (4) AG Ltr, 15 Jun 43. AG 320.3 (12 Jun 43) OB–I–SPMOU–M.

lished later in the various regions, were to bring about a further improvement, although defects continued to abound.

As PEA came to be engaged practically full time in work for the Army Air Forces during 1943, the burden of Signal Corps planning toward its own ACAN remained with the Washington organization, specifically with the Office of the Chief Engineer and the Traffic Branch, which was wholly responsible for Station WAR and the multiplicity of activities centered there, including technical supervision of the domestic wire systems and the overseas radio and cable circuits. That supervision had been somewhat curbed by a reorganization which had given Army commanders greater control over the domestic communications agencies within their domains, including strategic terminals of overseas radio circuits. The Chief Signal Officer wanted the control of such stations centered in the Army Communications Branch of his office rather than in service commands. But General Somervell, head of the Services of Supply, declined to make an exception of even these until it could be shown that conditions were unsatisfactory and that corrective action through commanders had failed.[31]

By the turn of 1942 the amount of commercial service required by the Army was increasing rapidly. Arranging for, and to an extent controlling, this activity became a sizable Signal Corps chore. Early in 1943 a Commercial Service Branch was established in the Army Communications Division, and within two months this branch also became a field operating agency, the Army Communications Commercial Agency at New York City.[32]

Particularly trying for PEA and the Army Communications Service (which the Army Communications Division became) were the needs of encampments at home. The rate at which Army camps mushroomed in population made it imperative that efficient telephone service be supplied quickly, indeed almost overnight. Camp Edwards, Massachusetts, provided a typical picture of a telephone plant serving a camp of many thousands of men. The plant consisted of a rented 12-position, type 605–A Western Electric switchboard with 800 lines and 17 city trunks to the Cataumet central office, 4 city trunks to the Falmouth central office, and 4 tie lines; 558 lines and an additional 137 bridged instruments served a total of 695 stations. It was estimated that the existing 12-position board allowed 770 of the available 800 lines to be utilized and 962 stations to be served. But cables to the Cataumet central office were already congested and any relief could come only through the release of cable pairs in use by the civilian population of the community or by the curtailment of pay-station service for soldiers.[33]

[31] (1) Memo, CSigO for CG SOS, 23 Nov 42, sub: Army Com Sv, and 1st Ind, CG SOS to CSigO, 28 Nov 42. SigC 300 Gen 1. (2) Ltr, CSigO to CGs All Sv Comds, 16 Dec 42, sub: Priorities. SigC 676.1 Gen 7, Dec 42. A case of unsatisfactory message flow in a signal office under a service command arose in the Transportation Corps where complaints were bitter about slow message service for ship bills of lading between New York and London. Joseph Bykofsky and Harold Larson, *The Transportation Corps: Operations Overseas,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1956), Ch. III.

[32] (1) Signal Corps Administrative Log, 1939–1945, OCSigO Orgn Charts No. 23, 1 Apr 43, and No. 26, 1 Jul 43, pp. 79–89. SigC Hist Sec File. (2) OCSigO Office Order 84, 9 Apr 43, par. 6.

[33] Inspection Rpt, 1st Lt K. F. McKittrick, ACD OCSigO, 4 Nov 42, sub: Telephone traffic facilities, Camp Edwards. SigC 676.1 Gen 6, Oct–Nov 42. For a general discussion of communication needs of Army camps, see Terrett, *The Emergency,* pp. 237ff.

At each camp and post the situation differed. The Plant Engineering Agency had constantly to survey and revise the wire systems to keep them in balance and to conserve such materials as were in critically short supply. By redesigning the construction plans for the outside telephone plant at the Navajo Ordnance Storage Depot, Plant engineers found it possible to reduce the requirements for scarce copper by 7,700 pounds; lead-covered sheathing by 46,800 feet; jute protection by over 67,000 feet; and telephone instruments by 68.[34] At Camp Devens, with 30,000 men, the ratio of working lines to total stations was much higher than at Camp Edwards and engineers were endeavoring to reduce telephone facilities there also.

There was no general policy for the assurance of wire facilities in case of damage or overloads. In some areas alternate routings were provided. The basic need was for a prearranged system of call controls fully co-ordinated with the local telephone companies, which would implement emergency plans in the event of disruption of the regular facilities.[35] Until a situation arose in Biloxi, Mississippi, which suggested what might happen in a major emergency, no arrangements had been made with the telephone companies to keep circuits open in times of stress for headquarters calls. All the soldiers stationed there had been called to duty by spot announcements over local broadcasting stations. As a result, so many of them had telephoned the camp for information that central office trunks were overloaded and there had been no possibility of making important outgoing calls.[36]

Toll service, too, suffered from unthinking use. The holding of a connection from a camp near Lincoln, Nebraska, to Los Angeles for an hour and forty-five minutes caused the War Production Board to recommend a three-minute limit on private calls. But General Stoner was reluctant to curb a soldier's conversation to that extent except as a last resort, and he declined to concur in the recommendation.[37] Control of commercial communications in the United States relied in the main upon the good faith of the individual citizen. The Board of War Communications, of which the Chief Signal Officer was a member, established a system of priorities for telephone calls essential to the war effort or to public safety, with penalties for violations, but there was no monitoring or listening in to detect violations. The success of the system depended upon the conscientiousness of the persons calling.[38]

One of the largest single telephone projects inside the United States with which the Signal Corps was concerned was not at an Army camp. It provided communications for the Hanford atomic energy site, a large area under the Manhattan District in the state of Washington. Because a number of independent telephone companies, as well as the Pacific Telephone and Telegraph Company, normally operated in the area, it was considered necessary that the Signal Corps furnish the telephone service

[34] Report of Progress and Problems, Plant Br, 11 Nov 42. SigC 319.1 Digest of Prog and Problems.

[35] OCSigO R&W Action 1, Col French, Traffic Br OCSigO, to ACD, 19 Feb 43, sub: Emergency protection measures for Army telephone systems. SigC 676.1 Gen 6, Oct–Nov 42.

[36] (1) Inspection Rpt, 1st Lt K. F. McKittrick, 28–30 Sep 42, sub: Telephone traffic facilities, Ft. Devens, Mass.; (2) Ltr, L. W. Hill, Southern Bell Telephone Co., to Hq Fourth Sv Comd, 12 Nov 42. SigC 676.1 Gen 6, Oct–Nov. 42.

[37] Ltr, Dir of Com Equip Div WPB to Stoner, 3 Dec 42. SigC 676.1 Gen 7, Dec 42.

[38] Board of War Communications Order 20, 8 Oct 42, with explanatory note, 29 Oct 42. SigC AC–97.

in order to avoid any confusion which might focus attention on this highly secret plant "for manufacture of materials." So read the directive to the Chief Signal Officer. This project, launched in January 1943, called for 600 telephones in the administrative area, another 300 for plant operations, and 90 pay stations; also 100 individual lines and 950 two-party telephones to serve the population of the town housing the workers.[39]

This order alone would make a big dent in the nation's stockpile of telephone equipment. Even the use of interoffice communicating systems was cutting into the low supply of telephone instruments to such an extent that the War Production Board clamped down on these.[40]

The War Production Board's restrictions on commercial communications applied to services for the military, just as they applied to the usual service for the civilian population. The installation of automatic telephone exchanges of over 100 lines was forbidden. Companies were required to estimate and report to the board the costs of any needed materials and to locate old equipment for use if possible. If new equipment had to be used, permission to install it had to be obtained from the War Production Board. For months the Signal Corps corresponded with the board, seeking to relax the restrictions as they applied to military necessities under which telephone or teletypewriter systems might immediately, day or night, have to be relocated, supplemented, or rebuilt. A situation in the First Fighter Command was cited as an example. The command planned to move a unit to Windsor Locks, Connecticut, and asked ahead of time for the installation of a teletypewriter circuit to that location, but not until four days after the unit arrived was the communications link provided. The telephone company had new equipment on hand, but no old. Before it could use the new, it had to secure the permission of the War Production Board. The Signal Corps pointed out that if an air raid had occurred in the interim, there would have been no sure means for alerting the unit. General Stoner proposed that the commanding generals of the defense commands be given broader authority to act in such instances, but the board was rather apathetic to his proposals.[41]

Traffic

The Traffic Branch of the Army Communications Service, under Colonel French, the officer charged with the War Department Message Center on Pearl Harbor day, continued to handle ACAN operation, centering in radio station WAR. Message loads, "traffic" in the terminology of the communicator, soared—radio, wire, teletype, and then radioteletype, both over Army facilities and over leased commercial lines. Leased facilities alone, which handled some 853,644 words at the Message Center in the first week of June 1942, carried double

[39] (1) Ltr, Dist Engr Manhattan Dist U.S. Engr Office to Maj Gen W. D. Styer, CofS SOS, 13 Jan 43, sub: Telephone rqmts, and 1st Ind, WD SOS to Stoner, 13 Jan 42. ASF CofS File, Sig Officer, Office of the Chief. (2) Capt Lloyd B. Dodds, History of Plant Engineering Agency Army Communications Service, 1941–1946, p. 181. SigC Hist Sec File.

[40] Ltr, Dir of Com Equip Div WPB to Stoner, 26 Nov 42. SigC 676.1 Gen 6, Oct–Nov 42.

[41] (1) WPB Gen Conservation Orders Nos. L–41 and L–50; (2) Ltr, Col Henry, Chief Engr ACD, to Dir of Com Equip Div WPB, 24 Feb 43. SigC 676.1 Gen 2, Feb 43. (3) Ltr, Stoner to Chief of Com Br WPB, 6 Nov. 42. SigC 676.1 Gen 6, Oct–Nov 42.

that load by the last week of October, an estimated 1,727,960.[42]

Teletypewriter traffic in particular multiplied again and again. TWX, Teletypewriter Exchange, a service provided by the Bell System, was an application of telegraph, or more precisely, of the teletypewriter. It had long served commercial interests and it now served the Army increasingly. On 1 July 1942 TWX military stations within the United States numbered 408. By the spring of 1943 they numbered 1,776. During the same period of time, leased-line teletype and voice circuits multiplied from 167 and 1,055, respectively, to 440 and 2,268.[43]

Radio station WAR and the associated Message Center provided more than simply a communications office for the War Department and a center for the entire ACAN system. It also served as a proving ground, a place for testing new projects, new equipment, and new methods touching communication operations. Concomitantly it provided a training ground for many of the men who manned the wire and radio nets. New developments in methods and in equipment had their tryouts there. Improvisation continued, as in the days of prewar poverty. Suitable equipment was still scarce and extraordinary demands were made on the makeshifts. WAR had the task of integrating into the primary command network the many signal centers which sprang up faster than they could be adequately supplied and faster than men could be trained to operate them.

From the time of the establishment of the radio network in the 1920's, one of its primary purposes had been to train operators and maintenance men in their wartime duties. The necessity for doing so did not abate with the building of big training centers in World War II. At best, school training stopped short of work experience. Yet General Somervell had been emphatic that only men who were experienced in operating the domestic network should go into the more important fixed stations on foreign soil. Thus, as messages transmitted by ACAN increased many times over, the provision of experienced communications cadres for the overseas fixed stations was a consistently increasing drain on WAR, and on the other stations of the domestic network, to which only a small nucleus of highly skilled enlisted and officer specialists was permanently assigned. At WAR, where the message volume was exceptionally heavy, operators newly graduated from the schools, lacking experience, were unable to pass the traffic along live circuits at a satisfactory

[42] (1) Memo, Stoner for Exec Control Br, 11 Jun 42, sub: Prog rpt 40, 4–10 Jun 42, Item 5a. SigC (AC) 319.1 Weekly Prog Rpt Army Com Br, Dec 41–Jun 42. (2) Weekly Digest Traffic Br, Col French, 28 Oct 42, Item II A 1. SigC 319.1 Drawer 483, AC 133, Weekly Digest of Prog and Problems, Rpts from Divs, 7–30–42–12–30–42.

In mid-1942 Colonel French reported the gross messages sent and the estimated work load for the week of June (22–28 inclusive) as follows:

	Gross Messages	*Gross Words (Estimated)*
Total Volume . .	85,673	4,401,844
Radio	49,317	2,564,484
Leased Wires	21,500	946,000
Telegraph	14,856	891,360

Memo, Stoner for Exec Control Br, 2 Jul 42, sub: Prog rpt 43, 25 Jun–1 Jul 42, Item 5a. SigC (AC) 319.1 Weekly Prog Rpt Army Com Br, Dec 41–Jul 42.

Compare these figures with the report of War Department Signal Center traffic a year later, for the last two weeks of June 1943: gross messages, 443,498; gross words, estimated, 29,900,028. Memo, French for Dir of Army Com Div, 3 Jul 43, sub: 15-Day summary of traffic. SigC AC 319.1 Digest, 30 Jul 42–1 Dec 44.

[43] Oakes, Army Command and Administrative Communications System, Pt. II, p. 13.

pace, even under supervision, and were therefore unable to gain the experience they needed. Some other means of developing speed and assurance in the fledglings had to be resorted to. WAR and the 17th Signal Service Company accordingly set up training courses for the operators who, when they became able to stand the pace, would be assigned to stations beyond the Atlantic.[44]

Similarly, the big ACAN station, WVY, at San Francisco conducted a comparable school for operators destined for the Pacific area. The courses consisted of approximately three months of training for radio operators and six weeks for code clerks and IBM radiotype technicians. The actual time the students remained in the schools depended, as at other training centers, upon the demands of the theaters for specialists. The graduate students first went through a period of operating under supervision and under actual working conditions but on simulated circuits. When a student gained proficiency on such practice lines, he was given a live circuit to work, under the close supervision of the regular operator. When he had mastered that and attained a satisfactory speed—just when he was becoming of some value to WAR or WVY—he was ready for assignment to an overseas station. Speed, however, was not the only qualification required. There were joint and combined radio procedures to be learned and radio discipline to be observed.[45]

Some reports from the field placed speed as a requirement secondary to a thorough understanding of net procedure—the knowledge of how to set up radio communications with other stations in the field and of how to transmit and receive accurately and surely under combat conditions. The reports pointed out that the field operators in tactical nets, with whom the fixed-station men would communicate in Morse code, were usually in the 15- to 20-word-a-minute class anyway. But neither speed nor knowledge of radio procedures could be acquired without experience. Field station operators badly needed practice in code and training in tape transcription. Yet they often lacked the equipment upon which to practice after they arrived overseas.[46]

There were also complaints that fixed-station operators who had been taught net procedure frequently did not route the traffic; it was done by message center clerks, who had had no training in net procedure at the training centers from which they had come.[47] Complaints differed according to the viewpoint of the commander or the inspector and according to differing local situations. General Olmstead noted during his inspection trip to the overseas theaters in the spring of 1943 that manual radio operators insisted upon transmitting with unnecessarily high signal strength, which caused needless interference to other radio stations, while they themselves were unable to receive signals through even moderate interference. He wanted all communications units taught to depend to a greater extent

[44] *Ibid*, pp. 65–68.

[45] Combined American-British radiotelephone procedure was approved by the Combined Communications Board on 9 December 1942. CCB 67/1 (corrected), 12 Dec 42. SigC 676.1 Gen 7, Dec 42. Joint Army-Navy Procedure, JANP, had been already instituted in the Pacific Theaters in September 1942.

[46] Msg, Maxwell, Cairo to AGWAR, 20 Aug 42, CM–IN 7242. SigC 311.2 Gen—Cablegrams MT–206.

[47] Ltr, Col Louis Cansler, Actg Chief of P&T Sv OCSigO, to CG ESCRTC, 15 Jul 43, sub: Msg center clerk tng. SigC 353 Ft. Monmouth 2 (RTC) Jun–Jul 43.

on radio in case wire failed during intensive bombardment by the enemy.[48]

But somehow, with surprisingly few failures, the Army's communicators accomplished their jobs despite initial inexperience and shortages of facilities. They became skilled through working the circuits under seemingly unworkable conditions. They came to believe that only by eternally plugging at the job through static or man-made interference could an operator learn to recognize under stress the tone of the signals intended for him as surely as a baby recognizes its mother's voice. Necessity accomplished what training could not.

By 1943 replacement training centers and schools in the United States, as well as Station WAR, had initiated more intensive training for fixed radio station teams. Practice circuits extended from WAR to Fort Monmouth and to Camp Crowder. Radio operators, code clerks, message center clerks, and message center chiefs were receiving highly practical training through this means.[49] Officers to be assigned to fixed stations overseas also were receiving practical experience in their duties at WAR. Most of the students were fresh from Officer Candidate School. WAR taught them the rudiments of all phases of signal center operation, including a smattering of cryptography and traffic security. Beginning with groups of 20 in October 1942, the program soon expanded to accommodate classes of 110.[50]

But even with these extra measures of practical training, both officers and men still lacked seasoning in net operations as they scattered over the world to become individually responsible for the important links in the command chain of communications. The stations of the even more extensive AACS were no better off for seasoned men. Although the operation of these latter stations was the responsibility of the Army Air Forces, in many places Signal Corps men and airmen worked side by side and often interchangeably on the administrative and air operational circuits with the odds in skill going to the Signal Corps men.[51]

Security

The functions of the third of the main subdivisions of the Army Communications Division, the Army Security Branch (which supervised the Signal Security Agency, a field installation shrouded in secrecy at Arlington Hall and Vint Hill Farms, Virginia) were, in brief, to preserve the security of the communications of the United States Army through the compilation and distribution of codes and ciphers (one security system in use, one in reserve, and one at an isolated point on the way to each holder of a system at all times) and to acquire as much enemy information as might be gleaned by piercing the enemy's security defenses. Throughout the war a weak point in maintaining the secrecy of messages was the number of persons who saw practically every one of them. A survey in the War Department showed that number to be from

[48] OCSigO R&W Action 1, Col William D. Hamlin, Exec Officer, to Sig Troops Div, 13 May 43, sub: Discipline of radio nets. SigC EO 333.1 Directives (CSigO's trip) 1943.

[49] (1) Ltr, Gen Van Deusen, CG ESCTC Ft. Monmouth, to CSigO, n.d., sub: Rpt on status of 822d Signal Fixed Radio Station Co, and 1st Ind, OCSigO to CG ESCRTC, 5 Feb 43. SigC 352 Ft. Monmouth 1, Jan–Feb 43. (2) Daily Prog Rpt, Radio Sec, Traffic Br, 16 Apr 43. SigC AC 319.1.

[50] WD Press Release, 23 Oct 45.

[51] This despite a difference in pay which in 1943 averaged $1,152 per year for Air Forces enlisted men and for Signal Corps enlisted men only $780. Charles P. Baer, Personnel Classification in Army, Navy, and Air Forces, May 1947. Armed Forces Staff College M–20.

300 to 500. In General Stoner's opinion, it was this fact which constituted the "big leak" in secret information.[52]

Aside from the compilation and use of codes, there were many other aspects to communications security and many opportunities for the unknowing or careless violations which were chargeable to military men of all ranks. Message senders frequently were unaware of what constituted breaches of security. A radiogram sent to a newly occupied area in the Pacific, for example, although in code, carried the address in the clear, thus revealing the presence of troops moved secretly to the island.[53]

Also, security required that the enemy's radio traffic be constantly analyzed for the cumulative picture it might give. Against enemy analysts, the Signal Corps security organization effectively used deceptions in American transmissions, such as padding traffic, setting up dummy stations, and other radio camouflage. Such radio forgery was an art practiced by the enemy also with great energy. Wire communications were likewise subject to interception and under certain circumstances the use of codes, ciphers, and authenticators was as necessary on wire circuits as on radio channels.[54] Telephone privacy equipment, or voice scramblers, were in great demand by commanders but they did not completely safeguard conversations. Since they gave users an unwarranted assurance of safety, they constituted something of a risk and their use was sometimes frowned upon.[55]

Verbose messages were a constant concern. They gave the enemy intercept service too much material to analyze, thus jeopardizing codes, and they cluttered up radio channels unnecessarily and overburdened the operators. The Signal Corps continually urged users of the networks to cut down verbiage. But the brevity of "We have met the enemy and they are ours" was seldom achieved.

The Army's monitoring activity gained greater headway in September 1942 with the opening of the Vint Hill Farms station, a part of the Signal Security Agency, located near Warrenton, Virginia.[56] The Federal Communications Commission also had an elaborate monitoring and intercept system in operation. In February 1943 Admiral William D. Leahy, acting for the Joint Chiefs of Staff, questioned the usefulness of the Federal Communications Commission's

[52] (1) Oakes, Army Command and Administrative Communications System, Pt. II, p. 54. (2) Stoner, Army Communications, 24 Sep 45, p. 7.

This secret Signal Corps activity, under the name Signal Intelligence Service (SIS), commanded by Lt. Col. Rex M. Minckler, numbered 181 officers, enlisted men, and civilians in Washington and 150 in the field at the beginning of World War II. The activity, quickly outgrowing its quarters in Office of the Chief Signal Officer headquarters, moved in mid-1942 to Arlington Hall, formerly a private school, with ample grounds for expansion, located in Arlington, Virginia. Army Security Agency, Mar 48, A Lecture on the Origin and Development of the Army Security Agency, 1917–1947 (unsigned), pp. 29–33. SigC Hist Sec File.

[53] 1st Memo Ind, ACSigO to CofS, 27 Feb 42, on Memo, Asst Secy WDGS for TAG, and CSigO, 25 Feb 42. SigC 311.23 Gen.

[54] WD, Signal Communications and the Staff, Feb 43. SigC 380.01 SMI, 1941–43 (CEB).

[55] (1) 2d Ind, CSigO to Chief of Transportation, 7 Nov 42, on Ltr, Brig Gen J. R. Kilpatrick, Hampton Roads POE, to Chief of Transportation, 30 Oct 42, sub: Spec telephone facilities. SigC 676.1 Gen 6, Oct–Nov 42. (2) In the early years of the war the radiotelephone conversations between Roosevelt and Churchill, though scrambled, were unscrambled by German experts and placed on Hitler's desk within a few hours after their interception, according to a German authority. Wilhelm F Flicke, MS, Pt. III, pp. 251–54. SigC Hist Sec File.

[56] Prog and Problems Rpt, Airways and Fixed Radio Br, 16 Sep 42.

activities in this field, and sought the transfer to the Army of FCC manpower and equipment employed in radio intelligence work. He assumed that FCC was duplicating work being done better by the military services, and that its system was endangering the security of military radio intelligence. No decision was reached until early fall when President Roosevelt, apparently with the concurrence of the Chief Signal Officer, declined to order the cessation of FCC's radio intelligence efforts.[57] Before the landings in North Africa, when it was essential that the Army know immediately of any hint from enemy or neutral countries that a counteroffensive was on the way, signalmen in the security organization monitored all major foreign broadcasts—those emanating from Algiers, Rome, Berlin, Madrid, Stockholm—translated them, and had the information they contained in G–2's hands at Gibraltar in a matter of minutes.[58]

There were many aspects to safeguarding the Army's message traffic which entailed continuing and constant vigilance to see that safe means of transmission were employed. The Atlantic submarine cables, for example, were suspected of being an unsafe means of transmission. The largest concentration of them lay in shallow water along the eastern seaboard and to the south, waters in which the greatest volume of sinkings of Allied vessels occurred. The area of the Caribbean was important in 1942. To the Navy it was the scene of U-boat attacks upon vital coastal shipping and of possible threat to the Canal; to air transport, it was the first leg of the long ferrying route to the east and north, and to defensive and offensive planning alike, it was the first zone of communications.[59]

The interruption of submarine cables had been a matter of concern to Colonel Sadtler soon after America's entry into the war and he had directed Maj. Clinton B. Allsopp of his office to study the possibility that they might be tapped by induction methods. Major Allsopp's report had been skeptical of the results that interceptors might obtain. His opinions were shared by engineers and officials of the commercial cable companies, who had felt that although eavesdropping might be tried, the possibility of intelligible signals was remote.[60] Therefore, as long as the cables remained uninterrupted, the users put aside concern about their security.

A break in a commercial cable in the Caribbean area in August 1942, however, had brought the matter to the fore again. By autumn it was conceded that perhaps the cables had not been cut because they were serving the enemy too well. The overseas messages of commercial shipping and marine insurance concerns, by government decree, had been confined to submarine cable transmission on the assumption that underseas wire provided greater security than radio circuit.[61] But now it seemed possible that the enemy had not cut the cables because the Germans and Japanese found them valuable sources of intelligence. So reasoned the Signal Corps, and in October, with the assistance of the Navy, Signal Corps engineers conducted tests off Long Island which

[57] *Congressional Record*, 78th Cong, 2d Sess, Vol. 90, Pt. I, 835ff; Pt. 2, 2719ff; Pt. 3, 3201ff.

[58] Speech by Gen Stoner to American Signal Corps Association, New York, 27 Feb 46, p. 10. Tab A, Com File. SigC Hist Sec File.

[59] Memo, E. K. Jett, Chairman Coord Committee, to Bd of War Com, 4 Sep 42, sub: Inauguration of emergency radiotelegraph circuit between New York and San Juan, Puerto Rico. SigC AC-91.

[60] Memo, Allsopp, ACD, for Sadtler, Chief of ACD, 7 Jan 42. SigC AC–94.

[61] Board of War Communications Order 28, Oct 42. SigC AC–97.

revealed that there was not a type of submarine cable signal which could not be detected and recorded. Thereafter cable users were required to encode all messages.[62]

However, postwar investigations in Germany and in Japan failed to uncover any evidence that the enemy ever intercepted messages passing through deep sea cables. In fact, the cables were rarely cut because of the difficulties involved, according to Maj. Gen. Francis L. Ankenbrandt, a Signal Corps officer who transferred to the Air Forces.[63] Furthermore, submarine cables were devoted principally to commercial, not military, use. The Army depended upon its ACAN radios, whose transmissions were protected from enemy cryptanalysts by Signal Security Agency's highly complicated and foolproof cipher machines. In these the Signal Corps took special pride. "There isn't anybody else that has got automatic coding that we know of at the present time," General Stoner told a board of officers in Washington on 24 May 1943, adding with understandable pride that the ACAN "is the finest network in the world." [64]

From the Caribbean to the Middle East

The invasion of North Africa gave impetus to communications all along the South Atlantic routes—to the long-established ACAN stations as in Panama and Puerto Rico, and especially to the very new AACS stations. For air transport was vital. And vital to it were ever more airfields and ever more radio and navigational aids. By the end of 1942 the estimate for airfields stood at 900, to be built within a year and a half. As the Air Transport Command mapped its sky routes, Signal Corps' Army Communications Service charted chains of fixed radio stations. Greater distances than ever before were involved. Whereas transmitter powers of 100 to 400 watts had previously sufficed, now outputs of 3 to 10 kilowatts became necessary. To handle large traffic loads signalmen were now installing more and more radioteletype and automatic enciphering equipment. These very new devices required better antenna systems. Space diversity, frequency diversity, and polarization diversity of antenna arrays became standard in order to eliminate fading effects at high frequencies over long-range radio circuits which depend upon sky waves reflected from the ionosphere.[65]

In general, commercial equipment of every description eked out the meager stocks with which the Army Communications Service met AACS needs. Last minute changes in Air Forces requests, improper marking of shipments by manufacturers, conflicting instructions from the Air Forces and the Signal Corps, the inability of manufacturers to produce on schedule, scattered supply sources, substitution of items—all these complicated the supply of equipment. There were organizational complications also. Col. Francis L. Ankenbrandt, Signal Officer of the United States Army Forces

[62] Memo, Gen Code, for CG SOS, 26 Oct 42, sub: Tests on security of cable com. SigC 676.4 Intercept.

[63] Ltr, Gen Ankenbrandt, USAF ACOS Communications, Hq Allied Air Forces Central Europe, to Gen Ward, Chief of Mil Hist, DA, 13 Mar 52. SigC Hist Sec File.

[64] Proceedings of Board to Investigate Communications, Tab O, p. 12.

[65] (1) Memo, Col Parker, Plant Br, Funds Required for Expansion of Procurement Program for Fixed Communications Equipment for Task Forces and Other Miscellaneous Activities and for Necessary Labor Involved for Construction and Installation; (2) OCSigO R&W Action 1, Parker to Army Com Sv, 20 Nov 42. SigC 121.2 Task Forces 1, 1942.

in the South Pacific Area, touched upon a central problem when he commented in June 1943 that "all of the dealings with the AACS all the way back to Washington have a tinge of the old 'Air Corps-Signal Corps' battle," which resulted in "lack of complete understanding . . . and considerable petty wrangling." [66]

Evidently the arrangements of Signal Corps' Plant Engineering Agency, under Colonel Parker in Philadelphia, were somewhat unrealistic. For example, PEA's engineers, accustomed to peacetime commercial practices and remote from the AACS stations for which they were prescribing, sometimes returned requisitions to their sources with a high, wide, and handsome authorization to buy locally, when the installation for which the items were needed stood hundreds of miles away from a dealer's shelves. To draw an illustration from the Pacific area, PEA's field headquarters at San Francisco, which was intended to look after AACS needs in the Pacific through Hawaii, was still too remote. "The fact that your office," Ankenbrandt wrote to the Office of the Chief Signal Officer, "persisted in handling all of our projects and the engineering concern from Hawaii, 4000 miles away from where the work is actually being done does not help matters, either. Hawaii, San Francisco and Washington are all too far away to be able to do the detailed projecting and engineering which is required at each site." [67]

To avoid as many complications as possible, PEA initiated the practice of assembling fixed-station equipment for overseas, shepherding it to the assembly point and to the dock, and then actually supervising its loading on the vessel. Equipment for one remote but vital station was gathered from supply sources scattered throughout the eastern portion of the United States. Officers and civilian engineers, who were flown from PEA to the various locations, personally convoyed the entire shipment to the port of embarkation and saw it on board—all within thirty-six hours—"not properly handled but it made the boat." [68] Even then, General Stoner was to complain that Colonel Parker's organization lacked one thing, a "whip cracker" to get things done.[69]

In setting up the fixed stations for the AACS, the Corps of Engineers did the preliminary work—cleared the ground, dug holes, anchored poles and guy wires, and erected the shelters and antenna towers—either with their own troops or with labor secured through local contracts. The Signal Corps installed the communications equipment and the Air Forces operated it, a division of responsibility which had been vigorously debated and finally confirmed during the course of 1942.[70] But in practice this division of labor was not always followed. There were places in which the Signal Corps had to do the construction work because the Engineers were not there. There were times when the Army Air Forces helped. Sometimes the Signal Corps even operated the installations.[71]

[66] Ltr, Ankenbrandt to Lanahan, 5 Jun 43, SCIA File 8 (see Bibliographical Note), Ankenbrandt-Newhouse Rpts, 1.

[67] *Ibid.*

[68] OCSigO R&W Action 1, Maj W. C. Thomas to Chief of Plant Br, 20 Dec 42, sub: Inspec trip to Richmond holding and reconsignment point, Bell Bluff, Va., and Hampton Roads POE. SigC 319.1 Inspec Rpts.

[69] Memo Routing Slip, Gen Stoner (unsigned but in his handwriting) to Col Treest, 19 Aug 43. SigC 321 Plant Engineering CEB, Dec 42–Dec 45.

[70] (1) CSigO, Annual Report, 1943, p. 57. (2) See above, pp. 281ff.

[71] There were also difficulties in apportioning responsibilities between the Corps of Engineers and the Signal Corps, especially in Trinidad, in 1942. See above, p. 107.

A most difficult task for the signalmen, when the Engineers were absent, was surveying the antenna layouts, where any appreciable error in computing the great circle courses could nullify the effectiveness of the whole antenna array by misdirecting the radio beam.[72] The Engineers had their troubles, too. Signal Corps engineering plans for installations in faraway places seldom anticipated the extent to which conditions varied in the different areas, even in the same part of the world. Along the South Atlantic ferry route, for example, soil ranged from sand dunes at Atkinson Field in British Guiana to swampland at Waller Field in Trinidad; from rock that had to be blasted at Ascension Island to areas of level, well-drained clay land along a part of the northern coast of Brazil. To anchor poles in the sandy soil of British Guiana, the Engineers cut the tops and bottoms from steel oil drums, welded two drums together, set the pole in the cavity, and filled it in with cement to provide a strong footing.

Transporting poles was a knotty problem and never-ending. They took up so much cargo space that wherever possible they were obtained locally. Those for the Brazilian stations were floated down the Para River from the jungle. The 70-foot poles for the rhombics were especially hard to get and to transport, and their weight of about 3,000 pounds called for heavy lifting equipment. Because it was so difficult to transport the unwieldy antenna supports, either locally or from the United States, the Signal Corps often resorted to the use of substitute wooden antenna towers. The variety in poles used for communications installations throughout the world was probably greater than that in any other item of equipment—steel poles and wooden poles, the latter ranging from light bamboo to hard mahogany. Even live trees were used. Inside equipment for the stations also comprised a variety of components, but every effort was made to standardize the transmitters and receivers. Everywhere, from 1943 on, Signal Corps teams from the Plant Engineering Agency provided radioteletype facilities for the world-circling stations of the AACS.[73]

Like Signal Corps' own ACAN system, the AACS chain suffered not only from the general scarcity of equipment but also from the hazards of shipping. Consignments from the United States often arrived minus important pieces, with generator castings smashed, shafts and dials jammed, and wires severed. The breakage of ceramic insulators was heavy. Crystals, roughly handled in transit, reached their destinations in poor condition. And because the AACS was a new project, the assignment of frequencies for the system, even in areas contiguous to the United States, necessitated months of negotiation, experimentation, and revision.[74] In areas beyond the Atlantic the problem was further aggravated by a complexity of international interests.

The flying route of the South Atlantic Wing of the Air Transport Command (the area in which the Southeastern Sector of PEA operated) began in Miami. Following down along the Antilles chain of island bases over the Caribbean, it skirted the northern coast of Brazil: Georgetown, Paramaribo,

[72] Incl 1, Memo on Training of Fixed Station Teams, Majs James A. Greene, Jr., and Ira P. Doctor, to OCSigO R&W Action 1, Col Carl H. Hatch, ACD, for PEA, 29 Apr 43. SigC 676.3 Gen.

[73] (1) Melia, Signal Corps Communications in World War II, Ch. I. (2) Capt Sidney L. Jackson, Radnese "100": Chapter II of International Radio Circuits (1944), SigC historical monograph E–2b, *passim*. SigC Hist Sec File.

[74] CSigO, Annual Report, 1944, p. 143.

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Belem, and Portuleza, to Natal, the easternmost point of South America. Across the ocean on the Gold Coast of Africa, Accra provided a logical terminus for planes flying the southern route at a time when Dakar was held by the Vichy French while the Axis nations controlled most of northwest Africa. Between the Brazilian bulge and the Gold Coast, however, stretched the South Atlantic, which few planes of those days could span without refueling. Strategically located midway, tiny Ascension Island provided an airbase where Signal Corps units installed AACS radio, navigational aids, and search radar.[75]

As the plans for communications along the South Atlantic route were changing before they could be implemented, the Africa-Middle East Wing of the Air Transport Command extended the air ferry overland in Africa, and the RADME (Radio Middle East) network began to take shape. It connected with the RADNESE (Radio North-East South-East) at Marrakech, French Morocco, and it continued on across North Africa to Abadan, Iran, and thence to Karachi, India. Karachi marked the end of the RADME network and the beginning of another which would take the line of AACS stations on to Calcutta, Chabua, and Kunming, and eventually, by 1945, back to Manila. When completed, the AACS would possess a world-wide radioteletype network, paralleling the ACAN system.[76]

The fluidity of war caused many changes in plans. Often the fixed installations of the AACS lagged far behind the fast moving air ferry, which in the interim used whatever communications facilities it found along its routes—frequently the systems of the commercial airlines, such as Pan American Airways in Africa, and equipment installed by the Civil Aeronautics Administration and the high frequency direction finding systems of the Federal Communications Commission. In British territory, the AACS made use of the systems of the Royal Air Force.[77]

Initially the ferry route across Africa to the North African theater extended from Accra to Oran, via Kano. The first flight on this link had been made on 13 November 1942. Three days later the Air Forces directed that equipment for an AACS station be installed at Kano. But the Kano-Oran hop was a long one, and when Dakar was opened to the Allies in December, that point replaced Accra as the terminus of the southern route to North Africa and the United Kingdom. Until arrangements could be made to land there, Bathurst in neighboring Gambia was used. Then the bulk of the travel from South America was switched from Accra to Dakar, and the Kano-Oran link was abandoned in favor of a route along the west coast to Marrakech.[78] General Arnold's headquarters pointed out that the single kilowatt Pan American Airways transmitter at Accra could communicate with Oran, and with Casablanca too, provided sufficiently powerful radios were installed

[75] Capt Dulany Terrett, Official History of the South Atlantic Division, Air Transport Command, 1946, *passim*. AAF Hist File, 15153.

[76] Jackson, Radnese "100," p. 2.

[77] (1) Ltr, James Lawrence Fly, Chairman of FCC, to Olmstead, 6 Oct 42. OCMH, SigC FCC. (2) Lt Col Brooke Sawyer, OCSigO, Signal Situation in West Africa, 12 Oct 42. SigC LP 676.3 Africa (Adm) Aug 42–Aug 43, PEA 2.

In October 1942 the Civil Aeronautics Administration program provided for the installation of instrument landing systems (ILS) to serve one runway at each of 106 airfields, although by April it was found that the program would not proceed according to schedule. Ltr, Dir of Federal Airways, CAA, to Dir of Communications AAF, 29 Oct 42; Ltr, Parker to Dir of Federal Airways, 9 Apr 43. SigC 121.2 CAA 1, 1942.

[78] Ltr, CG, AAF to CSigO, 16 Nov 42, sub: CAA Ranges. AAG 413.44 C, Radio.

AACS STATION ON ASCENSION ISLAND

at those places to complete the circuits.[79] The facilities of the 830th Signal Service Company were therefore diverted to establish the network from Accra up the coast to Marrakech. The change in the boundary line between the North African theater and the forces in central Africa, placing Dakar in the North African theater, made it advisable to organize two separate companies because they would work in separate commands. The 830th was therefore reorganized, and some of its men were used to activate a second Signal Service Company, the 976th. Later the same source provided the nucleus for a third unit, the 977th Signal Service Company.[80]

In December 1942 the Air Forces established the India-China Wing to transport men and materials to China over the high Himalayas, where the lofty peaks and strong air currents added to the dangers of flying over enemy-held territory. By early summer of 1943 planes were making 325 round trips daily over the Hump between Chabua and Kunming. In January the European Wing was created from the segments of the North Atlantic route of the Air Transport Command which lay in Great Britain. By then, Allied victories permitted the extension of the southern route from one corner of North Africa to the other and the opening of a new route to the Orient. Later these routes became the domain of separate

[79] Ltr, CG, AAF to CG, ETO, 22 Oct 42, (07338) R–2271. File cited in previous note.

[80] (1) History of the 976th Signal Service Company, 1944. Opns Rpts, SGCO 976–0.1 (6406) M. (2) Action on Project TO–3, 19 Mar 43. SigC 319.1 Project Rpts Office of Planning Dir, Dec 42–Jul 43.

North Africa and Central Africa Wings.[81] The Plant Engineering Agency followed the Air Transport Command into all these areas with its installation teams and its shipments of fixed-station equipment. Installation projects for the Air Forces exceeded anything envisioned when the PEA organization of Army Communications Division had undertaken the overseas expansion of the command and airways networks.[82] Meanwhile, Signal Corps troops were flown into these areas—a team here, a team there—and they set up initial communications systems, hardly knowing whether they were working for the Air Forces or the Signal Corps.

Thus the provision of the AACS facilities across the South Atlantic and Africa constituted a new and difficult task for PEA, breathtaking in its sweep and speed, unorthodox and exasperating in the welter of Air Forces interrelations. Much more orthodox and germane to Signal Corps' central concern were the ACAN stations over these same areas of the globe. In the fall of 1942 communications plans for the administrative radio network had called for some 950 additional stations throughout the world, with Africa high on the priority list.[83]

It was to be expected that direct radio channels from WAR would reach the Dark Continent soon after the North African invasion. Expected, too, was the establishment of supply activities there and subordinate networks to serve them. The first direct ACAN circuits from Washington to Africa had opened during the month of the invasion—WAR to Accra, to Cairo, and to Casablanca—followed in December by radio circuits to Algiers and to Asmara. From the time of the move to Allied Force Headquarters from Gibraltar to Algiers on 25 November 1942, WAR maintained communication with that headquarters through a commercial station at Algiers while an installation team in the charge of Maj. James A. Greene, Jr., Signal Corps, put in a big 40-kilowatt transmitter. It provided six duplex teletype channels between WAR and Algiers, with automatic enciphering and deciphering. Regarding this first single side-band multichannel Army installation, General Stoner said: "It is going to revolutionize radio because you don't have to da-da-dit on the damn thing. It is just a radio printer, and there is no commercial circuit that I know of that the United States has under its control that has such type of transmission." [84]

Equipment for the station arrived directly after the North African invasion. Contained in some 1,000 boxes and crates weighing from a few pounds to 20 tons, it was put ashore at half a dozen ports along the coast, after it had already undergone several reshipments. Bad breakages had occurred. Vital small parts were missing entirely. In

[81] Maj Arthur J. Larsen, "The Air Transport Command," *Minnesota History*, XXVI (March, 1945). The Minnesota Historical Society, St. Paul, Minn.

[82] In January 1943 the Signal Corps estimated that in order to install the stations scheduled for the AACS it should have 59 installation teams in overseas areas within six months and 15 in reserve to meet unforeseen requirements. As yet no installations were scheduled for the China-Burma-India theater, although it was apparent that needs would arise there too. OCSigO R&W Action 1, Lt Col H. H. Wagner, SPSLP to Dir of Planning, OCSigO, 23 Jan 43. SigC 400.52 Gen, Maint.

[83] (1) Memo, Col Parker, Funds Required for Expansion of Procurement Program for Fixed Communications Equipment for Task Forces and Other Miscellaneous Activities and for Necessary Labor Involved for Construction and Installation; (2) OCSigO R&W Action 1, Parker to Army Com Sv, 20 Nov 42. SigC 121.2 Task Forces 1, 1942.

[84] Proceedings of Board To Investigate Communications, Tab O, p. 12.

order to get the transmitter working on local power before completing the installation of the heavy diesel power equipment, the signalmen had to find a suitable transformer. The only one available stood in a sugar factory at Oran, several hundred miles away. It was painstakingly transported to Algiers over a difficult road. Then the men found that the transformer was too big to fit into its vault and they had to knock out a wall to make room for it.[85] Power, like poles, invariably constituted a large source of trouble for Signal Corps installation men overseas. If an electric power supply could be had locally, it was generally inadequate, unstable, or different from the American standard of voltages and cycles.[86]

Despite all difficulties, the powerful ACAN transmitter at Algiers went on the air by December 1942. The reach of its 40-kilowatt output was necessary to cover the great distances required by the ACAN design. Plans called for procuring a total of only fifteen commercial sets of this power, not enough to justify the time which would have been involved in developing this sort of equipment to meet Signal Corps specifications, had that measure of time been available. And it was not.[87]

By March 1943 the capacity of the high-speed multichannel circuits at Algiers permitted the Signal Corps to allot one channel exclusively to the Office of War Information for sending press matter and psychological warfare material. Speaking of this ACAN channel General Stoner told a group of officers in the Pentagon in May 1943, "We are handling between ten and twenty thousands of words of press now. You can go upstairs and see it roll in. . . . It has given our press associations in this country fast service. Formerly the traffic was routed via cable and radio to Gibraltar and cable and radio to the United Kingdom, and then the British would hold it until they released the press. . . ." [88]

Another channel of ACAN's new efficient Algiers transmitter was utilized for testing wire telephoto equipment to discover if it could provide radioed news pictures (also secret weather and tactical maps, provided equipment arrived to scramble them). The first radiophoto or facsimile released to the news agencies, picturing a gun crew in action in North Africa, was sent on 18 March 1943 through the Algiers station. The picture was reproduced in WAR within seven minutes.[89]

[85] (1) Maj W. C. Frierson, Preparations for TORCH, App. M, Shipping and Handling of Equipment in the North African Theater of Operations, May–Jun 43. OCMH. (2) Memo, Maj L. C. Sheetz for CSigO, 18 Jan 43, sub: Rpt on observations on North African Sig matters. SCIA File 3, Sheetz Rpts. (3) Memo, Stoner for Control Div, 7 Jan 43, sub: Weekly Digest of prog and problems. SigC AC 319.1 Digest, 30 Jul 42–1 Dec 44.

[86] The alternative was for the Signal Corps to ship in power units from the United States. There were never enough of them and those provided were apt to differ, even when they carried the same type designation. Efforts to standardize had reduced the number of types from 65 to 33, but it was standardization of nomenclature only. For Example, PE–99 equipment, procured from many different manufacturers, included generators and other parts of as many different makes. What was true of PE–99's was true also of other power units which the Signal Corps procured. Memo, R. J. Hermann, Associate Electrical Engr, for Col. W. L. Barker, AC&EC Agency, 19 Dec 42, sub: Power units. SigC Radio Power Units.

[87] OCSigO R&W Action 1, Lt Col J. E. Gonseth, Jr., Office of Planning Dir, to Dir of ACD, 18 Feb 43, and Action 2, Lt Col V. B. Bagnall, ACD, to Office of Planning Dir, 23 Feb 43, sub: Rpt on observation of North African Sig matters. SCIA File 3, Sheetz Rpts.

[88] Proceedings of Board To Investigate Communications, Tab O, p. 13.

[89] Col Carl H. Hatch, "Radiophotos," *Radio News* (February, 1944), p. 218. An account of the development of telephoto service by the Signal Corps is contained in Melia, Signal Corps Fixed Communications in World War II, pp. 49–55.

To serve AFHQ further, the Signal Corps set up an alternate installation and added a highly secret radioteletype conference circuit.[90] The Algiers transmitter was located at Radio Eucalyptus, site of the fixed station for French empire operations, about 10 miles east of Algiers, and the receivers at Boufarik, the French receiving station, about 20 miles southwest of the city. The voice-frequency teletype and cipher equipment were installed in the basement of the Hotel St. George. In addition to this large ACAN station at Algiers the signalmen operated the French Radio Eucalyptus part time, together with a number of transmitters at Beni Messous, which were remotely controlled from the St. George and which were used also by the British Corps of Signals, the Royal Air Force, and the Royal Navy to communicate with the United Kingdom, Cairo, Casablanca, Constantine, Oran, Malta, and other places. These transmitters employed both directional (rhombic) and nondirectional antenna arrays, widely dispersed as a precaution against bombing.[91]

The Accra station (WVNI) was installed late in 1942 by a detachment of the 830th Signal Service Battalion with the aid of some piano wire and valve springs from a Ford car to mount the equipment. Though it employed only a ten-kilowatt transmitter designed for Boehme high-speed operation, the station became one of the most useful in Africa. Even after Dakar virtually replaced Accra as a ferry stop, the latter continued to handle all administrative traffic in the area, relegating its short Dakar channel to a smaller one-kilowatt transmitter.[92]

ACAN's Casablanca station, equipped with radiotype, had gone on the air late in November. Two months later, in January 1943, its operators received a surprise when they fell heir to a flood of communications during the Casablanca Conference. Additional facilities were also provided solely for conference use.[93] On Christmas Day 1942, Col. Elton F. Hammond, the signal officer of the I Armored Corps, received orders to have local and long-distance circuits in readiness for the meeting. Planning the system and gathering its equipment consumed more time than the actual work of installing it. Begun on 7 January, the conference network was ready for operation three days later; an alternate system, farther inland, three days after that. Additional radio links were established from Casablanca to Britain, to other points in Africa, and to dignitaries enroute to the conference. The telephone system employed 23 trunk lines and 148 local lines. A two-position BD–100

[90] Memo, Col E. F. French and Maj T. H. Mitchell, ACD OCSigO, for Olmstead, 8 Mar 43, sub: Info for use on proposed trip. SigC AC 312 Gen CEB, Aug 41–Aug 45.

By 1944 facilities whereby commanders in the theaters could confer directly with Washington were established between WAR and headquarters in England, North Africa, Italy, Australia, India, and Brazil. The equipment was called radioteletype conference facilities. CSigO, Annual Report, 1944, p. 531. Without such elaborate facilities in the ACAN system, Washington military staffs, in particular the Operations Division of General Staff, could not have maintained close working relations with overseas commands. Ray Cline, *Washington Command Post: The Operations Division,* p. 290.

[91] Memo, Maj Lawrence C. Sheetz for CSigO, 18 Jan 43, sub: Rpt on observations on North African Sig matters. SCIA File 3, Sheetz Rpts.

[92] SigC 676.3 West Africa CC (CEB), *passim.* The WVNI–WAR radio channel opened on 9 November 1942.

[93] The Casablanca radio station was transferred to the Navy on 4 September 1943. By that time its radiotype had been replaced by radioteletype equipment. (1) Memo, Hatch for Control Div, 3 Dec 42, sub: Weekly Digest of prog and problems; (2) Memo, Stoner for Control Div, 17 Sep 43, sub: Digest of prog and problems 1–15 Sep. SigC AC 319.1 Digest, 30 Jul 42–1 Dec 44.

switchboard had connections to ten stations, including message centers, airports, and the terminals of radio and cable circuits. During the sixteen days the facilities were in operation the radio channels carried 450 encrypted messages totaling 60,000 groups, and the telephone lines received constant use.[94]

The direct WAR to Cairo (WVNV) circuit, after barely two months of service, was discontinued on Christmas Eve 1942 in favor of relay of the Cairo traffic by way of Asmara (WVNT) But the Cairo station remained active in the local network. It even continued to communicate directly with WAR, upon occasion, by means of a British 2-kilowatt transmitter.[95] The bulk of Cairo's traffic to WAR, however, sped by way of Asmara until June 1943, when the Cairo terminal was provided with a high-speed Press Wireless 15–A transmitter and associated equipment which could be depended upon to reach Washington directly.[96]

Toward completing a powerful ACAN station at Asmara, the Signal Corps had shipped a big 40-kilowatt transmitter manufactured by Press Wireless, Inc. But the valuable cargo had been lost at sea. A second transmitter, embodying a multichannel single side-band system, arrived in October 1942.[97] By the end of November men of the 209th Signal Depot Company had tallied in all the items for the station only to find that they had not enough to get it in operation without the aid of British and local purchases.[98]

The emergency power setup at Asmara required supercharged diesel motors and these were so scarce in the United States that only a part of the units required had been sent. Here, too, poles were a problem. The desired heights of 75 to 90 feet were not to be had locally.[99] A dozen steel poles were ordered but they could not be expected in time for the initial installation. Steel towers were fine once erected but they had to be put up in sections, which necessitated expert cutting and welding. The 75-foot poles for the Asmara station, therefore, had been shipped from the United States. Then it was feared that the road to Asmara from the port of Massawa on the Red Sea was too narrow and the turns too many and too sharp to permit transporting the poles overland. Moreover, they arrived unmarked and no one at Massawa was sure of the use for which they were intended. Nevertheless, they eventually reached Asmara by rail, anchored to a flat car with the ends projecting over a car to the front and one to

[94] Signal Corps Information Letter, No. 18 (May, 1943), p. 11. Engaged in providing communications for the conference were the 1st Armored Battalion; the signal section of the I Armored Corps; the 239th Signal Company, Operation; Company C of the 829th Signal Service Battalion (Special); the crew of HMS *Bulolo;* the Postes, Telegraphes et Telephones of French Morocco; Cables and Wireless, Ltd. Ltr, CG Hq I Armored Corps to CG AFHQ, 2 Feb 43, sub: Rpt on sig com for Anfa Conf. SCIA File 56, Cummings Rpts.

[95] This transmitter was coupled to a rather poorly designed, unterminated single-element rhombic antenna supported by steel masts, which the British had beamed on Australia. The radiation pattern was so distorted that it was possible to get good signal output off the sides and thus reach Washington.

[96] Hist Sec OCofS G–2, Hq AMET, Cairo, Egypt, History of Africa-Middle East Theater, U. S. Army, Sec. II. OCMH.

[97] (1) Prog Rpt, War Plans Div, OCSigO, 16 Jul 42; (2) OCSigO R&W Action 1, Bagnall to Plant Br, 31 Dec 42, sub: Disposition of 15- and 40-kilowatt transmitters. SigC SPSTP–25.

[98] Msg, Andrews to AGWAR, CM-IN 13043, 30 Nov 42.

[99] (1) Memo, Maj J. S. Tight, PEA, for Maj A. D. Wharton, ACD OCSigO, 27 May 43, sub: Info, North African theater; (2) Memo, Col Henry for Dir of PEA, 7 Jul 43, sub: Info requested in North African theater by Adm. Radio and Power Sec. SigC 676.3 African (Adm) Aug 42–Aug 43, LF.

the rear, with only a few poles damaged in transit as they brushed against the sides of tunnels on the sharp curves.

Despite all obstacles, the 40-kilowatt Asmara station, like its counterpart at Algiers, went on the air in December 1942. When General Olmstead visited the station in the spring of 1943, he considered it to be one of ACAN's best overseas installations. By then radio intercept equipment had been added at Asmara and in June 1943 men from the 2d Signal Service Battalion left the United States to establish that specialized service.[100]

The unit charged with the Asmara station was the 850th Signal Service Company (later, a battalion), whose men arrived in driblets all through the last months of 1942. Further increments arrived in January. The less experienced of them were assigned to Cairo to work the local circuits which stretched out from there. Most were in the 15- to 18-words-per-minute class, but long periods of inaction en route had tended to make them lose the speed they had acquired. Under the supervision of more experienced operators they worked eight hours a day, seven days a week, 1st Lt. T. J. Larabee working the more heavily loaded circuits because of his ability to operate at higher manual speed. The ten operators at Cairo handled about 400,000 groups manually in the month of April 1943, but the ten at Asmara did better. Their score was 620,000 groups in February and 840,000 in April. Until second-priority troops arrived in April, thirty-two operators kept the five stations at Asmara, Cairo, Tel Litvinsky, Bengasi, and Tripoli in operation.

With their ranks increased, the signalmen of the 850th helped the Office of Strategic Services to install a station in Africa. Others scattered to assignments in the Suez Canal Port Command, the Delta Service Command, the Anglo-Egyptian Sudan, and as far away as Ankara, Turkey. Some went to Addis Ababa to set up communications for the newly authorized United States Legation in Ethiopia, despite the reluctance of the Army Service Forces to accept what it considered to be a nonmilitary project.[101] Until the Signal Corps men installed this radio station, the only telegraphic communication with the Ethiopian capital had been provided by the British, who maintained an Army station there and a station in the legation compound. The Addis Ababa-Asmara circuit, its equipment ferried in by air, was to open 1 October 1943 with alternate routing by way of Cairo.[102]

Throughout Africa and the Middle East new stations were opening, others closing, as situations changed. The United States Military North African Mission, which had planned the initial installations, had necessarily taken into account only the immediate requirements in men, material, and service. But after the arrival of United States

[100] Daily Report, Maj N. C. Miller, 23 Jun 43. SigC 319.1 Daily Rpt, All Secs Office Planning Dir, Jan–Jun 43. The great Asmara station, WVNT, was the hub of channels reaching out to Accra and Takoradi on the Gold Coast, to Cairo and through Cairo to Tel Litvinsky on the Mediterranean, to Khartoum in the Sudan, to Basra on the Persian Gulf, and to Karachi. History of Africa-Middle East Theater, U. S. Army, Sec II.

[101] (1) Incl 1, Historical Data 3176th Signal Service Company, to Ltr, Capt Anton B. Goeringer, Hq USAFIME, n. d., sub: Hist record. SigC 314.7, 3176th Signal Service Co EBC, Folder 125. (2) 1st Ind, ACofS for Opns ASF to ACofS Opns Div WDGS, 15 Apr 43 (without basic memo). SigC CC 676.3 East Africa CEB.

[102] (1) Ltr, Breckinridge Long, Asst Secy State, to SW, 18 May 43. SigC 676.3 Adm Africa (CEB); (2) OCSigO R&W Action 1, Code to Chief of Sig Opn Sv, 22 Mar 43; sub: Com in Middle East; (3) OCSigO R&W Action 1, Chief of Army Com Sv to Chief of Traffic Opns Br, 6 Oct 43, sub: Addis Ababa-Asmara circuit; (4) Msg, Cairo to AGWAR CM–IN 1769, 3 Oct 43, SigC 676.3 East Africa CC.

troops in November 1942, the fixed administrative network stations faced almost as fluid a situation as did the tactical networks. Men and materials were moved from area to area to provide service under the changing conditions.[103]

Communications in the Libyan area were made possible only by the transfer of signal men from the Levant Service Command and by the use of British equipment or American equipment borrowed back from the British. The first radio installation in the Delta Service Command, which embraced Egypt and such adjacent territory in the western desert as might be occupied by the Allied forces, consisted of a 1,200-watt Pan American Airways transmitter borrowed from the signal officer of the Air Transport Command at Accra and operated by the 40-kilowatt team of Company C, 850th Signal Service Battalion, on detached service from the Eritrea Command.[104]

The Bengasi station and the Tripoli station, both in the network which centered at Cairo, went on the air in February and March 1943, respectively, using SCR–188 and SCR–299 sets supplied by the British. Bengasi received an SCR–299, also from the British, about a month later. The Tripoli station obtained a complete BC–447 fixed station assembly in April, only to be closed down finally in October. A high-speed channel between Algiers and Cairo opened in March.

Radio was regarded as the primary means of communication in Africa because of the great distances, the scarcity of civilian wire systems, and the poor roads. And in general it was fairly dependable, although subject occasionally to erratic performance over long desert distances. Nevertheless, whenever the American Army went into an area, telephone lines became indispensable. After the North African invasion, the Allies took over for military use about three fourths of the 40,000 circuit miles of existing wire plant, assuming responsibility for its maintenance and rehabilitation. They added another 5,000 miles of open-wire line, including carrier and repeater equipment. The maintenance of these circuits was in itself a stiff task. The communications systems had been built up independently, by naval, ground, and air units—British, French, and American. Methods and equipment differed and much co-ordination was involved.[105]

The wire system in the Africa-Middle East area—the Sudan, Eritrea, and extending to and including Iran—could be compared to nothing in the United States except possibly a few remote farmers' lines. There were exceptions—a number of superb lines which the Italians had built over difficult mountain terrain. The poles were of steel or of reinforced concrete because termites quickly damaged untreated wood. Otherwise, such switchboards as served the lines of the Egyptian States Telephone and Telegraph System were antiquated and badly worn. Repeater stations did not exist. Contracting with the Egyptian company for extensions of its service was a slow process requiring considerable supervision by Sig-

[103] With the dissolution of the North African and the Iran-Iraq Military Missions, the United States Army Forces in the Middle East established a services of supply, with four separate service commands—Eritrea, Delta, Levant, and Persian Gulf. Rpt of Activities, 15 Sep 42. SigC 319.1 Diary, Apr–Dec 42, OD–2.

[104] Ltr, Maj Fred L. Rauch, Sig Officer Delta Sv Comd to Hist Officer USAFIME, 10 Aug 44, sub: Hist record, Sig Sec. SigC 314.7 SigC MESC, Folder 70.

[105] (1) Memo cited n. 91. (2) Signal Corps Information Letters, No. 24 (November, 1943), p. 7; No. 25 (December, 1943), p. 5.

nal Corps men, often through a civilian interpreter of doubtful ability. Eventually even the contracts which had been entered into were canceled, and the Signal Corps took over the building of such additional lines as might be necessary.[106]

In January 1943 the Signal Corps agreed to provide emergency repair parts for the main Eritrea exchange maintained by the British at Asmara. But by the time the list of what would be needed was received—it amounted to a major overhauling of the entire installation—the diminishing need of the United States troops there for telephone service led to a decision that the British must supply the equipment if they wanted to rehabilitate the system. By the spring of 1943 central Africa no longer figured large in military plans. As the southern ferry route was virtually abandoned, the administrative radio circuits planned for central Africa were not developed and the AACS stations took over the small amount of administrative traffic that remained.[107] Work shifted to the north, where the 435th Signal Construction Battalion (Aviation) would build an eight-wire telephone pole line from Bengasi to Tobruk to serve the British Eighth Army and the Ninth Air Force. The 95th Signal Battalion would take over the telephone service in Iran and relieve the British signal units there.

Beyond Africa, detachments of the 833d Signal Service Company had already arrived in the Persian Gulf Command in order to extend the administrative radio network along the new and safer supply route to Russia. Between Russia and Iran, communication was entirely by radio. The first radio station installed by the 833d in the Persian Gulf Command was that at Basra, in Iraq, a link in the great equatorial belt of ACAN stations: Asmara, Cairo, Karachi. Other stations followed at Andimeshk, Ahwaz, and Tehran. During December and January, ports along the Persian Gulf were linked into the network—Bandar Abu Shehr (Bushire), Khorramshahr, Abadan, and Bandar Shahpur. A separate network was established for the Motor Transport Service and semifixed stations were set up along the supply route for emergency use.[108] Main stations of the British radio network were located at Baghdad and Basra, with terminals in Egypt, Palestine, Syria, Iran, and India. The only other radio installation was a commercial station operated by Iranian Posts and Telegraphs at Tehran, which communicated with London and New York. Later, in 1943, Tehran and Ahwaz obtained broadcasting stations planned and installed by the Signal Corps for the Office of Technical Information.

Radio traffic in the area increased rapidly. From about 20,000 groups in November 1942, the count rose to 180,000 two months later. By April 1943, with practically no increase in equipment or trained operators, more than 800,000 groups a month were passing over the network, although not without worrisome delays. These would decrease only with the provision of better equipment and the arrival of additional operators. With the later installation of teletypewriters, wire would become the primary means of communicating within the command, and radio the means for long-

[106] Sawyer, Signal Situation in West Africa, 12 Oct 42. SigC LP 676.3 Africa (Adm) Aug 42–Aug 43, PEA 2.

[107] Memo, Col Watters for Col Lanahan, 3 Mar 43, sub: Rpt on projects listed in Col Townsend's Memo, 27 Jan 43. SigC 319.1 Daily Rpt, All Secs Office Planning Dir, Jan–Jun 43.

[108] Capt Sidney L. Jackson, Communications in the Persian Gulf Command: Chapter IV of the Theater Fixed Networks (1944), SigC historical monograph E–1d, p. 7. SigC Hist Sec File.

distance communication and a stand-by for emergencies.

When American forces arrived in the Middle East, two telephone trunk lines, a part of the civil system taken over by the British Army, provided connections to Haifa, Palestine, and from there to Syria and Egypt. The equipment included American, British, and Indian types, with some German desk-type telephones. Poles were of steel tubing, with tapered sections eight feet long, of different diameters, so that varying heights and strengths might be reached. Telephone wires were copper pairs; telegraph wires, single iron-strand.[109] The British were operating a net of four teletype machines on the railway circuits, the printers installed at Tehran, Dorud, and Andimeshk, with physical relay at Dorud. Only the lines of the Anglo-Iranian Oil Company to the south employed carrier equipment. There was one bright spot in the picture, however. The steel pole line supporting the poor railway circuits was capable of supporting also the high-grade carrier circuits which Col. Samuel H. Thomas, Director of Signal Service, Persian Gulf Command, proposed to install from Ahwaz to Tehran, and from Ahwaz to Bandar Shahpur, Khorramshahr, and Cheybassi. In this one place, at least, poles would be no problem. But other needed equipment, in particular a C–5 carrier system, could not be expected before September 1943.

Meanwhile, the signal detachment which had come with the December 1942 contingent of troops, using its own BD–71 and BD–72 switchboards and borrowing equipment from the British, provided telephone service for Khorramshahr, Basra, Ahwaz, and Andimeshk. With the movement of the headquarters of the command to Tehran in January 1943, British Signals came to the rescue with a 40-line German magneto switchboard and all the Swedish handsets they could spare.

In March 1943 the 95th Signal Battalion arrived, but not its organizational equipment. Ten EE–97 teletypes, three BD–100 switchboards, and other items of organizational equipment scheduled for January shipment and due in April would not reach the unit until September, along with the carrier equipment requisitioned by Colonel Thomas. Moreover, the shipment had been short a number of items when it started out and these were not shipped until still later.[110] Nobody knew when they would reach Iran. Although the Chief Signal Officer had urged that Signal Corps troops be "unit loaded" to prevent just such separation of troops from their equipment, many other units as well as the 95th arrived at their destinations minus equipment and had to borrow and improvise and do the best they could with what they had.[111] Actually, the idea of unit loading conflicted with the facts of shipping. Men were carried by transports, which could not also convey equipment in Army bulk. The latter had to go in cargo ships. The manner of shipping, even of issuing T/BA signal equipment, was frustrating from many points of view. The priorities of units, before they were assigned to task forces, were so low that the men received little of the equipment they would use overseas. Then when priority was raised

[109] Mil Attaché Rpt 21, Baghdad, Iraq, 10 Sep 42, IG 6540. SigC AC-69 Iraq.

[110] Rpt of Maj Giles H. Gere, SigC, 1 Apr 44, sub: Instl, opn, and maint of teletype com facilities in Persian Gulf Command. SigC A46–160 Teletype (5).

[111] Memo, Maj J. E. Gonseth, Jr., Dir of Planning OCSigO, for Dir of Planning, 20 Aug 42, sub: Daily rpt, Equip Rqmts Sec. SigC 319.1 Diary, Apr–Dec 42, OD–2.

to permit a unit to move with a task force, it was too late to train men on the equipment even should it be received. When it was shipped separately, the men and their working tools sometimes did not meet for months, and then they were entirely unacquainted.[112] Thus the 95th Signal Battalion in the Persian Gulf Command had little of the equipment it needed when it took over communications from the British. There were 700 miles of copper wire to be strung, when it should be received, along the existing route of the railroad, which wound its way up the mountains to Tehran through 130 tunnels in eighty-four miles. Insulated tree wire was requisitioned because it was feared that electrical leakage from bare wire in the tunnels would be too great for satisfactory carrier operation. But since the Plant Engineering Agency could not locate eighty-four miles of such wire line, it was therefore decided to use bare wire and to offset the transmission losses by inserting repeater stations at Sultanabad and Dorud. Luckily, General Olmstead was in the area in April 1943 and he directed his office to hurry the shipment of the wire for the Basra-Tehran line.[113]

Summer was coming on then. The men newly arrived from a temperate zone endured such climatic conditions as they had never encountered before. In the port areas of Iran summer temperatures soared, humidity was high, and insects swarmed. It was the custom of the natives to work only from six to eleven in the morning and from four to six in the afternoon, but the nature of the signalmen's operations permitted no such lull. Temperatures high enough to kill mosquitoes and sand flies drained human energy rapidly, and men less able to stand conditions in the low areas were stationed in the mountain districts in summer. Others were rotated to Tehran for a two-week tour, with light duties, to enable them to relax and replenish their physical reserves. The 95th Signal Battalion, which represented over half the signal troops in Iran, and the 833d Signal Service Company were fortunate in having most of their men stationed in the mountainous parts where temperatures ranged from below zero in winter to a mere 110 degrees in the summer and where the humidity was low all year around. The 231st Signal Operations Company which arrived in June, drew the hot, humid central and port areas.[114]

The weather was quite as hard on the equipment as on the men. Lubrication maintenance checks had to be made at 150-hour intervals, instead of the normal 500 hours, and dust and sand in the port area wore out movable parts at five times the normal rate.[115] All these things added to the difficulties inherent in circling the world with modern communications installations.

From India to Australia

Between the Persian Gulf Command in the Middle East and the Pacific area, where military communications lines were reaching out from the Western Hemisphere, lay the vast expanse of the China-Burma-India theater (CBI), much greater in size than the whole United States and cut apart by

[112] Weekly Prog Rpt, Opns Br OCSigO. SigC Hist of Opns Br, 1942.

[113] (1) Memo, Maj N. C. Miller for Plan Div, 28 Apr 43, sub: Persian Gulf 700-mile wire line project. SigC 319.1 Daily Rpt, All Secs Office Plan Dir. Jan–Jun 43. (2) T. H. Vail Motter, *The Persian Corridor and Aid to Russia,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1952), p. 256.

[114] Jackson, Communications in the Persian Gulf Command, p. 4.

[115] Gere Rpt cited n. 110.

enemy occupation and a barrier of lofty mountains. As originally set up in the spring of 1942, the theater consisted of India, the extreme northern tip of Burma, and the interior portion of free China. The Japanese held practically the entire coastal region almost to Calcutta, thus controlling both water and land routes into China. The air provided the only path of supply to the Chinese allies. And what a path it was, from upper Assam in India over the wild Himalaya Mountain system. Communication installations and installation practices reflected the bleak supply outlook and the strange and unusual local conditions. They also reflected, more brightly, the stamina, ingenuity, and skill of the men responsible for the communications networks. The men caricatured the CBI initial letters as "Confusion Beyond Imagination." But they nonetheless carried out their mission with American ingenuity and drive. General Marshall had promised an increase in the effectiveness of the air ferry [116] which meant that airways, airways communications installations, administrative radio systems, wire systems, and aircraft warning systems would all be extended in the CBI theater. The story of the extension of these networks is a story of improvisation and of individual Signal Corps men who made up the theater's few signal units.

For a long time the CBI theater possessed the barest minimum communications needed to support air activities. Signal equipment consisted of little more than items in the tables of basic allowance. Lend-lease in reverse helped. British, Chinese, and Indian authorities filled 36 Signal Corps requisitions late in 1942 and another 279 during 1943. Over half the requests were for poles, crossarms, and pole line hardware. Local facilities for manufacturing most types of communications equipment were wretched, and the aggressiveness of the British and Russian delegation often resulted in exceedingly low priorities on American equipment for the Chinese Army.[117]

In areas of China where poles were scarce, linemen strung excessive quantities of field wire onto the crossarms, thirty pairs to an arm. Insulators, patterned after the standard IN–53, were made of uncured wood; then they were immersed in oil to reduce moisture absorption, and the knobs were insulated with tape at critical points. Lines laid in the early months combined lengths of iron wire, bare copper wire, and field wire. Terminal strips and distribution boxes were improvised from scrap lumber and parts salvaged from wrecked aircraft. There were times when overhead-type cable had to be used for underground installations because it was all the men had, and times, too, when underground cable had to be strung wastefully on poles for the same reason. Transportation of supplies was by any means available: planes or barges, parachutes or donkeys, barefoot porters, camels, elephants.[118]

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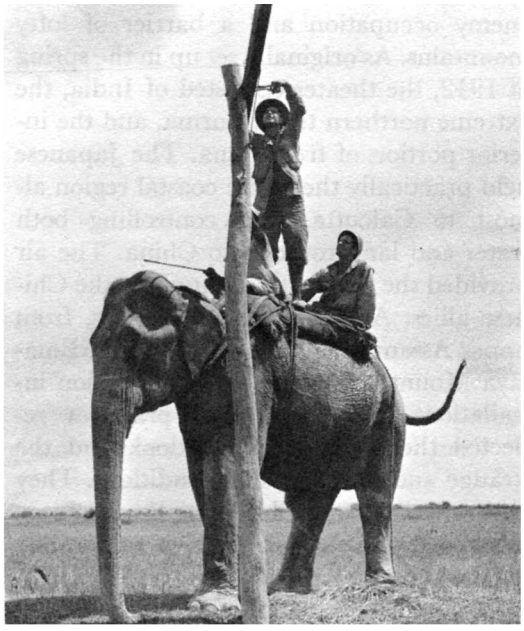
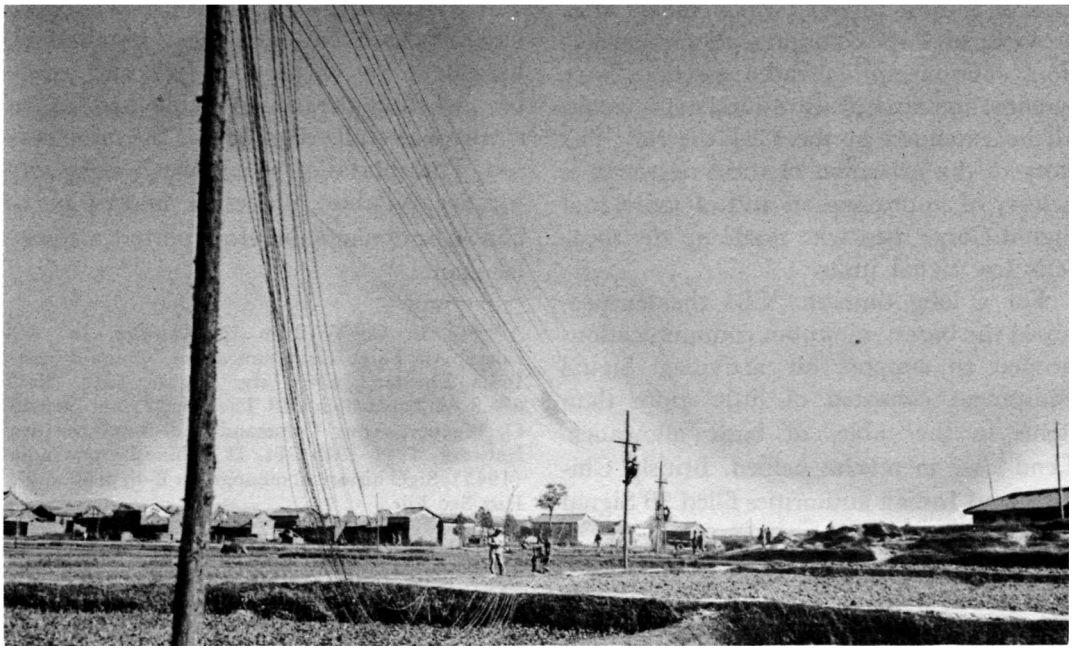
[116] (1) Joseph W. Stilwell, *The Stilwell Papers* (New York: William Sloane Associates, Inc., 1948), arranged and edited by William R. White, p. 171. (2) Proceedings of Board To Investigate Communications, Tab B (Testimony of Stilwell, May 43).

[117] (1) Lt Col William H. Knowles, Jr., Air Corps, Air Force Communications, China-Burma-India Theater, June, July, August, 1943. SigC 676.3 Air Force Com CBI Theater. (2) Dr. Donald O. Wagner, Army Command and Administrative Network, 1941–1945: Pt. II, China-Burma-India (1945), SigC historical monograph E–6, p. 66. SigC Hist Sec File.

[118] (1) Historical Report of the 835th Signal Service Battalion, April 1, 1943–October 31, 1944. Opns Rpts, SGBN–835–0.1 (28174). (2) "Elephants Boon to Signal Corps Soldiers in CBI," Camp Crowder, Mo., *The Message*, No. 2 (November, 1944).



COMMUNICATIONS IN CBI *depended frequently upon the initiative of individual members of small Signal Corps units. From the swamps and plains of India (upper left and right) to the rice paddies of China (below) wire lines were installed and maintained.*



In installing and maintaining pole lines, signalmen found elephants useful both to handle the poles and as elevated platforms from which to string the wire. They made similar use of native canoes at high water during the monsoons. Their main job was to provide ACAN facilities, both small local stations and the two larger ones at New Delhi and Karachi which communicated by means of medium-power Boehme equipment with Brisbane and Asmara, respectively, thus tying Africa, Asia, and Australia together and connecting with the circuits crossing the Pacific. And they did considerable AACS work also, not only installing airway radios but operating them too, before AACS units arrived.

Another assignment that fell to the Signal Corps in CBI was aircraft warning duty in Assam and Burma, serving the Tenth Air Force. At first the duty was without benefit of radar. Working as ground observers and radiomen, the men signaled sightings of Japanese aircraft. They served in groups of two or three, constituting a station outpost in the jungles, to which they traveled elephant-back or where they were dropped from airplanes. There they stayed for months at a time, supplies being parachuted to them. Throughout free and occupied China native observers and radio stations were added to the irregular pattern. Some of the stations used types of equipment discarded in the early 1920's by amateurs in the United States as obsolete, but the results attained with them were incredible. Their alerts could be depended upon to give twenty to twenty-five minutes warning of the approach of enemy aircraft. Some 200 spotter stations were scattered through the Shan states, in the Delta country, and in the upper Salween River region.[119]

[119] Interv, SigC Hist Sec with Col King, Ret., Washington, 11 Oct 49.

The 679th Signal Aircraft Warning Company (Visual) commanded by Capt. John G. Haury, also maintained a visual warning network in the Patkai and Naga Hills overlooking Burma. Some of these stations, too, were a several weeks' trek from civilization, in the midst of tribes of heathen headhunters, and in areas which British troops entered only in military force. But the natives treated the small groups of American soldiers very kindly. Colonel King, who later became signal officer for CBI, attributed their friendliness to the foundation of good will that American missionaries had laid.

In regions such as these, older types of radar were impractical. Even the lightest radar set, the SCR–602, weighed well over 1,000 pounds and the only way it could have been transported over the almost invisible trails would have been to break it down and have natives hand-carry the various parts. Even then, it would not have been effective because the advanced positions confronted hills, which would have prevented a radar sweep of the Chindwin Valley. A test in these mountains of the much heavier SCR–516, a medium-range version of the SCR–268, proved disappointing. The ponderous components, transported elephant-back after months of grueling road-building labor, served only to give radar a bad repute in these lands because wide-beam long-wave sets were unsuitable for use in such country. So many echoes from the hills smeared the oscilloscope of the SCR–516 that airplane reflections were lost in the glow. Except for the radars in the Assam Valley, the only others in the theater were four SCR–270–B's which the 675th Signal Aircraft Warning Company (Radar) operated in connection with the British fighter net around Calcutta.

Airborne IFF equipment, transponders, had been flown in and installed on airplanes in the area. But the transponders were useless because there were no ground IFF sets, interrogator-responsors, to challenge the aircraft. Only one radar maintenance officer was known to be in the theater, 1st Lt. John M. Edwards of the 1036th Signal Company, 305th Service Group, at Ondal. The quality of third and fourth echelon maintenance varied from one depot to another, depending upon the resourcefulness of the men who made the repairs without the spare parts that were needed and often with ancient tools which no technician in the United States would touch. Electronic equipment was often unaccompanied by instructional literature because its "secret" label so limited its distribution that even the men who needed it were unable to get it.[120]

The veteran signal unit of CBI was the 835th Signal Company, teams and detachments of which performed all manner of ACAN radio, wire, aircraft warning, and AACS duties from one end of the sprawling theater to the other.[121] As the Allies sought to open up a land route into China, the Ledo Road, early in 1943, a detachment of the company, Team 6, provided communications. Two officers and 71 enlisted men moved up to Ledo, a small town in the jungle at the foot of the Naga Hills, the headquarters of SOS CBI Base Section No. 3. The British had made a start and General Stilwell had taken over the task of building a road from Ledo to Myitkyina which would connect with the Burma Road into China. Only 120 miles away from Ledo lay Burma and the Hukawng Valley, held by the Japanese. But the intervening terrain was such that Merrill's Marauders spent seven days hacking their way through three miles of it to reach the enemy's flank. Soon the team established its radio station and waited for supplies for the pole line, which would parallel the road. Although the radio station they set up was a simple one, installing it was no simple matter. The transmitter and receiver positions perched on ledges of the hills, which rose in steep steps and which were reached only by jungle trails. Couriers ran the messages back and forth between "Radio Hill" and the message center established in a bamboo basha, or native hut, near the headquarters of Base Section No. 3. Each piece of equipment had to be laboriously hand-carried up these rough trails; then the station had to be supplied the same way.[122]

All equipment was extremely scarce at Radio Hill. Spare parts were unobtainable and power units a prize item. When a new one-kilowatt transmitter was expected by the men at the station, they sent a repairman to the distant port to conduct it safely through the hazards of an Indian railway trip.[123]

In addition to keeping the radio channels

[120] (1) Knowles, Air Force Communications, China-Burma-India Theater. (2) "AW Adventure," *Radar*, No. 11 (September, 1945), pp. 14–17. SigC Hist Sec File, A46–160, Drawer 31. Four SCR–602's arrived in Dinjan, Assam Province, in July 1943. They too were useless in the hills but could be, and were, used in the more open Assam Valley.

[121] By July 1943 the 835th Signal Service Company, grown to a battalion, numbered over a thousand officers and men. Other Signal Corps units in CBI at that time included over 1,500 men serving the Air Forces and about 500 serving SOS. Wagner, Army Command and Administrative Network, Pt. II, p. 67.

[122] John and Ward Hawkins, *History of the 835th Signal Service Battalion, 1942–1945*, pp. 25–26. SigC Hist Sec File, A47-200, Drawer 15.

[123] (1) *Ibid.*, p. 41. (2) Dodds, History of Plant Engineering Agency, p. 20, cited n. 39 (2).

working in the administrative network, radiomen from Ledo accompanied the construction crews who were pushing through the jungle to create the Ledo Road, the road Generalissimo Chiang Kai-shek later named the Stilwell Road. They followed the pioneer bulldozer in a radio-equipped command car and the portable equipment often got as far as twenty miles ahead of the widening and grading crews. Another team at road headquarters maintained communication with the forward set and back to Base Section No. 3.

At the same time other teams, with the aid of soldiers of the Indian pioneer troops, were building the pole line from Ledo out. The Americans understood no Hindustani and the Indian troops no English; yet six weeks saw twenty miles of poles and crossarms set. The working day was ten to twelve hours long, with two or more hours a day consumed in traveling back and forth from camp to the working area. Copper wire was strung on the new poles with the lines on the lower crossarms phantomed for two talking circuits to Ledo. In the absence of antiaircraft installations along the route, one of the physical circuits of the phantomed group was used to provide air raid warning. Trouble shooting became a 24-hour-a-day job.[124] Later these men would have the satisfaction of being on hand at Myitkyina to furnish communications for the drive that would clear the Japanese from that area.

Back at Ledo, others of the detachment were providing the telephone service for that locality. In April 1943 Ledo had two trunks to Tinsukia, two to the Margherita dial exchange, four to the 20th General Hospital at Margherita, five to Lakhapani, one to combat headquarters three miles beyond that town, two trunks to Hellgate and 55 local subscribers. After working all day in the radio station, the Signal Corps men spent many of their nights repairing the battered 40-line common battery switchboard obtained from the civil exchange through reverse lend-lease for installation in the rapidly expanding hospital at Margherita. As service increased, the native operators became less able to cope with the circuits and Ordnance and Quartermaster men were pressed into service as operators. One, a cook, became so skilled that he was made assistant to the wire chief.

At the turn of 1942 the signal officer of the Tenth Air Force, Col. Samuel S. Lamb, returned to Washington to obtain decisions from the War Department General Staff, the Signal Corps, and the Army Air Forces on CBI signal matters. He succeeded in getting equipment for five additional fixed radio stations—three of 1 kilowatt and two of 300 watts. He won recognition for the 835th Signal Service Company, recommending that it be redesignated the 835th Signal Service Battalion and include the five fixed radio station teams, a message center detachment, a telephone and telegraph detachment, and a wire-construction detachment. Both General Stilwell and the Operations Division, General Staff, favored the inclusion as well of the 235th Signal Operations Company and the 281st Signal Service Company, Aviation, thus continuing under one headquarters the administrative communication units of both the Air Service Command and the SOS. The 835th Signal Service Battalion, which grew out of the pioneering company, was officially activated in the theater on 1 April 1943, with its headquarters at New Delhi. Actually the new battalion, authorized 49 officers and 980

[124] (1) Historical Report of the 835th Signal Service Battalion. (2) Romanus and Sunderland, *Stilwell's Mission to China*, p. 306.

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men, included two companies formerly assigned to the Tenth Air Force—the 235th Signal Operations Company and the 861st Signal Service Company.[125]

The battalion's detachments, widely dispersed, comprised nearly half of all the Signal Corps men in CBI and the organization was as well known in China and India as the old 51st Signal Battalion had been in peacetime maneuvers in the United States. It remained the signal operating unit for the administrative systems of the entire theater, providing radio communication and maintaining telephone systems for administrative headquarters from western India to China; at Karachi, Services of Supply Base Section No. 1; at New Delhi, headquarters of General Stilwell's rear echelon and of the Tenth Air Force; at Agra; at Bangalore; at Chakulia; at Chabua, take-off for the route over the Hump; at Gaya, headquarters of the Air Service Command; at Barrackpore, headquarters of the India Air Task Force; at Calcutta, Services of Supply Base Section No. 2; at Ledo, Services of Supply Base Section No. 3; at Kunming, headquarters of the Kunming Area Command; and at Chungking, the forward echelon of the United States Army Forces in CBI.[126]

Wire circuits thinly penetrated the same areas. Two long distance circuits, a teletype line from New Delhi to Agra, and a teletype and speech connection between Barrackpore and Ondal in the Calcutta area, were among those in operation. In late spring 1943 a carrier circuit for teletype was made available for ten hours a day between New Delhi and Calcutta. The growing amount of Air Forces activity in the Kharagpur and Chakulia area was met by a carrier circuit between Calcutta and Kharagpur which later was extended to Chakulia.[127] Other circuits terminated at Lahore, Bombay, Bangalore, Tinsukia, Jorhat, Kinjikhoa, Dinjan, Borhapjan, Ramgarh, Peishiyi, and Chungking. The telephone systems in China were probably as frustrating as anywhere on earth. Native repairmen often sought to cure short circuits in twisted pair wire by shoving a stick or rock between the conductors or by propping up sagging line with a bamboo pole, clothesline fashion. Thus a call over the local lines was something of a gamble; the connection might be completed or not and, if completed, the caller might or might not be able to hear well enough to carry on a conversation.

By early summer of 1943, in addition to the units with the Air Forces and the 835th, the CBI theater had a radio intelligence company, the 955th, and a few V-mail detachments. Radio traffic was growing heavier and operations were becoming more interwoven.[128] For one thing, the increasing complexity of the radio nets, coupled with the necessity for frustrating enemy recep-

[125] (1) Maj L. P. Jacobs, Report of Activities, Theaters Section, 31 Dec 42; (2) Col G. L. Townsend, Report of Activities Theaters Section, 19 Nov 42. SigC 319.1 Diary Theaters Sec, Apr–Dec 42. (3) Activities of the Directorate of Planning, 31 Dec 42. SigC 319.1 OD–1 Daily Rpt. (4) Memo, Lt Col G. F. Moynahan, War Plans Br, for Prog and Statistics Br, 11 Mar 43, sub: Rpt of prog and problems, p. 2. Digest of Prog, 11 Feb–10 Mar 43. SigC Central Files.

[126] (1) Hawkins, *History of the 835th Signal Service Battalion*, p. 29. (2) Wagner, Army Command and Administrative Network, Pt. II, pp. 67–68. (3) Signal Corps History of China-Burma-India Theater (1944), Ch. I, p. 1. OCMH.

[127] (1) Wagner, Army Command and Administrative Network, Pt. II, pp. 78–79. (2) Hawkins, *History of the 835th Signal Service Battalion*, p. 35.

[128] Hawkins, *History of the 835th Signal Service Battalion*, p. 67. The expansion of the air transport center at Chabua, the India terminus of the airlift into China over the Hump, greatly increased ACAN nets and traffic loads. Wagner, Army Command and Administrative Network, pp. 76–77.

tion intensified the importance and the difficulty of controlling and changing frequencies, which first had to be approved by a board sitting at Washington and then by the appropriate authorities of India. Thus problems wider in scope developed as the networks in that land became more effective, taking the place of the individual problems which the early arrivals had met and conquered through individual ingenuity.

The globe-circling equatorial ACAN belt line came to earth at two points in India, at Karachi and at New Delhi. In its next jump, the belt line had first touched Australia at Melbourne. But in mid-1942 station WVJJ, Brisbane, replaced Melbourne, WTJJ, as the hub of ACAN nets in Australia and the Southwest Pacific. Brisbane also became the terminus of the direct circuit from WAR, by way of San Francisco. It would remain a key station until late in 1944 when the focus of military activity shifted farther north. Before the Papua Campaign late in 1942, Brisbane traffic had averaged only between 80,000 and 100,000 groups a day. Even so, the circuits had been so overloaded that traffic classified as routine and deferred had to be sent by officer couriers. The work load grew as the campaign progressed. Then, in February 1943, the pressure was somewhat relieved when the Army's single side-band multichannel sets became available on the Brisbane-San Francisco link. Traffic volume rose to 250,000 groups a day, 80 to 85 percent of it administrative business.

In March ACAN established an emergency link, Brisbane to Karachi, and replaced it a month later by a Brisbane-New Delhi channel. Soon 40-kilowatt equipment at Brisbane strengthened the links with the United States and with India. Belt line traffic from the West and the East passed through this main Australian terminal and on to other subordinate networks in Australia, New Guinea, and islands to the north. By the early summer of 1943 eight command and administrative circuits radiated from Brisbane: 10-kilowatt circuits to Honolulu and San Francisco, a 1-kilowatt circuit to Nouméa, 800-watt circuits to Adelaide River and Port Moresby, a 400-watt general headquarters circuit to Townsville, and 300-watt circuits to Townsville and Sydney.[129] Thus, as new conquests were made, the Signal Corps spread its radio and wire over widening areas, drawing outlying stations and subordinate networks into the flexible design of the administrative system, which changed to accord with strategic plans affecting island after island.

Before the end of 1942 the administrative communications situation had altered greatly in the Southwest Pacific. On the Brisbane-Sydney-Nouméa net, Sydney had become merely a stand-by station; little traffic went there and that little by way of Brisbane. The 832d Signal Service Company, organized from the various radio teams and base communications detachments in the theater, with headquarters at Sydney, was already operating the communications facilities at the advance base on New Guinea. Signal Corps men had gone into both Darwin and Port Moresby to set up the hubs of outreaching subordinate networks before the main bodies of combat troops arrived.

In the rear areas, Base Section 5 at Adelaide and Section 6 at Perth had practically been closed. Section 4 at Melbourne was

[129] (1) Wagner, Army Command and Administrative Network, pp. 27–28, including chart, Army Administrative Radio System, South Pacific, 16 Feb 43, rev. 7 Jun 43. (2) Memo, Col Treest, Dir of ACD, for Control Div, 22 Mar 43, sub: Digest of prog and problems, p. 1. SigC AC 319.1 Digest, 30 Jul 42–1 Dec 44.

dwindling although it would be retained because of the importance of the civilian agencies there. At Sydney, the 832d maintained the radio, teletype, and telephone facilities for the Services of Supply headquarters and for Base Section 7. At General Headquarters and Base Section 3 in Brisbane, the company was responsible for the large radio installations, including the construction and maintenance of the intercept station under General Headquarters and the radio stations working the United States, New Caledonia, and Hawaii, and for the telephone and teletype facilities required by headquarters and base as well. That section controlled one of the most important ports and the majority of the general depots, as well as the staging areas for the I Corps and the 32d and 41st Divisions supporting the Australian forces. The company's radiomen also operated and maintained floating radio stations used by task forces. In December 1942 one such vessel was anchored at Port Moresby, another was at sea. The Buna area, as soon as a supply base was set up there, needed signalmen, and the officers and men for these details came from the 832d Signal Service Company also.[130]

Other units meanwhile extended and improved military wire lines in Australia and in New Guinea. By planning and improvisation, under the spur of necessity, communications men pushed wire lines through the sodden, mud wastes of New Guinea in the rainy season, through the heavy jungles which stood like solid walls along the watercourses—all in the short space of days and weeks and months instead of years.

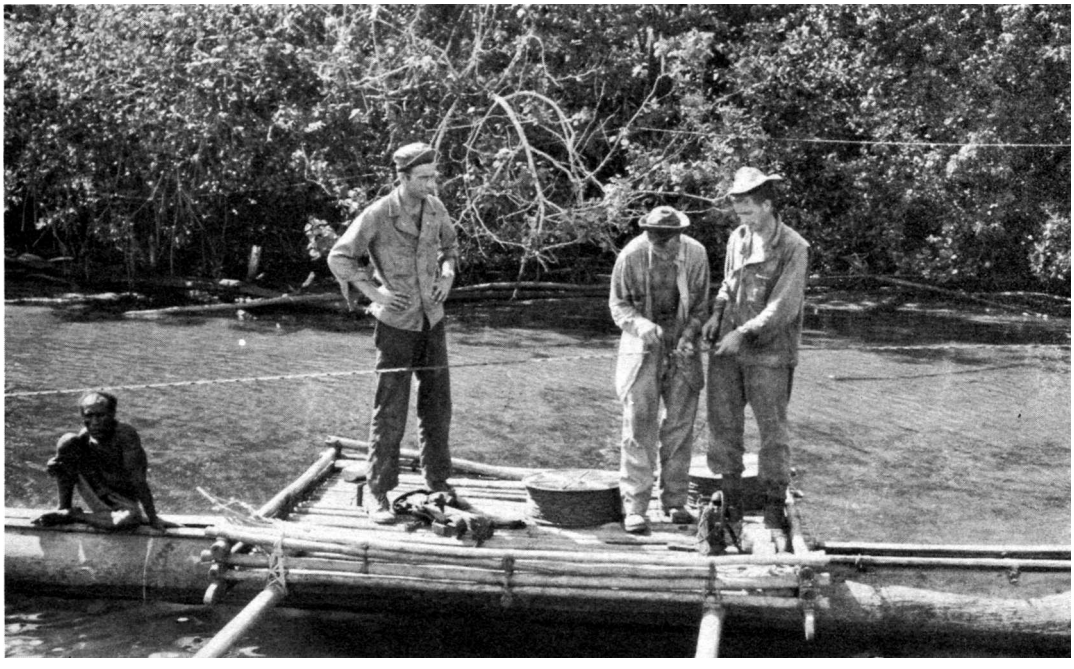
[130] Memo, Col Grable, OCSigO USASOS SWPA, to O/C War Planning Br OCSigO, 5 Dec 42. SigC AC 333.1 Inspec Trip to South and Southwest Pacific Areas, Maj Wharton, 1942.

Island Hopping Networks in the South Pacific

Island hopping in the Pacific placed new burdens on Army communications. When the military objective was a dot of land separated from other dots by vast expanses of water, the first communications need when an island objective had been won was a command channel to another island base. Obviously point-to-point radio was the only quick solution. Then, after the Army captured an island, the men had to make it a base for operations against the next enemy outpost. Any base requires an extensive wire system, in addition to radio channels, and the need for these wire networks had not been anticipated to the extent that radio had. Colonel Ankenbrandt remarked early in 1943 that the War Department apparently had "the impression that the South Pacific Area was a bunch of little tiny islands requiring no particular long wire lines; just put up a field switchboard, string a few locals, and there you are." [131] Instead, in some island bases, lines hundreds of miles long had to be built, generally over pathless mountain and jungle terrain.

Communications in the Pacific isles thus fell into three phases: assault, consolidation, and development. Assault communications were the responsibility of communications units serving with the combat troops. Theater signal officers were therefore concerned primarily with communications in the two latter phases. As soon as a tactical commander declared an island secure and free of organized enemy resistance, control passed to the island commander for consolidation and development. During the sec-

[131] Ltr, Ankenbrandt to "Duke" (Col Lanahan), 6 Feb 43, p. 5. SCIA File 8, Ankenbrandt-Newhouse Rpts, 1.



WIRE LINES IN NEW GUINEA. *Signal wire men repair a line across a stream (above) and hack their way through thick jungle to install a new line (below).*

ond, or consolidation phase, airfields were constructed, harbor facilities installed, and other fixed defensive installations built. All these demanded an extremely rapid build-up of internal communications.

To meet the requirements signal troops laid a temporary wire net, using rubber-covered cable or field wire and a field-type telephone exchange. To supply army airfield facilities mobile airways communication equipment was landed at the earliest possible moment. The matter of frequency assignments, always critical, had to be considered at once. Therefore, as soon as the senior commander went ashore, a joint Army-Navy communications center was set up, where all point-to-point administrative and operational circuits terminated.[132] All cryptographic facilities, those of the tactical troops and of the Air Forces excepted, were established at the joint center. Message traffic intended for local distribution went out over landline teletype circuits or in the hands of messengers.

Often a captured island became a base for further operations. Thus the third, the development phase, soon overtaxed the temporary communication system and required that more stable and more extensive networks be provided. A base needs airfields, weather stations, airways terminals, warehouses, repair and maintenance depots, docks, and tons upon tons of equipment to supply troops.[133] Without the adhesive and integrating powers of a suitable communications system, this tremendous gathering-together of command, operations, and supply activities would have fallen apart. It was the function of the Signal Corps to provide the glue, unobtrusively but surely. The demand was expressed by the 41st Division commander in the Southwest Pacific theater: "The chief of staff and myself have a limited knowledge of Signal Corps equipment. . . . When the signal communications function properly, as we expect they will, expect no praise, but should they fail, expect plenty of hell." [134]

In the wake of the northward advance to push the Japanese from Guadalcanal, the headquarters of the South Pacific theater had also moved north, in October 1942, from Auckland, New Zealand, to Nouméa, New Caledonia. There the headquarters signal detachment (it had just arrived the month before) provided all communications until the 230th Signal Operation Company entered the scene in December. To its credit, the small detachment met and conquered at least some of the communications obstacles it encountered, although many remained. In this area the administrative networks were very closely integrated both with the tactical nets and with the communications systems of the other services. The men here, as in the China-Burma-India theater, had to improvise in order to overcome equipment shortages, turning a hand to many a task not taught in training schools. They had to fit their operations into

[132] Rpt of Liaison Com Officers to Joint Staff Planners, Joint Command (Communication) Centers for the Island Bases in the South Pacific, 15 Jul 42. SigC OT 322 Gen.

[133] Brig Gen Carroll A. Powell, "Communications in Pacific Ocean Areas," *Military Review*, XXV:10 (January, 1946), pp. 30–34. These rear area communication needs led the War Department, a few years after World War II, to create a new type of versatile Signal Corps unit, the Signal Support Battalion. Two such units, the 39th and the 379th Signal Support Battalions, were active by 1953. Signal Corps, *Technical and Tactical Training Aid*, II:2 (March–April, 1953), p. 13. SigC Hist Sec File.

[134] Lt Col Irwin C. Stoll, Div Sig Officer 41st Div, A Chronological History of Signal Corps Operations of the Sunset Division in the Southwest Pacific Theater of War, p. 2. SCIA File 71, Stoll Rpts.

a closely knit joint Army, Navy, and Marine pattern in which their individual installations were vitally important to the functioning of the whole. Net procedure was paramount. The codes they used came from both Washington and Hawaii, and until a central code-issuing office was established in the theater early in 1943, the co-ordination of these was difficult. Both Washington and Hawaii assigned frequencies, but often the operators could use the assignments of neither because of radio interference from Australian stations employing the same wave bands. Additional interference came from installations located on other islands and on the Asiatic mainland also, which radiated over un-co-ordinated channels. The channel back to the United States was overloaded with reports which Washington required be sent by radio. Gradually these difficulties diminished as communication co-ordination and control improved.[135]

In the South Pacific, as in the Southwest Pacific Area, wire needs presented an immediate requirement which was not met as readily as the need for radio networks. When Colonel Ankenbrandt sought supplies for more telephone, more telegraph, and more teletype circuits, especially to serve the airfields, the Army Communications Division in the Washington headquarters of the Signal Corps sent Maj. Allen E. Wharton to the area in November 1942 to get firsthand information on what was needed and to help plan the telephone systems for New Caledonia and Fiji. Wharton's survey accented the inadequacy of T/BA equipment—inadequate, that is, to provide for island after island, where each new occupation demanded a wire system which had to be installed before the systems in the rear areas could be ripped up and moved, if they could be released at all under plans for occupying the bases. Some equipment could be leapfrogged for a second forward movement. But, at best, Pacific-island warfare expended communications equipment extravagantly, especially wire. Forward movements were contingent upon the tactical situation. The long shipping time from the United States precluded waiting for the development of a plan before requisitioning the communications material to support it.

Following the general communications design, administrative radio networks went into these islands before the wire systems could be built, and equipment was scarce for even these. Colonel Ankenbrandt pointed out to Major Wharton, "We have rebuilt every piece of equipment available in this area for use on these networks and are woefully short." Transportation vagaries contributed to the shortage. For example, a shipment of some 14,000 pounds of equipment intended for a station on Espiritu Santo was delivered at Plaines des Gaiacs in central New Caledonia. In March 1943 Ankenbrandt reported supply incidents "to make your hair curl." A ship which had arrived 22 December, containing 800 miles of wire and other items sorely needed, was not moved to a discharge point until 2 March. Another vessel arrived the day after Christmas with an SCR–511 and seven RC–52 radio sets. For six weeks it sat in the harbor still loaded; then it was sent on to Espiritu Santo where it remained a while, and finally it was ordered to sea again with its valuable cargo still on board. Under such circumstances, shipments became hopelessly lost and were not discovered for months. And before depot companies arrived in the area

[135] (1) Notes from a talk delivered by Col Ankenbrandt, 2 Dec 43. Southwest Pacific Folder, SigC Hist Sec File. (2) Ltr, Ankenbrandt to Lanahan, 23 Sep 42. SCIA File 8, Ankenbrandt-Newhouse Rpts 1.

to care for the signal equipment, even what had been unloaded was not always available to those needing it.[136]

A prevailing practice of grabbing whatever equipment might be acquired without regard to the consignee was rampant, and it worked to the advantage of nobody. Even material that had been placed in depots was not always readily available. The administrative organization placed island supply under the service commander, not the island commander. Hence the island signal officer had no real control over his signal supply except through co-ordination with the signal supply officer. Colonel Ankenbrandt emphatically expressed the opinion that setting up a complete services of supply in the Pacific, in the form it took, greatly complicated rather than simplified the supply problem. Getting material for airways systems was even more complicated, because the Hawaiian Department was responsible for its supply. Further, the requisitioning of items common to both the administrative and airways systems, such as telephones and field wire, produced another area of confusion.[137]

Not all the supply troubles were local. Some stemmed straight from Washington. Upon a first look at the power situation, Ankenbrandt had requisitioned twelve electric power units, 25-kilowatt capacity, capable of 24-hour operation. Skeptical Signal Corps officers in the Washington headquarters wanted to know exactly what purpose the power equipment was to serve. By that time a second look had convinced Ankenbrandt that the need for such units was immediate and widespread. Yet it took an exchange of six telegrams to convince Washington. In this connection he affirmed that the SCR–299's "paid for themselves many times over . . . even though they are not always used by the unit that brought them down." The sets were invaluable not only because of the usefulness and popularity of the radio itself but especially because of its excellent power unit PE–95. Its size made it usable in many places and it was durable enough to provide steady 24-hour operation for most of the small radio stations. The smaller PE–75 power units soon landed on the scrap heaps, completely worn out, Ankenbrandt complained. "We have found ourselves behind the eight-ball," he said, "every time we count on the power plant [being] shipped with a radio station . . . and we end up with a power unit less a radio station, or a radio station less a power unit." [138]

Plans for administrative communications in the South Pacific contemplated that when the Army and the Navy operated in close proximity, both would use either the Army or the Navy station already in the area, setting up cross-channel links as needed. However, Colonel Ankenbrandt really favored four major radio channels to link the main bases: a complete Army administrative net, a complete Navy administrative net, an Army airways net, and a Navy airways net—these in addition to the various local tactical air and ground communications required. He noted, "It is good in theory to combine facilities and use the same

[136] (1) OCSigO R&W Action 1, Wharton to Chief of Plant Br OCSigO, 7 Jan 43, sub: Rpt on temporary duty orders, 28 Oct 42, South and Southwest Pacific—Wharton. SigC AC 333.1 Inspec Trip to South and Southwest Pacific Areas. (2) Ltr, Ankenbrandt to Lanahan, 3 Mar 43. See also SigC Opns Br 111, Ankenbrandt's Rpts. Regarding the shipping problem, see Leighton and Coakley, *Global Logistics and Strategy: 1940–1943,* Ch. XIII.

[137] Ltr, Ankenbrandt to Lanahan, 6 Feb 43. SCIA File 8, Ankenbrandt-Newhouse Rpts 1.

[138] Ltr, Ankenbrandt to Lanahan, 2 Feb 43, pp. 4–5. File cited n. 137.

channels for multi-purposes, but in actual practice when the chips are down . . . then the need for all these facilities becomes readily apparent . . . ."—as it had during the fighting on and around Guadalcanal. He also noted that where "the regular tactical channels are used for airplane traffic, it is the rule rather than the exception to have the plane get in before the message, often to the embarrassment of all concerned—such as AA fire and pursuit attack!" [139]

Although the Navy's circuits were better manned, in numbers and in quality, than those of the Army, they were crowded with the Navy's own traffic. The Army's administrative messages had to wait. Comparatively, from the standpoint of both communications men and equipment, the Air Forces on New Caledonia were better supplied than the Ground Forces, Ankenbrandt asserted, although, in setting up troops for the island air commands at New Caledonia and Fiji, the Air Forces had made no provision at all for communications troops and had to borrow from the tactical units or from the island commanders.[140]

Originally the plans for the South Pacific administrative radio network had called for a 15-kilowatt station at Nouméa to work Auckland and Brisbane, and four 300-watt stations, one each at Nouméa and Efate and two at Espiritu Santo. Equipment for the stations had arrived in Australia on 10 December 1942. But the headquarters had already moved north. The plan no longer applied in its entirety, and makeshift stations were in operation. Nouméa replaced Auckland as the pivot of the administrative radio networks in the area and became the South Pacific terminal of the WAR circuit by way of Hawaii.[141] Circuits from Hawaii also terminated at Auckland and Tutuila. Direct circuits were in operation from Nouméa back to Brisbane and Sydney, and other circuits radiated to Auckland, Suva in the Fijis, Guadalcanal, Espiritu Santo, and Efate.

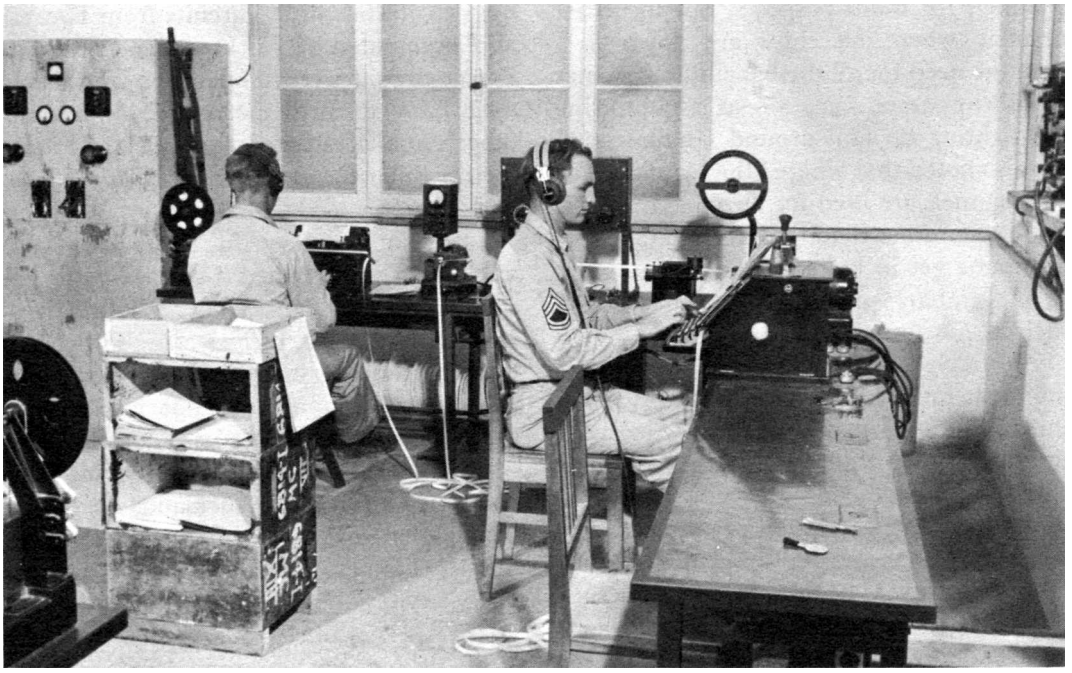
The Nouméa-Espiritu Santo-Efate triangle was maintained by a commercial Hallicrafters set, an HT–4, rebuilt to operate above eight megacycles. The Navy provided housing and power for the Nouméa installation and used it jointly with the Signal Corps. Efate used Navy equipment exclusively until Army equipment could be received. At Auckland, the Signal Corps men operated a Navy TCC (Collins 10-channel) transmitter, located at the Navy's station. In December the station got an HT–4 modified to transmit on three Army frequencies with directional antenna. At Suva also the Army and Navy combined their facilities, the Navy supplying the power. Suva used a rebuilt SCR–299 transmitter until its 300-watt equipment should be received. The Guadalcanal station went on the air in December 1942, using an SCR–197. Espiritu Santo, headquarters of the Thirteenth Air Force, was linked into the Nouméa-Guadalcanal circuit, as well as into the Nouméa-Efate-Espiritu Santo network. On 1 February 1943 Nouméa opened a 15-kilowatt manual circuit, soon changed to Boehme high-speed operation, for joint Army-Navy communication with San Francisco.

There had been a little coolness, according to Ankenbrandt, between the Nouméa and the San Francisco ACAN operators because the San Francisco radiomen were unwilling to work the island station manu-

[139] Ltr, Ankenbrandt to Lanahan, 23 Sep 42, pp. 5–6. File cited n. 137.

[140] Ltr, Ankenbrandt to Lanahan, 6 Feb 43.

[141] CSigO, Annual Report, 1943, p. 319.



BOEHME HIGH-SPEED OPERATION *in the base message center at Nouméa.*

ally. When they could not clear traffic automatically, they "dumped" it on Brisbane for manual relay to Nouméa, thus delaying the messages and creating a larger margin for error.[142] In the early summer of 1943 an additional 1-kilowatt transmitter was installed at Nouméa to provide an extra tactical channel between that point, Brisbane, and Port Moresby. As more and more equipment began dribbling into the South Pacific theater, fixed Signal Corps facilities, including the new radioteletype, gradually replaced the mobile SCR–197's, 188's, 299's, Navy radios, and old commercial sets which had been pressed into service to establish the first ACAN nets in those quarters of the Southern Hemisphere.[143] Meanwhile officers in the field had learned to modify their demands, and inexperienced technicians had trained themselves in the use of the equipment they had at hand and had accomplished more with it than either they or anyone else had thought possible.

The installation of AACS stations in the South Pacific theater had been very slow, partly because there were so many factors not under the control of the Signal Corps. The buildings, as in other places, were constructed by the Engineers from materials provided by the Services of Supply in the area. Like other service troops, the Engineers available were few. It was impossible

[142] (1) Memo, Ankenbrandt, 29 Oct 42. SigC AC 333.1 Inspec Trip to South and Southwest Pacific Areas. (2) Ltrs, Ankenbrandt to Lanahan, 1 Apr and 14 Apr 43. SCIA File 8, Ankenbrandt-Newhouse Rpts 1.

[143] Ltrs, Ankenbrandt to Lanahan, 2 Feb, 1 Apr, and 5 Jun 43. File cited n. 142.

for the Signal Corps to install equipment with speed. A score of Army Airways Communications System installations under way in the 20th Region, AACS, were put up by a small group of officers and engineers loaned by the Hawaii Signal Office.

It was the old story of compromise between the users who wanted the equipment on the air at once and the radio engineers who wanted to do a thorough fixed installation job, such as they had done in peacetime. Early in 1943 the Signal Officer of the South Pacific Command established a section in his headquarters to handle all AACS communications, following the general desires of the Air Transport Command, but catering particularly to the needs of the local cargo planes engaged in moving emergency supplies and evacuating the wounded. Stations were then in operation on Guadalcanal, Espiritu Santo, Efate and at Plaines des Gaiacs, Tontouta, and Nandi. Other Pacific stations, controlled directly out of Hawaii, were operating at Samoa, Aitutaki (Cook Islands), Bora-Bora (Society Islands), and Penrhyn (Tongareva), most of them using makeshift equipment. Gradually, however, the improvised facilities on the AACS network were replaced with standard fixed radios and navigational aids such as homing stations, radio ranges, radar beacons, control towers, and ground direction-finding and instrument-landing equipment.[144]

Radar equipment was on hand at most of the air bases, but there were too few skilled crews to install it. The theater wanted no more SCR–271's. An SCR–270 could be installed in a week or ten days by the operating company but it took months to put a 271 on the air, and there were enough of the 270's on hand, including those supplied by the Navy and the Marine Corps, to provide aircraft warning service. New Caledonia had three SCR–270's in operation and three SCR–271's on hand awaiting the arrival of the 673d Aircraft Warning Company to install them. The Coast Artillery was operating five SCR–268's along the southeast coast of the island. Fiji had three SCR–270's in place, with five SCR–271's on hand for installation by the 672d Aircraft Warning Company when it should arrive. On Espiritu Santo two reporting platoons of the 674th Aircraft Warning Company were awaiting water transportation for their two SCR–271's, the only means of getting them to their sites. So it was at other points.[145]

Radio and radar needs in the South Pacific had been at least partially anticipated. But wire nets had not. Telephone construction slowed almost to a standstill during the winter of 1942–43 for want of switchboards, field wire, open wire, insulators, construction troops, teletype machines—practically everything needed for telephone systems. Colonel Ankenbrandt said in February 1943: "Circuits do not exist and my guess is they will not for six more months." He borrowed from the Navy and the Marine Corps in an attempt to make wire ends meet. He managed also to get 1,000 miles of heavy field wire of Australian make, hard to handle and hard to ship, but satisfactory once it was installed. Even the full amounts of T/BA equipment seldom accompanied the signal troops who made the long journey down under from the United States. The 905th Signal Company, Depot, Aviation, for example, arrived without switchboards or teletypewriters. The theater signal officer

[144] Ltrs, Ankenbrandt to Lanahan, 2 Feb and 1 Apr 43. File cited n. 142.

[145] Ltr, Ankenbrandt to Lanahan, 3 Mar 43. File cited n. 142.

pleaded: "Surely production is increasing all the time and you should be able to meet some of these requests, at least partially, soon." Even more than wire equipment, Colonel Ankenbrandt needed wire-construction units.[146]

The fact that he himself, during the preliminary planning at Washington, had shared the common view that wire communication would be relatively unimportant on the island bases did not ease his anguish. On Fiji the division signal company organized a provisional construction unit out of tactical troops and set the men to building a pole line to connect Suva and Nandi. Defense strategy called for the defense of the harbor at Lautoka and added another area to the list of places desperately needing wire networks. It would have been easier to build the Suva-Nandi line along the road, paralleling the commercial line, but Signal Corps officers chose a more difficult inland route, half the length, in order to conserve the small stock of wire and protect the line should the enemy land along the coast. On Guadalcanal nearly 1,000 miles of open wire had been unloaded by the end of February 1943 and Signal Corps men began construction on a tenpin crossarm line from Koli Point to Lunga. A similar line was still needed on Espiritu Santo.[147]

In February 1943 Ankenbrandt painted a dark picture of the wire situation and of the code situation, too. But about radio he was more hopeful. To improve the code situation he and his Navy colleagues took a few risks frowned on by Washington. They placed cipher machines in the forward areas—with appropriate safeguards—and brought about at least a 200-percent improvement in communication with Guadalcanal, Espiritu Santo, and Efate.[148] It was April, however, before the first repair kit and two trained repairmen arrived to service the sixteen cipher machines employed at message centers on the various islands in order to supplement the strip cipher systems and M–209 equipment.[149] Meanwhile cryptographic officers arrived from Washington to supervise code activities and to serve as itinerant inspectors and instructors in code procedures, thus further improving the situation.

By spring 1943 the administrative radio net had been rearranged to serve existing needs and to provide for extensions to the north. The Suva-Hawaii channel was discontinued except as a stand-by, after an analysis of the traffic revealed that only about 1 percent of the messages it carried were addressed to Hawaii. Over one third were relayed back to Nouméa. By discontinuing this channel and establishing point-to-point links from Suva to Nouméa and Nouméa to Auckland, it became possible to cut down the traffic on the air and to operate the main network much more efficiently. Aitutaki and Penrhyn were then linked to Suva. A channel from Guadalcanal reached out to the 43d Division, which had landed on the Russell Islands late in February. Traffic to Tongatabu and Bora Bora in the South Pacific continued to pass over the Navy's circuits.[150] Equipment was on hand for a semifixed station on Guadalcanal and the station was expected to be in operation by the end of April. Although the Japanese were still bombing the island occasionally, the strategical outlook there was so bright that Ankenbrandt decided against dugouts to house the equipment. "Camouflage and a

[146] Ltr, Ankenbrandt to Lanahan, 6 Feb 43.
[147] Ltr, Ankenbrandt to Lanahan, 3 Mar 43.
[148] Ltr, Ankenbrandt to Lanahan, 6 Feb 43.
[149] Ltr, Ankenbrandt to Lanahan, 1 Apr 43.
[150] *Ibid.*

few sand bags," he felt, would do just as much good, "except in the case of a direct hit, then nothing would be any good." [151]

Meanwhile, as plans for projecting fixed ACAN systems into newly occupied islands took form, tactical signal troops were moving forward with the advancing XIV Corps. The corps had no organic service troops, and Col. Evan D. Cameron, the corps signal officer, used detachments from the 26th Signal Company of the Americal Division and from the 25th Signal Company of the 25th Infantry Division in order to establish headquarters communications until other troops should arrive.[152]

The 26th Signal Company under the command of Lt. Col. Robert B. H. Rockwell had landed on Guadalcanal in December 1942 with the Americal Division and had taken over communications from the marines.[153] The wire lines serving the division headquarters extended also to naval headquarters, to naval construction and service units, to Marine service units, to other Army service units in the area, and to Air Forces units. The initial radio installations consisted of a message center in the trailer of an SCR–197–C at Americal Division headquarters, with machine cipher equipment. The transmitter was housed in a truck located nearby, both installations being set against the south side of a steep ridge. They were well camouflaged by trees and nets. The radio intelligence platoon was formed from men of the radio and telephone sections of the company who had had no previous training in that work. They had three obsolete SCR–206–A direction-finding receivers, but no plotting boards or other equipment usually associated with an intelligence company. An infantry officer, well grounded in radio engineering, took over the training of the unit and, by checking its data with a Navy direction-finding station equipped with an Adcock DF, he was able to provide at least the direction-finding aspect of Radio Intelligence duties.

In December and January the aircraft warning system consisted of two SCR–270's located south of Henderson Field, Radar 1 and 2 operated by the Marine Air Wing, and one located at Koli Point operated by Marine antiaircraft forces. The marines had laid a telephone circuit from Koli Point to Radar 2 and shared with the 26th the duty of maintaining the line. The Ilu River served as a convenient dividing line to apportion responsibility between the two services. The 26th laid the circuit between Radars 1 and 2 at Henderson Field and wing operations. The Australians operated valuable coast-watching stations on Guadalcanal and on other nearby islands.[154]

Following the 26th in a few days, the 25th Signal Company, with the 25th Infantry Division, filled to strength in Hawaii from other units and supplied with such T/BA equipment as the Hawaiian Signal Officer could spare, landed on Guadalcanal a week before Christmas to install wire cir-

[151] *Ibid.*

[152] Lt Col M. P. Chadwick, Experiences with Signal Communications on Guadalcanal. Southwest Pacific Folder, SigC Hist Sec File.

[153] For caustic comments, attributed to General Vandergrift, upon the communications and communications equipment (Navy-Marine) during the early stages of amphibious operations against Guadalcanal, see Min of Meeting Held 4 Feb 43, attached to OCSigO R&W Action 2, Col Watters to Lanahan, 19 Feb 43, sub: Data secured from 593d Engr Amphibian Brigade. SCIA File 121, Vandenberg Rpts.

[154] Ltr, Col Rockwell, Sig Officer, Americal Div, to Sig Officer, 18 Apr 43, sub: Sig officer's rpt Guadalcanal Campaign period 2 Dec 42–3 Mar 43. File cited n. 153. The marines were operating SCR–268's on the island as gun-laying sets with AAA guns.

cuits and set up radio networks for the attack on 10 January 1943.

The soldiers in the wire-construction platoons, having no carbines, were armed with rifles, the drivers of their jeeps with Tommy guns. Jeeps and trailers carried all the wire they could hold. In the forward positions the signalmen, without bolos or machetes to cut the trails, pulled the wire by hand through the mysterious and malevolent jungle, moist and stifling with its stench of vegetable decay. They strung wire on trees across miles of water-covered bog where the mud was too deep for a man on foot and the water too shallow for a boat. But somehow they managed. Then, as frequently happened, after the wires had been laboriously strung, the Engineers, opening roads, chewed them to pieces. Near the fighter strips, particularly, Japanese bombs cut them up. Then the crews went out to repair the lines, often under fire from snipers hidden in the dense undergrowth. At night the signalmen worked in the dark, by feel, climbing trees to locate breaks in the lines, using test telephones on each line in turn, then circling about, trying to find both ends of a broken wire, sometimes working all night long without success. They coveted one feature of the Japanese wire equipment for their own—but only one—the bright yellow color of the field wire which made it visible in the dark, dank jungle, even at night.[155]

Neither civilian experience nor Army training in the United States, at its best or at its worst, had prepared men for maintaining communications under conditions such as these troops found on Guadalcanal during 1942–43. In training camps they had griped at the rigors of basic training, but now they found that physical fitness was their greatest asset. Anything that had taught them endurance paid dividends as they cleared the jungle or dug foxholes in coral.

In January 1943 the 69th Signal Service Company arrived to augment the Signal forces on Guadalcanal, bringing with it a pigeon detachment. Lacking officers, the detachment acquired an infantry lieutenant to take command. The men established lofts for the birds on Guadalcanal and on Tulagi Island, about twenty miles to the north, and flew the birds back and forth with fair success. Training the pigeons to fly from ships at sea to their lofts was more difficult. Most of the pigeons on hand were old birds, slow to learn new tricks, and there is no record of their performance in competition with electrical communications.[156] Meanwhile Lieutenant Van Ness's unit of the old 162d Signal Photographic Company had arrived on Guadalcanal to make its first combat pictures.[157]

Although the 69th did not land until 17 January 1943, the company nonetheless saw considerable activity before Japanese

[155] The enemy's telephones were noisy, 1938 models, always in need of repairs. Captured radio equipment also consisted of 1938–39 models. The tubes were poorly made and microphonic, the insulating materials inferior. Chadwick, Experiences with Signal Communications on Guadalcanal.

The Chief Signal Officer seriously considered having Signal Corps wire colored, but to introduce the additional process meant reducing deliveries to the extent of about 9,000 miles per month, at a time when deliveries were not meeting demands. Therefore the change was not made. OCSigO R&W Action 1, Maj Gen H. C. Ingles to Chief of Traffic Opns Br, 11 Aug 44, sub: Sv msg to Rumbough. SigC File F. [Deputy CSigO File.]

[156] Historical Data 26th Signal Company, Solomon Islands Campaign, Americal Division, 1943. Opns Rpts 300 Sig-0.2.

[157] Memo, Ankenbrandt, Answers to Questionnaire for Pictorial Division, 29 Nov 42. SigC AC 333.1 Inspec Trip to South and Southwest Pacific Areas.

resistance collapsed on 9 February. It installed a tactical control telephone circuit for the 2d Marine Air Wing at Henderson Field; helped the 26th to construct field telephone lines for the Americal Division; and augmented the communications of the 31st Bomber Squadron.

Finally, a detail of seven men stepped into a boat for the opposite, or southwest, side of the island, aiming, first, to establish a radio station at Beaufort Bay which could transmit warnings of enemy ships and aircraft detected by a radar already functioning there; and, second, to provide communications for the 132d Infantry, moving from Lavora Pass up the southwest coast toward Cape Esperance.

Arriving at Beaufort Bay on 26 January, the detail split to accomplish its double mission. One party installed the radio equipment, laid a telephone link to the radar station, and established a channel with the radio station at Henderson Field. The second party, equipped with a portable radio, continued on toward Lavora Pass, about thirty miles up the coast. On the way, the man in charge fell ill with malaria. Learning of this from a native messenger, the noncommissioned officer charged with the new radio station at Beaufort Bay had no choice but to leave it in the care of the operators, who now worked as long as thirty-five hours at a stretch. Traveling for three days and nights on foot and in native canoes, the sergeant joined the second party. Their boat was strafed by unidentified airplanes, but without casualties. The radio was water-soaked, but repairable. After patrols had cleared the beach of enemy machine gun nests, the Signal Corps party went ashore, set up the radio and maintained it.[158]

For such actions, the laconic credit line the Signal Corps men received read something like this: "Rations, water, wire and communications were brought forward promptly." [159] At the end of January a detachment of the 26th embarked for Cape Esperance to provide communications for to 2d Battalion of the 132d Infantry whose mission was to attack the Japanese from the rear. Other men of the company, who had been assisting the Australians in the operation of an interisland aircraft warning and coast-watching net, returned to join the organization in February, and on 19 February the 803d and 807th fixed-station radio detachments arrived to develop the permanent network in the conquered area. Then the 26th prepared to withdraw to the Fiji Islands, and on 6 March the first echelon landed on Viti Levu. Joining the 37th Signal Company there, the men began establishing a communications system for the Americal Division, also withdrawn from Guadalcanal. The work was not heavy, however, and training courses were set up, as much to occupy time as to develop technicians.[160]

From Guadalcanal, other Signal Corps troops advanced to the Russell Islands. A detachment of the 43d Signal Company and one platoon of the 579th Signal Battalion went ashore with the first waves of the 43d Division. The Russell Islands were strategically located between Guadalcanal and New Georgia, the latter occupied by about 15,000 enemy troops. Active enemy airfields, naval bases, and troop concentrations throughout the northern Solomons, New Britain, and New Ireland made antiaircraft

[158] History of the 69th Signal Company, Service Group. AF Archives, SIG-69-HI, 1 Jan 43. (Also SIG-1069-HI, 1 Apr 43, 5393-27.)

[159] Operations of the 25th Infantry Division on Guadalcanal, 17 Dec 42–5 Feb 43. Opns Rpts 325-33.4 (2667) Sec. II, p. 31.

[160] Historical Data, 26th Signal Company, Americal Division, 1943.

and shore defenses urgent in the Russells. On the day of the landing, an hour before even the field kitchens were functioning, the Signal Corps men established telephone communication to all major elements of the landing force in order to augment air, warning, and command radio, which had been available since the moment of landing. Five days later, the 579th Signal Company, Radar, was in position on high ground on Pavuvu, the second objective of the occupation. But radio silence precluded the operation of its radar until 6 March, when the Japanese launched their first air assault, inflicting damage to supply dumps and buildings. Radio silence was lifted then and the company began operating. Within a few days a Navy SCR–270 entered the warning network, which thereafter regularly picked up planes 80 to 90 miles away and frequently at distances of 140 to 150 miles. In all air attacks except the first the troops were alerted in time to get fighter planes from Guadalcanal.[161]

Guadalcanal imposed the first severe and extended testing of the Pacific's communications equipment. The sound-powered telephone and the familiar EE–8–A field telephone were excellent. The switchboard BD–71 was too heavy; battalions needed something lighter like the old World War I BD–11. The assault wire was good but too fragile and easily damaged. Dampness attacked tremendous numbers of batteries, corroding the terminals and decomposing the paper containers. The old-type walkie-talkies, SCR–194 and 195, were a disappointment. These radio sets gave poor results because the jungle blocked the line-of-sight transmission, which their very high frequencies required. But because the Navy's type TBY gave somewhat better results, Colonel Ankenbrandt was unwilling completely to dismiss very high frequency radio for jungle operations.[162]

The long-range vehicular SCR–193 was best when put to use for air-to-ground and regiment-division-corps communications. Several sets had been installed in Engineer half-tracks. The SCR–511 fell a victim to dampness all too often, but when it could be kept in operation it was far better than other small portable radios. Infantry communicators liked the SCR–245, especially for spanning the frequencies between 2 and 6.5 megacycles. Nobody liked the SCR–284, which was neither light enough for the men to carry with any ease nor rugged enough to be carried in jeeps. Further, its hand-cranked generator made such a noise that it invariably drew Japanese fire.[163] Nevertheless, some of the users considered this set highly dependable, if unpopular. Altogether, only a relatively small percentage of the signal equipment was rendered useless during the campaign, perhaps 20 percent at the point of greatest action. During the 10–25 January offensive a detachment of the 175th Signal Repair Company, serving with the 25th Signal Company, put seventy radio sets in operating condition and returned them to the users, usually within twenty-four hours.[164]

[161] (1) Hq 43d Inf Div, Report of Occupation of the Russell Islands, 8 June 1943. Southwest Pacific Folder, SigC Hist Sec File. (2) Miller, *Guadalcanal: The First Offensive,* pp. 354–55.

[162] Ltr, Sig Officer USAFISPA to CSigO, 15 Jan 43, sub: Tactical ground radio sets. Rpts, South Pacific Area, SigC Hist Sec File.

[163] (1) Hq XIV Corps, 3 Jun 43, Informal Rpt on Combat Opns to CG, South Pacific, Sec. Id, Communications, pp. 17–20. WDGS G-3 Guadalcanal Opns 3.2.17. (2) Miller, *Guadalcanal: The First Offensive,* p. 317.

[164] (1) Chadwick, Experiences with Signal Communications on Guadalcanal. (2) Hq USAFISPA G-2 Info Bulletin 2, 11 Jan 43, sub: Observations,

By February 1943 Colonel Ankenbrandt was able to report that after a "*very slow*" start (the italics are his) the Signal Corps had done "a good job" for the Army troops in the South Pacific Area. He felt that the Army was keeping up its end of the joint operation despite the Navy's obviously higher "standard of living." He listed the six main categories of signal activity in the area in the order of their excellence, as follows: radio, units, codes, supply, personnel, and telephone.[165] A month later so many complicating factors had arisen that he could no longer attempt to rate the activities comparatively, he wrote to Lanahan, but he thought that the theater was at least beginning to better a situation wherein it had been merely "getting by." [166] Finally, early in June 1943, he felt sufficiently encouraged about the ACAN system in his area to write: "Our Army Administrative Net has shaken itself down operationally . . . it is working very well indeed in my opinion." He took particular satisfaction in the fact that "several of the Junior Navy Officers and Radiomen who are familiar with our labors through the various joint stations we are operating down here have stated privately to us that our circuits are working better and more efficiently than their own!" [167]

By now, in mid-1943, Signal Corps men in the South and Southwest Pacific Areas, and their communications equipment as well, had undergone the tests of jungle warfare. Many Signal Corps units not mentioned here were undergoing the same experiences and meeting them with the same fortitude. The remarks of Maj. Gen. J. Lawton Collins, commander of the 25th Infantry Division, concerning the performance of the soldiers of the 25th Signal Company on Guadalcanal, could truthfully be applied to many others: "Practically all of the critiques of maneuvers that I have heard have damned the Signal people. We did not have that here, which is a tribute to the Division Signal Company and the communications personnel throughout the division. Personally, I don't believe that any men in the Division worked as hard as the signalmen, particularly the linesmen. I have always taken my hat off to them." [168]

Alaska and the Aleutians

The South Pacific island approach toward Japan had its counterpart in the north, where the Signal Corps was providing Army communications through the northwest reaches of the North American mainland and outward into the Aleutian Islands chain. All the military activity going on in the area had a twofold purpose: to lay foundations for strong permanent Alaskan defenses and to provide facilities for American landings in the Aleutians to dislodge the Japanese entrenched there. Toward the first of these objectives, the Signal Corps was devoting special effort to complete the telephone pole line which paralleled the Alaska Military Highway (or Al-

Guadalcanal. Rpts, South Pacific Area, SigC Hist Sec File.

[165] Ltr, Ankenbrandt to Lanahan, 2 Feb 43. SCIA File 8, Ankenbrandt-Newhouse Rpts 1.

[166] Ltr, Ankenbrandt to Lanahan, 3 Mar 43. File cited n. 165.

[167] Ltr, Ankenbrandt to Lanahan, 5 Jun 43, p. 1. File cited n. 165.

[168] 25th Div After-Action Rpt. Operations of the 25th Infantry Division on Guadalcanal, 17 December 1942–5 February 1943, p. 167. General Collins no doubt had in mind such maneuver reports as those of 1939 and 1940 which indeed brought out the weaknesses in Signal Corps units and equipment of those militarily emaciated prewar years. Terrett, *The Emergency*, pp. 160, 176ff.

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can, as it was popularly called) across Canada to the Alaskan subcontinent.

Alcan Highway Pole Line

The telephone pole line project had got off to a slow start. Building the line was not considered to be a tactical project and, in any event, the Signal Corps had too few construction troops available to handle such an assignment.[169] Therefore the Corps of Engineers had contracted with a civilian construction company to build the line on a cost-plus-fixed-fee contract to be administered by the Engineers, with the Signal Corps' Maj. Ora F. Roberts, as resident engineer, to supervise the technical aspects of the work. The Signal Corps felt that this arrangement left it without any effective method of enforcing its standards of workmanship and complained of unsatisfactory progress and poor quality of work. The construction company retorted that it was Signal Corps changes in plans and specifications which accounted for much of the delay, and that Signal Corps methods of procurement had added excessive costs to the project.[170]

It was certainly true that delivery of materials was long-delayed, but not all the difficulty was due to Signal Corps negligence. All the materials were purchased through the Office of the Chief Signal Officer and the Plant Engineering Agency. Requirements for the pole line were superimposed upon a mountain of communication equipment needs for other areas, and it was very difficult to force through the priority ratings necessary to get material. Furthermore, the initial plans had failed to include electric power supplies. The planners had assumed that the Corps of Engineers would provide them, but by February 1943 it was plain that the Signal Corps would have to accept full responsibility. Trucks, too, had been almost impossible to get in adequate numbers. On at least one item, the Signal Corps' own procurement procedures had been at fault. In August 1942 all the requirements for crossarms and hardware had been filed with the Philadelphia Signal Corps Procurement District, with a request that the entire job be turned over to the Graybar Electric Company, which possessed the necessary raw materials and could begin deliveries within thirty days. In the course of placing the contract, the Office of the Chief Signal Officer's Purchase Branch, anxious to spread the work, let the contract to six separate companies, including Graybar. None of the other five had the necessary material on hand. New orders had to be let, and practically no pole line material was available by November, when it was to be used.[171]

Thus amid a number of initial fumbles, the pole line project got under way. The line was built in three sections, each subdivided into smaller segments. The first 500-mile section from Edmonton, Alberta, to Dawson Creek, British Columbia, probably offered the most difficulties. The administrative pulling and hauling was still going on, and the supply situation had not yet

[169] (1) Capt Sidney L. Jackson, Stringing Wire Toward Tokyo: A Brief History of the Alaska Military Highway Telephone Line (1944), SigC historical monograph E-1, p. 45. SigC Hist Sec File. (2) See above, pp. 136ff.

[170] (1) *Ibid.*, pp. 68–72, 80–81. (2) Hist of ACS, p. 233. (See Bibliographical Note.) (3) Ltr, Roberts to Miller Construction Co., Inc., 19 Dec 42; (4) Incl 8, Ltr, Miller Construction Co. to Roberts, 12 Jan 43, with Ltr, Miller Construction Co. to Col Henry, 15 Jan 43. SigC 676.1 Alaska Military Highway 1942–43.

[171] (1) Hist of ACS, pp. 234–35. (2) Jackson, Stringing Wire Toward Tokyo, pp. 29–35.

shaken down, when on 10 November 1942 the Office of the Chief Signal Officer informed Major Roberts that this first section of the line must be finished by 1 December. Some 400 miles of poles were set, but they lacked crossarms. Almost no hardware had yet arrived. The War Production Board's disapproval of the amounts of copper necessary for all-copper wire had compelled substitution of copper-coated steel wire. Since the substitute wire could not provide the same long-distance transmission characteristics, the builders had to provide more amplification, relocating the repeater stations and placing them closer together. Actually, though, none of these stations had yet been built. The civilian contractor had the plans, but the lumber, though on order, was not yet delivered.

In the next few days, everything went wrong, engendering one frantic emergency after another. A heavy snowstorm closed the lumber mills, and no lumber for the repeater stations could be obtained. But just then, the contractor received some Yakutat huts, and started placing them at the repeater station sites. Washington flew temporary repeater equipment in by air, and speeded special shipments of hardware by express. The Northern Electric Company of Canada sent ten of its best men to install the repeater equipment in the Yakutat huts. They were to be assisted by enlisted men assigned from the 843d Signal Service Battalion. But when the soldiers arrived from Seattle on 17 November, there were no quarters for them and hurried arrangements had to be made to house them in Canadian barracks. Meanwhile, the contractor (the Miller Construction Company) continued to set poles. Then fifty of its workers were isolated north of Peace River when a chinook (a warm wind) broke up the ice in the river and swept away the bridge, and two days later a heavy snowstorm further ensnared the men.

All hands agreed to emergency measures: the pole-setting crews would set only every other pole, and place crossarms on every second pole only. Instead of stringing wires one and two, nine and ten, the men would string wires three and four because of the fewer transpositions required on the latter circuit. Special crews of American Telephone and Telegraph Company men from the United States would string the wire, and ten crews of ten men each from the Canadian Bell System from Montreal would be sent to reinforce them. Roberts asked Washington to send 100 miles of twisted-pair copper wire to close the gaps where poles were not set, and he obtained permission from the Northern Alberta Railroad to place this wire on its poles. It was now 19 November; more than 500 circuit miles of wire had to be strung, and there remained but twelve days in which to do it.

Then came another order from Washington: radio communication between Edmonton and Dawson Creek must also be activated by 1 December. That meant more crews, more housing, more supplies, and more transportation. The whole route from Edmonton to Dawson Creek became a bloodless battlefield, with more than 500 soldiers and civilians fighting local engagements against time and the elements. Men drove three-ton trucks over half-frozen rivers and felt the ice dip and sway under them. They floundered in five-foot snowdrifts, drove cars over roads that were sheets of glassy ice, put on crossarms and strung wire by oil lamps, flashlights, and automobile headlights in temperatures thirty degrees below zero. They slept and ate when and where they got a chance. In

the early hours of 1 December trouble shooting crews were still at work along the pole line making emergency repairs and tests.

Finally, at 1940, Washington time, a call came through from Dawson Creek to Edmonton and thence by commercial telephone systems to Washington. General Stoner in the Office of the Chief Signal Officer talked briefly to Col. Heath Twitchell of the Corps of Engineers at Dawson Creek. The deadline had been met. When the conversation was completed, the line went dead, and stayed out for two days while weary crews tried to put it in more orthodox working order. As for radio communication, it too met the deadline with only a few hours to spare. The transmitting equipment for the radio stations at Edmonton and Dawson Creek had been delayed in transit from Seattle. It arrived in the rail yards at Edmonton on the night of 30 November. Signal Corps crews unloaded it and had it in operation in the stations by the next morning.[172]

The telephone line so hurriedly "finished" to meet the deadline was but an improvised circuit. The real task lay ahead: first of all to make it into a reliable telephone line, and next to extend it through the wilderness to Fairbanks. The work lagged during the next three months. Civilian workers and the extra telephone company crews went home for Christmas—and stayed there. Of the 500 men on hand 1 December, there were now only 150. The schedule called for completing the line as far as Whitehorse, Yukon Territory, by 1 May. Correcting defects in the original line and pushing it 50 miles beyond Dawson Creek took until the middle of February. The Miller Company had subcontracted to the Onan-Smith Company the portion of the line between Fairbanks and Watson Lake, and crews worked toward each other from each end of the line. The work progressed slowly.

By the last of January Colonel Henry, Chief Engineer of the Army Communications Division in the Office of the Chief Signal Officer, who had been sent to Alaska as a trouble shooter, was warning that the only way to meet the deadline was to use Signal Corps construction troops after all. A Signal construction battalion to take over approximately 300 miles of pole line construction would be necessary, he thought, and it would have to be on duty by 1 March.[173] The 255th Signal Construction Company got the assignment, leaving San Francisco on 1 March. Since the 255th would arrive in Alaska somewhat behind Colonel Henry's schedule, 300 Engineer troops were pressed into temporary duty to clear the right-of-way, dig holes, and place poles in the section between Whitehorse and Watson Lake, until the Corps of Engineers required their services.[174]

There had been repeated delays in locating and building the repeater stations, a responsibility of the Corps of Engineers. On 5 March Colonel Henry reported that only about half of the stations had been built, and in these the floors would not be able to support the heavy load which the equipment would impose. The equipment and the crews to install it, provided by the Western Electric Company, were due to

[172] (1) Hist of ACS, pp. 234–43. (2) Signal Corps Technical Information Letter, No. 25 (December, 1943), pp. 23–24.

[173] (1) Memo, Henry for Stoner, 23 Jan 43, sub: Telephone line, Alcan Highway; (2) Ltr, Henry to Asst O/C ACS, 26 Feb 43, sub: Telephone line along Alcan Highway. SigC 676.1 Alaska Military Highway 1942–43.

[174] Memo, Chief of Army Com Sv, OCSigO, for Prog and Stat Br, 2 Mar 43, sub: Digest of prog and problems, p. 3, Item 2. Digest of Prog, 11 Feb 43–10 Mar 43. SigC Central Files.

arrive the very next week (between 8 and 17 March). This was but one of many points of disagreement which caused strained relations between the Signal Corps and the Engineers on the Alcan project. Partial relief came in the form of an agreement by the Commanding General, Northwest Service Command, and the Officer in Charge, Army Communications Service, which allowed the Signal Corps to deal directly with the construction contractor on engineering questions.[175]

On 31 March Colonel Henry was forced to tell the Chief Signal Officer that the completion date of 1 May for permanent construction could not be met, mainly because the repeater stations were not ready by the dates promised. He urged that the completion date for the pole line be advanced to 21 May.[176] Already the enemy was changing from winter to the spring thaw which melted the frozen rivers and turned roads into quagmires. As soon as each repeater station took form, crews of Western Electric men were waiting to swarm over it, installing the repeater equipment. Civilian and soldier crews set poles and strung wire. On 22 May 1943 a second call went through to Washington, this time from the chief of staff of the Northwest Service Command in Whitehorse to the chief of staff for the Army Service Forces in Washington, and to General Olmstead.[177] The line was not yet complete, but already it served a valuable military purpose: linking the headquarters of the Northwest Service Command directly with Washington.

In early summer the contractors swung northward in the final phase of work that would bring them into Fairbanks. The weather was favorable, daylight lasted 18 to 23 hours, and the work progressed rapidly. The civilian workers bypassed one particularly bad fifty-mile stretch of line just east of the Canadian border, leaving it to a twenty-man detachment of the 255th Signal Construction Company to string twisted-pair wire to close the gap. Engineers had graded the highway in that section in the winter when the ground lay perpetually frozen beneath a protective two-foot layer of muskeg. It had been possible to scrape away the muskeg, and grade the icy ground into an excellent road. But when the thaws began in the spring, the ground that had been frozen for centuries thawed, for it was no longer protected by an insulating blanket of muskeg. The road became a bottomless bog over which no vehicle could travel, and which sucked bulldozers down like quicksand. With two Indian guides, twenty pack horses, and a supply of K rations, the detachment of the 255th started into the swamp. It took four weeks of dirty, muddy, fatiguing work to put in that section of the line. By the middle of October 1943 the whole job was finished—more than 2,000 miles of gleaming copper wire stretching across the Canadian and Alaskan wilderness, a vital link in the westward movement of the war.

The telephone system served three purposes: (1) it provided a direct and secure line of communications between the United States and the armed forces in Alaska; (2) it provided telephone and teletype commu-

[175] (1) Memo, Henry for Col Strong, 5 Mar 43, sub: Const of repeater stations for telephone line on Alcan Highway. SigC 676.1 Alaska Military Highway 1942–43. (2) Jackson, Stringing Wire Toward Tokyo, p. 68.

[176] Memo, Henry for Dir of Army Com Div OCSigO, 31 Mar 43, sub: Com facilities, Alcan Highway. SigC 676.1 Alaska Military Highway 1942–43.

[177] Memo, Chief of Sig Operating Sv, for Olmstead, 20 May 43, sub: Wire com along Alcan Highway. File cited n. 176.

nications between the principal military airfields and weather stations on the northwest staging route, thus permitting up-to-the-minute weather service and better control of air operations; and (3) it permitted direct and immediate communications between various points along the Alaska Highway and oil distribution pipelines, thus facilitating administration and control of all operations in the Northwest Service Command.[178]

The Alaska Military Highway pole line was not the only rugged telephone work completed during the winter of 1942–43. There was intense Army activity at Alaska Defense Command Headquarters at Fort Richardson, Elmendorf Field at Anchorage, the new air base being built at Ladd Field, and Fort Raymond which was under construction at Seward. Telephone and telegraph traffic in these areas overloaded existing ACAN and Alaska Communication Service facilities and called for new wire lines. The one circuit of the Alaska Railroad between Seward and Anchorage, and between Anchorage and Fairbanks, would obviously be unable to carry the load, even if it were in perfect condition, which it was not. It had therefore been decided to rehabilitate the whole line from Seward to Fairbanks, and to build a new line between Seward and Whittier, traversing two mountains. In June 1942 Signal Corps crews had started work that continued throughout the winter. The drenching rain of summer gave way to howling blizzards, to temperatures hovering between 20° and 40° below zero, and to snow 6 to 14 feet deep. By January of 1943 circuits to Whittier were complete. By July C carrier equipment between Anchorage and Fairbanks was put in service, giving the Army two voice channels and twelve telegraph circuits between Anchorage and Fairbanks.[179]

Aleutian Action

The first sizable American amphibious operation in the North Pacific theater of war was known merely as the "Umnak Dispersal." It involved occupying uninhabited Adak and Atka Islands of the Andreanof group in the Aleutians in order to prepare bases from which to strike at Japanese-held Kiska and Attu.

The Japanese had bombed Dutch Harbor on 3 June 1942. By mid-July the first plans for the Umnak Dispersal were taking shape. On 23 August 1st Lt. Lauris S. Parker at Fort Richardson was told to get together enough radio equipment to set up a small station, and to have it ready by noon, 25 August. On 26 August Parker and five of his ten men joined the motley fleet which was to comprise the landing force. Parker's equipment, including a receiver, a transmitter, a hand key, and antenna parts, was stowed aboard an old four-masted fishing schooner, the *Sophie Christiansen*. Four days later the amphibious force anchored in Kulak Bay on the northeast side of Adak Island. Precariously far from a base of operations, the task force had to have com-

[178] (1) Hist of ACS, p. 256. (2) ASF Control Div Rpt 175, The Alaska Highway, 1 Jun 45, pp. 45–46. (3) Signal Corps Technical Information Letter, No. 25 (December, 1943), pp. 25–27.

Troops of the 258th Signal Construction Company, a Negro unit, arrived at Dawson Creek in April 1943, both in order to widen existing rights-of-way and repair and improve the telephone lines, and in order to put in new stretches of line and additional facilities along the Canadian section of the highway. The 258th was on duty in the area until January 1944. Ltr, Capt Frederick N. Moseley, CO 258th Sig Const Co, to CG ACS, 15 Feb 44, sub: Hist records. SigC 000 Hist Diary, File 1—ACS, 1934–Dec 1943.

[179] Hist of ACS, Pt. III, "Anchorage," pp. 16–25.

munications, and the Alaska Communication System station, which it was Parker's job to install, got third priority, preceded only by an airfield and the installation of an SCR–270 radar for air warning. There were of course no landing docks on Adak. The radio station equipment got roughly handled amid sea spray, rain, and sand, as it was loaded and unloaded several times before it could be set up. At first the men operated only the receiver, copying Japanese, Russian, and American signals. Radio silence prevailed until 7 October, when the Japanese discovered the Adak landings. Thereupon the men switched on the transmitter and established Adak in the ACS network. From then on they never lost radio contact with ACAN. This was particularly important, because there were periods when all tactical nets in the area failed, including the Aircraft Warning System, the Navy, and the Eleventh Air Force nets.[180]

As more and more troops funneled into Adak late in 1942, the ACS on the island followed the usual pattern of development, putting in better facilities and enlarging its activities. The men built a new and better station, put in a remote receiver station, started installing first a field telephone system, and then permanent lines for the island, together with switchboard facilities serving the air base, harbor, and other installations. They also began work on a VHF direction-finding project, which called for a fighter control center, equipped with receiver, transmitter, and homing direction-finding stations on Adak, Atka, and Ogliuga. A temporary plane-to-plane and ground-to-air AACS facility was in operation by early November 1942, with a much more elaborate installation planned. Cryptographic and censorship duties began early in October. Adak was slated to be the net control station (NCS) for an interisland radio net embracing stations on Atka, Fort Glenn, and Amchitka. Stations on Attu, Kiska, and Shemya were to be added when those islands were occupied.[181]

Atka Island, an hour's flying time to the east of Adak, was not expected to become a major base, but with the decision to garrison some troops there communications became a vital necessity. The Alaska Communication System's 1st Lt. William E. Morris received instructions to go to Fort Glenn on 20 September to meet a ship carrying materials for a new radio station on Atka. Atka was off the beaten Aleutian track, shunned by ships and airplanes alike. The ship which Morris was supposed to meet never arrived. He "hitched-hiked" passage to Atka, but his Signal Corps supplies and men were three weeks late. The Quonset huts to house them, expected in September 1942, finally arrived in May 1943. In the meantime, by dint of almost superhuman effort, communication installations went up. Of all the Aleutian bases, Atka required relatively the greatest use of human motive power. All the equipment, material, and supplies had to be brought in by manpower alone because the swampy tundra would not support motor transportation, not even the lightest of tractors. A 100-man infantry unit hauled the heavy power plants on skids up the hills to the operations site, each man sinking ankle-deep at every step. There were no laundry facilities, no lumber to winterize the tents, and not even the proper kind of boots to protect the soldiers' feet from the soupy tundra. The 10-man crew of the radio station nicknamed the place "Atkatraz," and referred to themselves as the "Atkatraz

[180] Hist of ACS, Pt. III, "Adak," pp. 1–11.

[181] *Ibid.*, pp. 13, 15, 28–31, 41–43.

Rats." The Atka station joined the inter-island net on 23 April 1943, relaying through Adak.[182]

The Umnak Dispersal into the Andreanofs had shortened the distance between American bombers and the Japanese. It was about 800 miles from Dutch Harbor and Fort Glenn to Kiska. From Adak to Kiska it was only about 350 miles. In January 1943 the next step, to Amchitka, brought the bombers even closer: just 66 miles away from Kiska.

A task force went ashore on Amchitka on 12 January 1943. Japanese reconnaissance planes discovered the landing eleven days later, and dropped their first bombs, whereupon the task force commander broke radio silence. Immediately the Amchitka radio transmitter went on the air and within twenty minutes established contact with Adak. The Amchitka base was intended to provide fighter and bomber facilities, and therefore one of the first demands upon the Signal Corps was for the installation of modern and effective aerial navigation aids. While the Signal Corps men of the ACS were still operating in tents in February 1943, a construction crew under civilian engineer Elwood Philbsen was siting the radio range. Philbsen was to co-ordinate the construction of facilities for aircraft warning, for the AACS, and for associated VHF installations. His installation crews were mostly Air Forces men, with a leavening of soldiers and radio engineers from the ACS. Temporary systems were operating by the end of April, and more elaborate permanent construction was well under way. Meanwhile, other Signal Corps crews had strung a field wire and field telephone system for the island, to be replaced later by permanent installations. By July the ACS had sixty-six men and seven officers on Amchitka.[183]

With advance bases secure, the Western Defense Command and the Alaska Defense Command were ready for the first phase of the assault upon the enemy garrisons on Attu and Kiska. In March 1943 Col. George L. Townsend, Signal Officer of the Western Defense Command, had told the ACS that it must furnish three complete radio stations and three "teams" to man them. Each team would consist of an engineering officer, an operations officer, and from five to twenty enlisted men serving as engineers, radio operators, maintenance, men, cryptographers, and censors. Every piece of equipment had to be complete down to the last bolt and nut, and every man on the team had to know his job so thoroughly that he could perform it with split-second timing and accuracy. The ACS had the material, and it had excellent technicians, but its men lacked field experience. Like other Signal Corps organizations it had sent its technicians out to stations to perform desperately needed technical work, at the expense of basic field training. Now, with less than six weeks remaining before the first tactical assignment began, the ACS worked frantically to teach the men at least the rudiments of self-defense. At the same time it drilled them constantly on the technical details of the equipment.[184]

Team A, fifteen enlisted men, led by 2d Lts. William C. Greene and Lawrence W. Bucy, left the embarkation point at San Francisco for Attu on 24 April on board the transport *Perida*. On 11 May the assault began. On 12 May the *Perida,* edging closer

[182] Hist of ACS, Pt. III, "Atka," pp. 1–17.

[183] Hist of ACS, Pt. III, "Amchitka," pp. 1–17, 25, 27, 29–30.

[184] Hist of ACS, Pt. III, "Attu," pp. 2–3.

to the rocky shores of Massacre Bay, rammed a pinnacle of rock. Water gushed into the Number 1 hold where the Signal Corps equipment was stowed. Pvt. G. I. Counter, guarding the hold, rallied the signal team to save its equipment. Within fifteen minutes, nineteen feet of oil and water had flooded the hold, but most of the signal equipment had been dragged to safety on deck. On the morning of the 13th, half of the team went ashore and picked out a temporary station site, a half mile from the front and a short distance ahead of the task force artillery. That afternoon the remaining men brought the cryptographic material and packs ashore. With the bedlam of a landing going on all about them, amid the comforting boom of 105-mm. shells from two nearby batteries and discomforting shellbursts and ricocheting bullets from the enemy, the men set up their station, dug in their operations tent, and erected the antennas. As soon as the antennas went up, they turned on the radio to establish contact with Adak. But Adak was not yet listening, supposing that Team A was still on board ship in Adak Harbor. Finally, after sending a coded message to Adak through Navy channels, contact was made. Attu, Station WXFR, was on the air.[185]

Of the three cipher machines which had been assigned to the task force, only the one with the ACS unit got ashore and into operation promptly, the others being misdirected in the landing.[186] For five weeks the team handled all the cryptographic messages for the task force. The battle for the island went on. On 29 May the Japanese counterattacked with the remnants of their force. During the night they had infiltrated positions near WXFR. When the attack broke, the ACS men turned out with full battle equipment to defend the station. The Japanese were stopped about 500 yards away.[187]

While the battle for Attu was in progress, Team B (Capt. Richard Murray, 1st Lt. Donald Beyer, and sixteen technicians) was on its way to nearby Shemya. Actually, Team B had been slated for Attu, but an error in code designators had sent them to Shemya instead, leaving the rigors and combat of Attu to a team considered relatively inexperienced.[188] Team B was a well-organized, well-equipped outfit, accompanied by eighteen tons of equipment packed into three 6-ton caterpillar trailers. No one knew whether Shemya contained enemy units. As it turned out, the landing was unopposed. Captain Murray and Lieutenant Beyer went ashore with the first units on 2 June. The next morning the equipment was unloaded, a site selected, and within four and a half hours, Shemya Station WXFT was on the air and in contact with Attu and Adak. Shemya, only two miles wide and four miles long, was slated to become a large air base. This meant that, as on Adak and Amchitka, Signal Corps responsibilities for air warning, a VHF system, and AACS installations would have very high priority. In addition, Shemya and Attu would be linked by ocean cable. There would follow many telephone projects, and finally a much-improved and permanent radio station.[189]

Thus, by mid-1943 the Aleutian campaign was entering the third and final phase. There remained only bypassed Kiska to reclaim. The members of the team training

[185] *Ibid.*, pp. 10–17.
[186] *Ibid.*, p., 20.
[187] *Ibid.*, p. 24.
[188] Hist of ACS, Pt. III, "Shemya," p. 1.
[189] *Ibid.*, pp. 7, 12–26.

for the Kiska assignment did not yet know that when they landed on Kiska in August they would find an island abandoned by the enemy without a fight. But already the pattern was clear: Alaska was stronger than ever before. A major contribution to that strength was the communications network which the Signal Corps had provided from the Alcan pole line to the Aleutian radio nets. At war's end, the Alaskan circuits, probably to a greater extent than any other Army-installed networks in the design for global communications, would remain a source of strength in the defense of the United States. Signal Corps soldiers would leave evidences of their labors and ingenuity in the Caribbean bases, on small Ascension Island, across Africa and Iraq and Iran, in China, Burma, and India, and throughout the islands of the southern Pacific—and most of all in the European areas. But nowhere else would military communications systems be retained entire and intact, as they would remain in Alaska, not only for Army use, but also, in the tradition of the Alaska Communication System, for the use of the civilians of the territory, providing them with such ready and far-flung communication as they had not enjoyed before.

CHAPTER XV

The Technical Service a Supply Service

(Late 1942–Mid-1943)

The Signal Corps function of providing a global network of communications for a global war was a highly technical duty typifying the technical aspect of the Signal Corps' mission. Yet at the same time, from the standpoint of organization it could be regarded as a supply function, in the same sense that providing guns, aircraft, or medical services is a supply function. The duality and intertwining of the technical and supply missions was the most important characteristic of the Signal Corps' place in the military organization in 1943.

In March 1943 the Services of Supply became the Army Service Forces. The chief, General Somervell, announced that henceforth the seven supply services would be known as the "technical services," since their functions obviously embraced much more than mere supply. The announcement took official notice of a fact that certainly had always been true of the Signal Corps, yet it came at the very time that the Signal Corps, possibly the most technical of the services, was devoting less and less time to this aspect of its traditional functions and more and more to the business of supply. Even the laboratories, as General Colton had pointed out two months earlier, must be regarded as production agencies, since they were depending on industrial concerns for nine tenths of the development of signal equipment.[1]

Technical Specialization vs. Mass Supply

As a matter of fact, throughout the entire organization, nine tenths of all Signal Corps effort was now centered on some phase of supply. At the same time, the remaining one tenth devoted to technical specialization consistently made supply problems more difficult. This conflict arose from the essential incompatibility of the two aspects of Signal Corps responsibility: on the one hand, the increasing need for mass supply engendered by the commitment of large numbers of troops to offensive action, and on the other hand, the equally pressing need for technical specialization brought about by the changed techniques of modern war.

The Signal Corps was well aware that problems of supply were greatly simplified

[1] Supply Sv OCSigO, Review of Production Plans, 12 Dec 42, p. 6. SigC DS 400.192, Prod, 1942–43.

whenever one piece of equipment could be made to do the work of two. Its engineers in all the research and development activities worked unceasingly to effect standardization and interchangeability of items of communications equipment. The Signal Corps also constantly sought to extend these aims through three of its agencies, two of which included representatives of other services: the Army Communications Board (until January 1943 called the Army Communications and Equipment Board), the Signal Corps Technical Committee, and the Communication Coordination Division.

The Army Communications Board, which technically was a supporting agency of G–4, in particular encouraged greater standardization among the using arms of Signal Corps-procured items, although until August 1943 it had no power to enforce its recommendations. The board was in reality a working committee, with the Chief Signal Officer as chairman and with a membership composed of representatives of the Secretary of War, the AAF, the AGF, the Navy, the Marine Corps, and some of the Allied nations.

Representatives of using forces also attended the meetings of the Signal Corps Technical Committee, which received data and prepared military characteristics and standardization actions for communications equipment. The SCTC also maintained liaison with comparable committees of the other technical services, with the NDRC, and with other agencies inside and outside the War Department.

The Communication Coordination Division supervised the assignment of radio frequencies throughout the Army, compiled and assigned tactical and international call signs for all Allied armed forces (except naval) operating in U. S.-controlled theaters, and represented the War Department at the Interservice Radio Propagation Laboratory, on the Combined Communications Board, and on other important committees. Obviously, the division's interservice and international duties made it, too, an ardent advocate of standardization, simplicity, and interchangeability.

Nevertheless, in the final analysis, it was the using forces, not the Signal Corps, that decided whether a new item of communications equipment was needed. When, for example, a commander in the Armored Force stated that he needed a radio set which would do certain things, it was the job of the Signal Corps to provide the item, whether it meant designing and producing a wholly new set, or merely altering and improving an existing model. Thus research and development became in truth the first phase of supply.[2]

Each new complexity or delicate refinement introduced into a piece of signal equipment meant a loss of time in producing it. It meant new drawings, perhaps new tools, a hunt for materials, for manufacturing facilities, for skilled workers. Always it involved a mass of paper work—new contracts or change orders, letters, telegrams, records, files, drawing numbers, standardization procedures, catalogue listings, and incorporation on tables of equipment, to name but a few. The thickening of the Signal Corps catalogue bore testimony to the increasing technical specialization of signal items. In World War I, the Signal Corps' entire equipment list totaled some 2,500 items, but more than 70,000 items appeared in the catalogue at the end of June 1943.[3]

[2] Proceedings of a Board of Officers To Investigate Communications, Exhibit P, Testimony of Gen Olmstead, 24 May 43. AG 311 (10 May 43) (1) Army, RG 207.03, Job A50-55.

[3] CSigO, Annual Report, 1943, p. 6.

The emphasis on supply, both in quality and quantity, was producing an uninterrupted expansion, agency upon agency, place to place. All together, in the field alone there were 104 agencies by the end of June 1943 and 37 of these, more than a third, were concerned in one way or another with supply.[4]

All this is not to say that designing signal equipment to do a particular job and to do it better was undesirable, but only that it diverted time and attention from quantity production. The Army, the Air Forces, and all the other users of signal equipment had a choice—they could accept fairly standardized items which could be produced quickly, or they could get custom-designed items less quickly.

The point was well illustrated by the problems of producing radar equipment, as General Colton pointed out in his production meeting in December 1942. Colton, a top research man who was also the director of the Signal Supply Service, was well qualified to speak on the subject. If the Signal Corps had been content to build radars on a strict production basis, without incorporating new improvements and better designs, he said, there would have been plenty of them. But the improved designs had in the long run been well worth the delay. "Any time that we schedule . . . radar equipment as if we were manufacturing nuts and bolts, it will mean that we have stopped trying to get the very best that can be obtained, and . . . if that attitude had been taken three years ago, in my opinion several battles would have been lost. . . . If we had been satisfied with production, if we hadn't made a compromise, our military position . . . would not be as good as it is now." He pointed out the handicaps under which radar had had to operate: priority ratings as low as A–1–g, far below tanks and armament; insufficient allocations of aluminum, copper, meters, brass rod, and selsyns; secrecy; and the difficulties of scheduling because of constantly changing demands in the tactical situation. The enthusiasm of the using forces and their demands, not only for more, but for greatly improved radars, had led to the setting up of production schedules which could not possibly be met unless research, development, procurement, and production all proceeded without any difficulties at all. Colton observed, "No production line can keep up with the scribbling of a pen." [5]

The conflict between technical specialization and mass production constituted the most important drag upon Signal Corps supply in early 1943. Unfortunately, it was not the most evident factor or the one most readily understood and, in any event, little could be done about it. It was a matter not easily reduced to terms of charts and statistics. Other, more predictable problems, such as the manpower supply, received the major share of attention.

The Shrinking Labor Market

In November 1942 a Signal Corps staff officer had warned that lack of manpower in manufacturing plants would constitute one of the biggest stumbling blocks to Signal Corps production in 1943.[6] Retooling

[4] Dr. Courtney R. Hall, Development of the Office of the Chief Signal Officer (1944), SigC historical monograph D–1, Pt. I, p. 168. SigC Hist Sec File.

[5] Supply Sv OCSigO, Review of Production Plans, 12 Dec 42, pp. 3–4, 17–19, 20, 25, 30.

[6] Memo, Col Meade for Gen Colton, 29 Nov 42, sub: SigC 1943 prod rqmts. SigC 400.192 Prod Control (Delayed Proc of Critical Radio and Re-

and conversion of industry were virtually complete, but the largest part of the production job and therefore the greatest demand for labor still lay in the future. Of 160 important market areas analyzed by the federal Bureau of Employment Security in June 1942, 35 had a shortage of male labor, and in 81 a shortage was anticipated in the near future. Only 44 areas had a labor supply thought adequate to meet present and anticipated future needs.[7]

The position of the Signal Corps in the labor market was unique. For producing its equipment, it had to depend almost wholly upon the electronics industry, which had grown up in the twenty years between the two world wars. The industry was staffed with youthful workers, a great majority of them within draft age limits. This immediately created a dilemma; as a supply service, the Signal Corps had to bend every effort to keep electronics workers on the job turning out communications equipment, yet the same men were especially valuable to it as communications soldiers.[8]

Industry experienced an especially trying loss when military service called up "second line" men: production planners, expediters, and foremen, who acted as the spark plugs of assembly line operations, and whose knowledge and experience were practically irreplaceable. The Bendix Radio Plant at Towson, Maryland, furnished an example. The plant was new, and had few workers in the older age brackets. In a little over two years the number of male employees had increased from 968 to 2,539, and of female employees from 404 to 3,656. During that period 768 men were lost to Selective Service, 350 of them from the original 968. At the same time production schedules increased; for example, the July 1943 schedule raised radio compass MN–26 requirements from 1,800 to 3,000, and airborne radio sets SCR–522 from 2,500 to 4,000.[9]

The devastating effects of Selective Service inroads were especially evident in industries which could not employ production line techniques, but instead depended upon "experience and such data as the men [carried] in their vest pockets." Industries furnishing meteorological equipment and photographic supplies fell in this category. The methods required for production of optical glass, for example, very closely approached laboratory techniques. Quite often neighborhood draft boards were ill-qualified to determine the essentiality of such highly trained craftsmen. Other industries coveted such workers, too, and if Selective Service did not take them, they might be lost through labor-pirating.[10] In the rotary equipment industry, where the draft had taken skilled workers from the foundries, the only replacements to be found for the most part were inexperienced farmers who

lated Equip Required by the AAF) 1942. Deputy SCigO File.

For a general discussion of the subject, see Jonathan Grossman, Industrial Manpower Policies and Problems of the War Department, a forthcoming volume in this series.

[7] Rpt, Bureau of Employment Security, Social Security Bd, The Labor Market, Jul 42. SigC 905 Facilities-Labor Problems, Industrial Mobilization Div, Philadelphia SigC Proc Dist.

[8] Lt Col James I. Heinz, Report of the Signal Corps Labor Office (1945), p. 53. SigC Hist Sec File.

[9] Memo, Dir of Control Div OCSigO to Dir of Control Div ASF, 13 Jul 43, sub: Info for Thursday morning Rpt. SigC 004.06 Labor.

[10] Prod Div Philadelphia SigC Proc Dist, Industrial Summaries as follows: (1) I. D. Adams, Industrial Summary: Signal Corps Procurement of Photographic Equipment, 31 Jan 46, pp. 16–17; (2) Leon C. Collar, Industrial Summary: Signal Corps Procurement of Meteorological Equipment, 31 Jan 46, pp. 10–11. SigC Hist Sec File.

could not stand the summer temperatures of a foundry and who worked only during the winter months.[11]

Another factor affecting the Signal Corps' labor position was the prevailing low wage rate of the electronics industry. At the beginning of the war, the seven major industries from which the Signal Corps procured its equipment were among the ten lowest-paid industries in the country.[12] With living costs soaring and industries competing fiercely for workers, the migration to higher-paid jobs was very heavy.

Fortunately, the electronics industry had always used women workers in large numbers. In most cases, major components and subassemblies could be put together on a production line under conditions suitable for women employees. Use of female labor brought other problems, however. Labor laws in many states limited the number of hours that women might work. In New Jersey, for example, where many women were employed in the critical steatite industry, labor laws prohibited their working between the hours of midnight and 6 A. M. Even where no restrictive legislation existed, it was very difficult to hire women for the second and third shifts in factories. The capacity lost by one-shift operation had to be made up by building additional plants, an expensive and time-consuming solution.[13]

Aside from electronics, there were other industries in which the Signal Corps had a substantial though secondary labor interest. The metal-working industry furnished the machine tools without which manufacturing plants were helpless. A mining shutdown could cut off copper, a vital ingredient of wire equipment. The logging industry of the northwest furnished telephone and telegraph poles, and large amounts of wood products—pulp, paper, and processed wood—for the growing amounts of packing for overseas shipments. Continuing production in rubber plants was vital to the Signal Corps for sheathing and covering for cable and wire. By midyear 1942 more workers were engaged in producing Signal Corps equipment than had been employed by the whole prewar electronics industry. It was imperative that these individuals stay on the job, and that even more workers join their ranks.

The Signal Corps was not directly responsible for control of labor problems. Indeed, during the early stages of preparedness, and in the first months of war, the War Department as a whole had rather consistently maintained a "hands off" policy concerning labor problems.[14] Early in his administration, General Olmstead had designated Col. Conrad E. Snow, chief of the Legal Branch, as his labor representative. But under War Department policy, Snow had no authority to do anything more than to gather facts on impending or actual

[11] Henry C. C. Shute, Prod Div Philadelphia SigC Proc Dist, Industrial Summary: Signal Corps Procurement of Rotary Equipment, 15 Mar 46, p. 17. SigC Hist Sec File.

As an example, an ambient temperature of 120° in one foundry caused 80 percent of the workers to "go fishing" for a week, resulting in the loss of production of 5,000 cylinder blocks for 5,000 urgently needed engines. *Ibid.*, pp. 18–19.

[12] Heinz, Report of the Signal Corps Labor Office, p. 67.

[13] Prod Div Philadelphia SigC Proc Dist, Industrial Summaries as follows: (1) I. D. Adams, Industrial Summary: Signal Corps Procurement of Electron Tubes, 15 Jan 46, p. 20; (2) I. D. Adams, Industrial Summary: Signal Corps Procurement of Radio-Grade Insulation, 15 Feb 46, p. 18; (3) J. A. Everitt *et al.*, Industrial Summary: Signal Corps Procurement of Radio and Radar Equipment, 1 Jul 46, pp. 30–31. SigC Hist Sec File.

[14] André E. Gerard, The Story of Supply in the Signal Corps in World War II, Pt. III, Production (1945), SigC historical monograph B–1c, p. 43. SigC Hist Sec File.

strikes, labor shortages, deferments, morale problems, and the like, and to pass the findings along to the Under Secretary of War, who transmitted them to the appropriate civilian agency. By the second quarter of 1942, with manpower problems growing daily more critical, the Signal Corps and its sister services felt that it was time for the War Department to play a more active and direct role in handling labor problems.[15] Obviously, in the larger sense anything that affected production of signal equipment was a Signal Corps problem.

In October, largely as a result of Signal Corps insistence, the Army Service Forces instructed all its services to designate labor officers, who would enjoy a wide scope of operative functions. To implement the directive, General Olmstead reorganized the Legal Branch, divorcing it from the Materiel Division and transferring it to the Administrative Division, where it remained briefly before it was raised to staff level in December, reporting at first to the Deputy Chief Signal Officer and later directly to the Chief Signal Officer.[16] Colonel Snow became the Legal Director, with six assistants heading six sections, each with a corps of attorneys, patent advisers, engineer advisers, and accountants.[17] To head the labor activities he named Maj. Kenneth D. Johnson, and set him the task of organizing field offices, each to be staffed with one labor officer and an alternate.

In selecting the locations for the field offices, Johnson considered the geographical distribution of Signal Corps contracts, and the concentration of factories in the electronics, wire, and battery industries. The plan was to locate the offices so that all, or nearly all contractors could be reached by overnight train travel, or within two to three hours by plane. The labor officers were not to operate in an ivory tower of remoteness in their offices, but in the plants. The problems they were to handle arose at the workers' benches, not at the officers' desks. The first field office was organized at Chicago on 1 December, the second at Philadelphia on 20 December, the third at San Francisco on 29 December. In February 1943 two more came into being at New York and Boston. In June the Dayton office was established, although it later moved first to Toledo and finally to Cleveland. Los Angeles and Buffalo sites were established later in 1943.[18]

With the organization of the headquarters office and the first field offices, the Signal Corps was in the labor relations business. Yet the only statutory authority rested with civilian agencies such as the War Labor Board, the United States Employment Service, the War Manpower Commission, the War Production Board, and the Fair Employment Practices Commission; plus the older peacetime agencies of the Labor Department. Whatever the Signal Corps could accomplish by tact, persuasion, cooperation, fair-mindedness, and deftness in the art of human relations could be chalked up as the measure of its success. General Olmstead struck the keynote when he told his labor officers at their first conference in Washington in January 1943, "I

[15] Heinz, Report of the Signal Corps Labor Office, p. 6.

[16] Signal Corps Administrative Log, 1939–1945, OCSigO Orgn Charts No. 18, 30 Sep 42; No. 19, 14 Dec 42; No. 26, 1 Jul 43. SigC Hist Sec File.

[17] Memo, Snow for Dir of Control Div OCSigO, 27 Nov 42, sub: Weekly digest of prog and problems. Digest of Prog, 25 Nov 42–16 Dec 42, SigC Central Files.

[18] Heinz, Report of the Signal Corps Labor Office, p. 2.

look to you to handle delicate conditions with judgment and force and integrity." [19]

The "delicate conditions" of which General Olmstead spoke included matters of labor supply, labor relations, draft deferment, and morale-building programs. On the day-to-day operating level, the labor officers were expected to keep a watchful eye on the numbers and kinds of workers in manufacturer's plants; to inform contracting officers of the labor situation when a new contract was in the making for a given plant or city, or when a new factory or facility was planned; to help manufacturers obtain satisfactory wage scales; to urge employment of women, and handicapped, and overage employees. So far as possible, the officers must prevent strikes and help to settle those which did occur. On draft deferment problems, they would help the employer through the maze of paper forms and justification sheets. Morale programs might involve making talks to employee groups, showing movies of signal equipment in battle, sponsoring personal appearances by soldiers returned from the battle front, and recommending and presenting the Army-Navy "E" flags in recognition of outstanding production achievement.

The Chicago office, headed by Maj. John M. Niehaus, with 2d Lt. Robert D. Morgan as his alternate, was one of the more important. Its geographical area of responsibility covered nearly one half of the nation—sixteen states from Indiana west to Colorado, and from North Dakota south to Texas. Nearly 1,300 Signal Corps war plants lay in the area, and the officers had to establish and maintain friendly relations with 4 service commands, 5 War Production Board regions, 5 War Manpower Commission regions, 5 regional offices of the War Labor Board and Salary Stabilization Unit, 16 state directors of labor, and 16 state directors of Selective Service, besides innumerable local groups and individuals.[20]

It was a large order for two men to fill, but the first six months of work gave evidence that they had already made a good start on the job that would earn them an outstanding record before the end of hostilities. One of the earliest successes came in December 1942. A jurisdictional struggle between the AFL and CIO unions seeking to organize the plant of Eicor, Inc., in Chicago, resulted in a strike which completely shut down the plant and halted the production of critically needed dynamotors. Major Johnson and Lieutenant Morgan of the Chicago office hurried to the plant and persuaded the workers to return to the job the following day and to submit their problems to the government agencies set up for that purpose.[21] In January the Chicago office succeeded in ending a slow-down strike at the Dryden Rubber Company, after Navy Procurement and Sixth Service Command Internal Security District officers had failed to do so.

The Chicago office also started the surveys and reports which eventually led to the solution of a procurement problem that had existed for years: the unpredictable nature of the battery business. Dry batteries were bought under a general contract, let on an annual basis, with maximum and minimum requirements set forth. The Signal Corps then issued calls every thirty days

[19] Lt Col Kenneth D. Johnson, Introduction, Conf SigC Labor Officers, Chicago, Ill., 14 Jun 43. SigC Hist Sec File.

[20] History of Activities, Chicago Regional Labor Office, 14 December 1942–1 October 1945, Foreword. SigC Hist Sec File.

[21] (1) History of Activities, Chicago Regional Labor Office, 14 December 1942–1 October 1945, p. 3. (2) CSigO, Annual Report, 1943, p. 101.

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for delivery of numbers of batteries within the defined limits, to be produced within a month's time. Since batteries are perishable, no great quantities could be made up ahead of time. The effect was to treat the battery industry like a faucet, to be turned off or on at will and expected to gush forth the product as needed. In peacetime, this was not serious, because the battery companies could keep their production lines busy turning out batteries for civilian use at times when there were no military orders. Now, however, with civilian battery uses drastically cut, with military requirements rising to fantastic levels, and with the labor market drying up, the battery manufacturers faced great hardships. Halfway through the 1943 fiscal year the procurement officers discovered that there was a surplus of certain types of batteries and immediately dropped the manufacturing calls to the minimum level for that year. The manufacturers would have been reduced to maintaining skeleton labor crews had not the War Production Board saved them by allowing them to manufacture enough farm radio batteries to take up the slack. Called in to study the labor supply problem in the industry, the Signal Corps labor officers saw that it could not be separated from the procurement problem. Their successive reports on the situation focused attention upon it until procurement officers took the necessary action to correct it.[22]

The Philadelphia office served a smaller area, but a particularly heavy concentration of Signal Corps suppliers lay in that region, covering Pennsylvania, southern New Jersey, Delaware, Maryland, and West Virginia. Lt. Col. Robert J. Walsh, Jr., and Capt. J. H. Rhudy set up offices in the Philadelphia Signal Depot, where numerous other Signal Corps activities were housed, including the Philadelphia Signal Corps Procurement District, which had been handling labor problems through its Industrial Relations branch.

Capt. Joseph M. Asbury and 2d Lt. Robert Savage of the San Francisco labor office performed double duties, being also the Signal Corps' west coast procurement officers. It is more than 1,300 miles from Seattle to San Diego, and a swing around the area starting from San Francisco to the largest cities, Portland, Seattle, Spokane, Salt Lake City, Los Angeles, San Diego, and back to San Francisco, would approach 4,000 miles, without visiting Idaho, where the Signal Corps secured telephone poles by the trainload, or Arizona, where many of its most strategic metals were mined.

In much of the region, and especially in the northwest and along the waterfronts, the labor unions were exceptionally well organized and powerful, while in Nevada and southern California there was little unionization. The electronics industry, very young as industries go, was manned by even younger men in the west coast region, and Selective Service was making fearful inroads. Labor officers, accustomed to calls for help in getting deferments for electronic employees, found themselves asked just as often for help in deferring the boss himself. On the west coast the Signal Corps also had to face competition for labor and facilities from the huge shipbuilding and airplane industries, whose employees outnumbered those of the Signal Corps a thousand to one. Activation of new military installations, and the movements through the area of troops bound for the Pacific added to the congestion and to the problems of housing and

[22] Lt Col John M. Niehaus, Labor Supply and Its Relation to Procurement, Conf SigC Labor Officers, 14 Jun 43.

transportation. By May 1943, with an influx of more than 100,000 workers monthly, the housing situation was desperate. Laborers were sleeping in tents, trailers, sheds, or any conceivable structure that had a roof. The War Manpower Commission reported that not a single city in the entire region could be listed in Group IV (where labor was plentiful and expected to continue so) and that 90 percent of all the cities in the region were classified in Groups I and II (where an acute shortage of labor existed or would soon exist). Obviously, a labor crisis was approaching on the west coast.[23]

Boston, too, had regional problems, but of a somewhat different nature. Lt. Col. Harry E. Olsen and Maj. Arthur Tager, operating from an office in the Boston Signal Depot, had all the New England states except Connecticut under their jurisdiction. All together, about 300,000 people worked for the Signal Corps in the region, in 500 plants, ranging from small ones employing no more than two people to General Electric's 16,000-worker plant. A major part of the Signal Corps' field and assault wire came from twenty-one plants in this area, and in addition there were rubber insulating plants, mica mines and processing plants, and factories producing radio, radar, headset switchboards, capacitors, fuses, wire communications equipment, storage batteries, and crystals. These plants had to compete with the textile industry dominant in New England. Business practices were conservative; over 50 percent of the Signal Corps plants lay in labor areas designated as Group I or II, yet there was very little use of female labor, few incentive plans for workers, and not much attention to such things as workers' cafeterias, adequate ventilation, sanitary conditions, and the like.

The Boston labor officers bent their efforts toward tactful suggestions along these lines. By June they had visited 70 plants, persuaded 14 different plant owners to provide 26 improved facilities, given advice to 31 companies, averted 1 strike, and settled 2 others, rendered assistance in 11 War Labor Board cases, delivered 15 talks to plant employees and other groups, obtained 8 relaxations of federal and state labor laws, and completed 21 labor-supply and utilization surveys to assist the War Manpower Commission. The Boston office had already gained a measure of fame through a program that later became known as the "Bristol Plan" and was widely copied throughout the war. At Bristol, Rhode Island, the United States Rubber Company, with a capacity of 12,000 miles of wire per month, was producing only 5,000 because it could not get enough workers. Bristol was a small town, and the War Manpower Commission had stated flatly that no additional workers could be obtained there, and the plant's personnel department agreed that the saturation point had been reached. Nevertheless, the Signal Corps labor officers proposed a community-wide program to the Rotary Club, which agreed to sponsor the project with speeches from pulpits, at civic clubs, and elsewhere in the community, urging citizens to "go to work for the rubber company and help win the war." Within a month the 700 needed workers were obtained, and many prominent people in the community, who neither needed jobs nor wanted them, went to work to keep the essential industry staffed.[24]

[23] (1) Capt Joseph M. Asbury, A Labor Officer on a Thousand Mile Front, Conf of SigC Labor Officers, 14 Jun 43. (2) Grossman, Industrial Manpower Policies and Problems of the War Department.

[24] (1) Heinz, Report of the Signal Corps Labor

The New York office under Capt. James C. Short had only the state of New York and the northern part of New Jersey under its jurisdiction, but that was enough. The dollar value of Signal Corps contracts in that area was so great, and the number of products so varied, that almost every conceivable problem was sure to arise.

By the end of June 1943 the headquarters agency and the field offices then organized had averted 41 threatened strikes, and had helped to settle 37 others, had successfully processed 186 applications for wage increases through the regional War Labor Boards, had made 667 visits to Signal Corps war plants, and had delivered 173 morale talks to employees. Nearly 650 companies had consulted them, and they had received 131 letters of commendation and thanks from manufacturers, unions, and employees.[25] But production requirements were still mounting, and the available labor supply was still shrinking. In the months ahead the Signal Corps labor officers would be busier than ever.

International Aid

Meantime, another aspect of signal supply was beginning to compete with the primary effort to achieve mass supply of signal equipment. Unlike most of the supply functions, the duty of furnishing lend-lease materials to the Allied nations had not been decentralized, but remained in the Washington headquarters. In many ways, it was a taxing and vexing duty. For several reasons, Signal Corps participation in the foreign aid program did not materialize as early as did that of other arms and services. For one thing, although most nations classed signal equipment as "munitions," the United States did not. Furthermore, foreign nations felt that their own electronic industries were sufficient for their needs and spent their money in the United States on heavy equipment. There were technical reasons, finally: foreign frequency bands differed from those used by the United States, foreign operators were trained to use their own equipment, and electronic components manufactured in the United States were not interchangeable with those of other countries.[26]

An increased flow of technical information between the United States and Great Britain began after the exchange of military missions between the two countries. After the passage of the Lend-Lease Act in March 1941, the Signal Corps became an active participant in the foreign-aid program, with a section in the Office of the Chief Signal Officer staffed by two officers and four civilians. By the summer of 1942, approximately 18 months later, this section had become the International Aid Branch, staffed with 10 officers and 87 civilians. In the first 13 months of operation, the Signal Corps' lend-lease organization had provided $33,500,000 worth of signal equipment, but by October 1942 that amount was being equaled every three and a half months.

Instead of shipments to three countries, as at first, the list now stretched over five continents and embraced Liberia, Free France, New Zealand, Australia, China, Russia, Iran, Turkey, Greece, Yugoslavia, Czechoslovakia, Poland, Belgium, the Neth-

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Office, Pt. V, pp. 7–8. (2) Ltr, Maj Angus J. Walker, O/C ASF SigC Regional Labor Office, to Dir of Legal Div OCSigO, 19 Sep 45, sub: Hist of Boston Regional Labor Office. SigC 004.06 Labor-Boston.

[25] OCSigO, Annual Report, 1943, p. 100.

[26] André E. Gerard, Activity and Participation of the Signal Corps in Foreign Procurement and Lend-Lease (1944), SigC historical monograph B–5, Pt. I, p. 4, n. 7-A. SigC Hist Sec File.

erlands, Norway, Great Britain, Iceland, Canada, Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Haiti, the Dominican Republic, Venezuela, Colombia, Ecuador, Brazil, Bolivia, Peru, Uruguay, and Chile. Not only the number of items, but the quantities were impressive: 201,174 telephones; 100,000 poles; 1,109 telegraph sets; 51,205 radio sets of all types; and millions of bits and pieces, such as resistors, condensers, relays, plugs, and jacks. The total of wire alone was 1,303,886 miles, enough to extend from the Pentagon to Tokyo 167 times. Russia had received more than 1,500,000 radio tubes, and Great Britain another 3,500,000.[27] But the quantities of items and the dollar values reported did not reflect the complete value of Signal Corps equipment furnished to foreign nations, for no account was taken of the countless communication devices installed in airplanes, tanks, and other mobile equipment which were not included in Signal Corps International Aid transfer statistics. The value of the command radio set SCR–274, for example, was $2,431; that of the liaison set SCR–287 was $4,455; and the altimeter SCR–518 cost $1,607. A single B–24 bomber carried nine items of communication equipment valued all together at $11,262.[28]

The Signal Corps did not make the policy decisions that allocated equipment to various foreign nations, but it was responsible for carrying them out insofar as they related to communication items.[29] Often this duty required a tremendous amount of work and considerable ingenuity, as in the case of an early request from the Chinese for "800 gross tons of telephone equipment." Translated by the Signal Corps engineers, that meant a complete telephone system, along with a train-dispatching system for the railroad being constructed from the Burma border to Kunming in the heart of Yunnan province.[30] Nor could American equipment simply be shipped from stock and expected to work satisfactorily. Nearly always it had to be modified to meet the voltages and types of current in different countries. It was usually designed for operation on 110 volts of alternating current at 60 cycles, but many countries had direct current, or if they had alternating current, it operated on various voltages from 105 to 250 and at various rates of cycles per second from 40 to 60.[31] Climate introduced another variable, as in the case of telephone EE–8. Thousands of them had had to be modified to accommodate the larger, heavier, "non-freezing" battery that the Russians used in the below-zero temperatures of the winter front.

Modifying equipment to meet special needs of foreign countries involved many extra hours of engineering work. Often it meant setting up new production lines or even new manufacturing facilities. On the other side of the ledger, the Signal Corps benefited by receiving valuable information concerning equipment performance under battle conditions. Its laboratories incorporated a number of improvements brought about either by the special demands of lend-lease nations or by technical information they had supplied. Lend-lease,

[27] (1) CSigO, Annual Report, 1942, pp. 98, 101; 1943, pp. 276–77.

[28] Folder marked 1st and 2d Lend-Lease Aircraft Programs. SigC 400 Lend Lease.

[29] For discussion of lend-lease policy, see Leighton and Coakley, *Global Logistics and Strategy: 1940–1943*, ch. X.

[30] (1) Memo for File, J. Ernest Hartz, PEA, 17 Jul 45. SigC 461 Publications Gen 1, Mar 42. (2) CSigO Annual Report, 1942, p. 99.

[31] CSigO, Annual Report, 1942, p. 104.

as a matter of fact, was being regarded by many military planners as the equivalent of a large-scale supply maneuver in preparation for our more active participation in the war. A number of experimental and developmental models of signal equipment received from Great Britain through reverse lend-lease were turned over to the laboratories. By the end of 1942 the Signal Corps had received from the Allies equipment valued at $1,174,445.85.[32] This included models of British and Canadian GCI sets, which indicated height as well as azimuth and which became the SCR–527 and SCR–588; the plan position indicator oscilloscope, which was being incorporated on later models of the SCR–270 and 271 radars as well as on newly designed radar equipment; and Askania theodolites, which were more accurate than the American ones.[33] Whether one chose to regard the exchange as strictly reverse lend-lease, or, as General Colton did, "a contribution between allies," the beneficial result was the same.[34]

Throughout the summer and fall of 1942, the build-up of huge stockpiles of military supplies in the European theater went on, and much of it was accomplished by means of reverse lend-lease procedure. The report of the purchasing agent for SOS, European Theater of Operations, U.S. Army, in October showed 15 categories of signal supplies in which such transactions were under way. They included 10,000 seventeen-foot telephone poles; over 2,000,000 yards of wire, with the necessary "bobbins, pins, and stays"; 800 special batteries; 800 miles of twisted cable; communication equipment for the deputy theater commander's special train; 400 miles of permanent telephone line for signal headquarters; equipment for a photographic studio; 500 battery radios; 975 long-wave radio receivers; quantities of walkie-talkies; 2,400 transformers; 84,000 cartridge signals; and miscellaneous Signal Corps equipment.[35]

When the invasion of North Africa was launched, lend-lease demands shot upward. Large quantities of material went to the French forces: more than $4,000,000 worth in the first six months of 1943.[36] The transfer statistics reflected the tactical situation. By the end of the fiscal year, the total of material transferred to foreign governments amounted to $139,298,701, an increase of more than 400 percent over the preceding fiscal year. For June alone material worth $19,249,230 was furnished.[37] Until now, lend-lease procurement had had little adverse effect upon Signal Corps procurement, but with foreign aid programs incorporated into the Army Supply Program, and with demands rising, it began to pinch a little.[38]

The Shifting Emphasis in Procurement

The first six months of calendar year 1943 was a period of progress toward the Signal

[32] Rpt of International Air Activities for 1942. SigC 400, Role in Lend-Lease, Folder 11d.

[33] (1) OCSigO Engineering and Technical Sv, History of the Signal Corps Research and Development in World War II, Vol. II, "Introduction", 5; Vol. IV, 1–2. SigC Hist Sec File. (2) SigC 400 R/L No. 30 W-4. (3) SigC 400 R/L No. 30 W-6.

[34] Incl with OCSigO R&W Action 1, Colton to Chief of Spec Activities Br, 14 Jun 44, sub: Comments on lend-lease, App. A, Activity and participation of the Signal Corps in Foreign Procurement and Lend-Lease, Pt. I. SigC Hist Sec File.

[35] Office Gen Purchasing Agent, London Echelon SOS ETOUSA, Rpt on Status of Deals as of 1 Oct 42. SigC 400 Lend-Lease (16-17).

[36] OCSigO, Annual Report, 1943, p. 277.

[37] *Ibid.*, p. 275.

[38] Gerard, Activity and Participation of the Signal Corps in Foreign Procurement and Lend-Lease, Pt. I, p. 92, n. 19-A.

LEND-LEASE TO THE FRENCH *involved not only supplying the material but also instructing our Allies in the use of our equipment.*

Corps' goal of mass production, despite the factors tending to impede its accomplishment. As spring wore on a shift of emphasis became evident. Equipment for which contracts had been placed in 1941 and in the first months of 1942 was beginning to come off the production lines in ever-increasing volume. Another year would pass before contracting reached its peak. But attention was shifting from procurement to distribution.[39] By the spring of 1943 the procurement agencies had hit their stride. With more than a year's experience under the frustrations and limitations of wartime operation, they had acquired competence. Standard procedures had been established which cut down paper work and red tape, and permitted heavy work loads to be handled with a minimum of confusion. New duties such as renegotiation, cancellation processes, and close-pricing programs were being integrated into the procurement structure. The inspection function, now centered in the Signal Corps Inspection Agency at Dayton, was past the initial reorganization headaches and was beginning to show strength. Best of all, the over-all production statistics of the Signal Corps were encour-

[39] André E. Gerard, The Story of Supply in the Signal Corps in World War II, Pt. II, Procurement (1945), SigC historical monograph B–1b, p. 9. SigC Hist Sec File. For a general discussion of War Department procurement policies see Smith, Army Procurement and Economic Mobilization.

aging, although there were weak spots in some fields.

Industrial Capacity for Production

The electronics industry by early 1943 was beginning to reach heights of productive capacity hardly deemed possible only a year before. In only twelve months it had been changed from a basic assembly industry to one in the first stage of mass production.[40] There was still both public and official impatience when any headline seemed to indicate a lack of radio communication at the times and places troops needed it. What the public, and indeed many field commanders, did not fully understand was that military communication equipment was much more complex and difficult to build than comparable equipment for civilian use.

The peacetime radio industry, for example, was on a highly competitive, mass-production, low-price basis. The quality of the product was good enough for the conditions of use encountered, but fell far short of military quality standards. It required a long time to change over to the high quality level required in military communication equipment. Even the more experienced and reliable peacetime Signal Corps suppliers had difficulty in meeting the quality standards for making the more complex types of Signal Corps equipment.[41]

A civilian radio set could not simply be transported to the field of battle and put to use. Home radios operated only a few hours a day, in carefully controlled temperatures. Moreover, the portion of the radio spectrum reserved for commercial broadcasting was large enough to permit far more lax adjustment of the sets.

Military radio had to be exceedingly precise. Each army used as many as 4,000 transmitters, and three, four, five, or more armies might fight jointly on a single front. That meant slicing the radio spectrum into thousands of bits—thin bits. It also meant that radio receivers as well as transmitters must squeeze in between the closely packed channels, and once there, stay there. Furthermore, the radios of the armed services worked around the clock, in all sorts of weather, under the most severe climatic changes. They had to survive rough handling, frequent packing, and moving about in all manner of vehicles. In short, like the soldiers they served, they had to withstand all the hardships of battle. It was not easy to build that kind of equipment.[42]

Some Signal Corps planners believed that the industrial capacity of the communications industry was large enough to support all requirements, except for a few special items. Maj. D. C. Graves of the Facilities Branch said in April 1943 that there had always been excess capacity available except for radio transmitters, highly complicated equipment such as radar, and certain critical parts, materials, and components. What appeared to be lack of capacity was in reality caused by a lack of raw materials; new developments, particularly in radar; changes in specifications; and requirements not anticipated far enough in advance of desired deliveries.[43]

Nevertheless, it was these few special

[40] CSigO, Annual Report, 1943, p. 255.

[41] 1st Ind, Col Lester J. Harris, Dir of SigC Inspec Agency, to IG, 12 Jun 43, on Ltr, Lt Col A. H. Nordstrom, IGD, to IG, 21 May 43, sub: Study of adm of SigC Inspec Agency. IG 333.1 SigC Inspec Agency (21 May 43).

[42] Stong, "Allo Maroc!" *Bell Telephone Magazine*, XXII, 154–55.

[43] Memo, Graves for O/C Facilities Br OCSigO, 10 Apr 43, sub: Reasonable stabilization of prod schedules. SigC FM 400.192 Prod Lines—Continuation, Cessation, Maint, 1942–43.

items that were still causing production difficulties. The wire and cable industry furnished an example. Four months after war began the Signal Corps' $7,000,000 expansion of wire facilities, aimed at providing 120,000 miles of wire W–110–B monthly, had cleared all procedural obstacles and was actually under way.[44] But in peacetime there had existed no need for quantity production of the machinery required to manufacture wire: plastic and rubber extruders, braiding machines, knitting machines, twinning and cable machines, and test equipment. Only a few small companies manufactured such machinery, and they alone possessed the necessary machine tools, patterns, and the special knowledge. Furthermore, most machines had to be specially built for each separate wire company. Suddenly everybody wanted this machinery, and wanted it at once. Without it, wire plant expansions could not proceed. The Army, the Navy, the Office of Rubber Director, and three separate divisions of the War Production Board (for copper, chemicals, and tools) all had legitimate interests in machinery produced at the small plant of the single manufacturer of wire insulating machinery, John Royle & Sons Company. Furthermore, the Office of Production Management had followed its established procedure of assigning to plant equipment priority ratings no higher than those of the material to be manufactured, and Signal Corps wire had only recently been raised to A–1–b from a lowly A–1–i, in a time when AA's and AAA's were appearing, and A–1–a's abounded. It took 20 months from the time funds were approved for the largest wire plant constructed during the war until finished wire was coming out of the plant,[45] and 33 months till acceptance rates equaled rated capacity. Smaller plants needed at least 6 months to come into useful production.[46]

Lack of plant capacity was usually only one of a number of reasons which accounted for lagging production of special items. For example, power units for radio equipment were in short supply by late 1942. The Signal Corps had sponsored two plant expansions, at Eicor, Inc., in Chicago, and at the Bridgeport, Connecticut, plant of General Electric Company, and the industry itself had financed many additional ones. In spite of this, plant capacity was not sufficient to produce the estimated 2,000,000 units needed for 1943. Manufacturers were loaded with orders, but were handicapped by shortages of material and manpower, and power units were simply not being delivered fast enough. Expediting efforts had not been very effective so far. For one thing, standardization of the brushes was necessary if production rates were to be improved. Another big difficulty was that power units were actually the product of two separate industries, and involved the coupling of a generator with an internal combustion engine. Usually, a manufacturer who produced one did not produce the other. Immediately after Pearl Harbor, generators became the critical components of power units because of the heavy load on the electrical industry in equipping new war plants. In late 1942, more generators were

[44] L. H. Drake and F. W. Thomas, Industrial Summary: Signal Corps Procurement of Wire and Cable, p. 45. SigC Hist Sec File.

[45] The St. Louis plant of the General Cable Corporation.

[46] Drake and Thomas, Industrial Summary: Signal Corps Procurement of Wire and Cable, p. 52.

available, but engines were in very short supply.[47]

In the dry battery field, for a further example, the situation was so uncertain as to border on the chaotic. The Signal Corps figured requirements in terms of battery types, while the industry figured capacity in terms of cells, which in various combinations make up battery types. Trying to track down actual requirements, the Signal Corps succeeded only in producing sets of figures that fluctuated from month to month. The changing conditions of battle, the impossibility of climate control, the demand for new radio sets by the using forces, and the fact that in many cases parts breakdowns for sets were lacking, all contributed to the uncertainty. The only thing the Signal Corps could be sure of was that a lot of batteries were going to be needed. The full realization of the critical nature of dry battery supply did not become evident until near the end of 1942.[48] In December 1942 the Signal Corps hurriedly pushed through the first two of the dry battery expansion plans which by the end of the war would cost $7,500,000 in Defense Plant Corporation funds alone. Both concerned the National Carbon Company, and were expected to yield 7,448,000 cells monthly for proximity fuze batteries, and 9,000,000 cells monthly for SRC–509, 510, and 284 radios. It would take more than two years to bring these plants into maximum production after surmounting difficulties which included critical shortages of acetylene black and African manganese, a lack of labor, and storage and distribution problems.

The Procurement Districts

By midyear 1943 business was booming in the Signal Corps' three procurement districts at Philadelphia, Dayton, and Monmouth. The Philadelphia Signal Corps Procurement District was the largest and most important of the three. Except for aircraft items, contracted for by the Dayton Signal Corps Procurement District, and ground radar items, purchased by the six-month-old Monmouth Signal Corps Procurement District, Philadelphia bought all the thousands of Signal Corps items, large and small. In dollar value, the Dayton district was overtaking Philadelphia, because airborne communication devices were very intricate and expensive. But the dollar value of contracts let was not the significant measure of work accomplished. It took almost as many man-hours to process the necessary papers to buy a single small and inexpensive piece part as it did to handle a $50,000,000 order. Philadelphia handled the contracting for nearly 100,000 items, fifty times as many as Dayton did. The three districts together employed about 2,250 people, and of these more than half were at Philadelphia.[49]

By this time the measure of control which the Office of the Chief Signal Officer exercised over contracting had been greatly relaxed. Contracting procedures had smoothed out; contracting officers could

[47] (1) Minutes of Meeting of the Fractional Horsepower Industry Advisory Committee, 6 Nov 42. SigC 412.41 Dynamotors, Industrial Mobilization Div Philadelphia SigC Proc Dist. (2) Shute, Industrial Summary: Signal Corps Procurement of Rotary Equipment, pp. 12–14, and Incl 1, pp. 46–47.

[48] Henry C. C. Shute, Prod Div Philadelphia SigC Proc Dist, Industrial Summary: Signal Corps Procurement of Dry Batteries (15 Jan 46), p. 21. SigC Hist Sec File.

[49] (1) Supply Sv OCSigO, Review of Production Plans, 12 Dec 42. (2) Cerruti, Historical Narrative of the Philadelphia Signal Corps Procurement District, Vol. I, Tab I, p. 29. (3) MS Comment, Brig Gen A. A. Farmer, USA, Ret., 15 Mar 52.

place up to $5,000,000 without first getting permission from higher authority,[50] and the use of informal contracts and letters of intent had speeded the mechanics of placing orders. In December 1942 the Washington headquarters had ceased to designate the manufacturer who would receive the order for a specific item, and instead permitted the procurement districts to handle that responsibility.[51] Thereafter the Washington headquarters provided only the Army Supply Program item number, and the procurement district office collected the specifications, which sometimes totaled as many as 100, got out the quotation requests, and selected the manufacturing facility. This system continued throughout the war.[52]

There was one exception, in the winter of 1942–43, to this trend toward decentralization of contractual responsibility. Airborne equipment used thousands of small electrical parts, and the rapid advance of the radio art, plus the "investigative vigilance" of the enemy in analyzing equipment on captured Allied aircraft, had to be dealt with by the constant change of components. This resulted in repeated requests from the Air Forces for changes in equipment even before it got off the production line. Only the large suppliers, such as Bendix Aviation and Western Electric Company, could handle such changes quickly and effectively. In these special circumstances, the Office of the Chief Signal Officer felt it necessary to control contracts for airborne equipment to the extent of directing the Dayton Signal Corps Procurement District to place the contracts with specific manufacturers. On 85 percent of the contracts, such large companies got repeat orders time after time.[53]

As the winter months wore on, it became more and more difficult to place contracts. The larger, more experienced firms were glutted with orders; although at first they had resisted the 40 percent subcontracting provisions of Signal Corps contracts, now they were eager to pass along some of their work to smaller firms, and on some items refused to take additional contracts. The number of small firms able to take on substantial orders was decreasing, too, and those that could take orders often were not able to follow the somewhat sketchy performance specifications. New, detailed specifications had to be worked out, and additional help given on every detail. All this increased the unit cost of items. And with shortages in raw materials and difficulties in obtaining components such as tubes and dry batteries growing more acute, it became ever more difficult to keep production lines going without interruption.[54]

Nevertheless, the growing difficulty of placing orders was largely offset by the increasing expertness of the contracting officers. By February 1943 the Monmouth district alone, although the most recently activated of the three districts, had 151 contracts totaling $234,509,626 completed,

[50] By directive from Chief, Sig Supply Sv OCSigO, 17 Jul 42. All awards over this amount were processed by Bid Analysis Sec, OCSigO, and forwarded to Dir of Purchases, ASF, for approval. CSigO, Annual Report, 1943, pp. 270–71.

[51] Supply Sv OCSigO, Review of Production Plans, 12 Dec 42, p. 7.

[52] Cerruti, Historical Narrative of the Philadelphia Signal Corps Procurement District, Vol. I, p. 164. See pages 140–85 for detailed accounts of the successive changes in contracting policy and procedure affecting the procurement districts in 1942–43.

[53] Ltr, Lt Col Charles B. Watkins, IGD, to IG, 22 Nov 43, sub: Spec investigation of Dayton SigC Proc Dist. IG 333.1 Spec investigation of Dayton SigC Proc Dist.

[54] Cerruti, Historical Narrative of the Philadelphia Signal Corps Procurement District, Vol II, p. 462.

in current operation, or under negotiation.[55] By the end of June the procurement districts were placing orders at the rate of $500,000,000 a month. During the fiscal year, 74,000 contracts were placed, for equipment valued at $3,413,000,000.[56]

During the first year of war, the primary concern of the procurement districts had been to place contracts—to get the orders on the books in order to permit manufacturers to start production rolling. By 1943, however, some other aspects of contracting were beginning to claim a larger share of attention. These factors were termination problems, renegotiation procedures, and close-pricing policies.[57]

"Termination" began with cancellation of a contract, but the procedures following cancellation had to be very carefully worked out in order to achieve a settlement which would be equitable both for the government and for the contractor. Not infrequently, contracts had to be canceled, either because of changes in equipment devised by the laboratories to remedy operating deficiencies reported from the theaters, or because the tactical need for certain equipment had ceased to exist before it came off the production line. All contracts contained a termination article allowing the government to cancel the contract. At first the article required the contractor to make an extremely detailed documentation of all expenses incurred. This was followed by long-drawn-out auditing procedures. One of the first wartime terminations, begun in August 1941, on a $6,460,325 contract with General Electric for radio transmitter BC–420, was still not settled sixteen months later.[58]

To avoid this cumbersome procedure, the termination article was rewritten to provide for a negotiated basis of settlement. As the war drew to a close and the Army cut back its orders, termination activities obviously would increase in volume and importance, and procurement officers were already worrying about the matter. Terminations had, as yet, not reduced the total signal requirements; if a manufacturer's contract was canceled, it meant a loss of time and material, but the contractor was sure to receive a substantial new order, often bigger than the first one.[59]

By June 1943 the Signal Corps had terminated 145 supply contracts, of which 92 were still not settled. The rate of termination was rising: from January to June, 33 cases were settled, 19 of them without cost to the government.[60]

Renegotiation rested upon a different principle; it was not a cancellation or cutback procedure, but rather an attempt to recapture excess profits. The Renegotiation Act passed by Congress on 28 April 1942 established methods and procedures for working out equitable settlements. Actually, excess profits resulted most often from miscalculations of unit costs in the first place, or a too hasty setting up of the whole contract structure. Neither procurement officers nor manufacturers could tell ahead of time exactly what the costs would be; there were too many unknown factors—the price of

[55] Ltr, Col Rae, IGD, to IG, 11 Mar 43, sub: Spec inspec Monmouth Proc Dist Lab Purch Div SigC Ground Sig Sv, Bradley Beach (11 Mar 43). IGD 333.1.

[56] CSigO, Annual Report, 1943, pp. 267–68.

[57] James V. Clarke, Contract Adjustment in the Signal Corps, 1 July 1939–15 August 1945 (1945), SigC historical monograph B–3, pp. 41–43. SigC Hist Sec File.

[58] *Ibid.*, pp. 21–24. The contract was finally settled in July 1943, twenty-three months after it was canceled.

[59] Cerruti, Historical Narrative of the Philadelphia Signal Corps Procurement District, Vol. II, pp. 366–67.

[60] CSigO, Annual Report, 1943, p. 271.

materials in a widely competitive market, the cost of labor, engineering costs on new items, and many another speculative item. As it eventually worked out, as much was saved by the pressure to estimate costs more closely as by the recovered excess profits under the act.

Thus pricing policies and renegotiation were closely related, and indeed some supply officers considered them inseparable. If costs and prices could be calculated with absolute accuracy, there would be no excess profits and therefore no need for renegotiation. At first the whole business of establishing pricing standards was largely in the hands of the district procurement officers, under the over-all supervision of the Purchases Branch in the Office of the Chief Signal Officer. Obviously a great deal of time and money could be saved by negotiating bids at reasonable prices if the contractor knew before he submitted a final bid just what the government would consider "reasonable." Early in the year, Purchases Branch set up a Price Policy Committee, whose members were available to talk over with manufacturers such things as proper contingency allowances, allowable and unallowable items of cost, pricing of subcontracts, application of overhead charges, and profit mark-up.[61] All this was preliminary to the contract signing. Even with the most earnest good will on both sides, there still remained the possibility that there would be unforeseen circumstances which permitted too much profit advantage to the manufacturer. It was at this point that renegotiation procedures took over.[62] From July 1942 to June 1943 Signal Corps renegotiators saved the government $187,078,214.[63] Two-thirds of that sum was renegotiated in the procurement districts, the remainder by the appropriate staff section in the Office of the Chief Signal Officer.

The Signal Corps Inspection Agency

With the increased flow of deliveries of signal equipment items, heavier duties devolved upon the Signal Corps Inspection Agency. As has been noted, its commanding officer, Colonel Harris, found it difficult to keep enough inspectors. The demands of Selective Service ate steadily into the supply of 2,273 male inspectors, most of them of draft age. With some misgivings, the Signal Corps turned to hiring women, and was pleased when they proved to be excellent for many inspection jobs.[64] Still more inspectors were needed, and in May 1943 the Signal Corps set up the first of several six-week training courses to teach unskilled workers to perform inspection duties. High schools, vocational schools, colleges, and contractor's plants offered their facilities. The Chicago zone graduated 339 trainees; San Francisco, 34; Philadelphia, 103; Newark, 200; and Dayton, 31. At first the graduates did simple mechanical inspection of wiring, soldering, setscrews, fastenings, and mounting fits, and assisted in electrical inspections. Gradually they took over more responsible duties, and most of them became full-fledged inspectors.[65]

[61] *Ibid.*, pp. 271–72.

[62] For a full discussion of War Department policies and problems of pricing see Smith, Army Procurement and Economic Mobilization.

[63] CSigO, Annual Report, 1943, pp. 269–70.

[64] By the end of the war, 55 percent of all field inspector positions in the Signal Inspection Agency were filled by women. History of the Signal Corps Inspection Agency, Supplement R, p. 3. (Hereafter referred to as Hist of SigC Inspec Agency.) SigC Hist Sec File.

[65] Hist of SigC Inspec Agency, pp. 1–3.

Other approaches to the manpower problem involved methods of increasing the efficiency of the inspectors, simplifying the jobs, and sharing the inspection load. The Signal Corps tried them all. It standardized inspection procedures, published more complete instructions, and delegated more responsibility to the inspectors. It broke down many processes into simpler elements to permit less highly skilled personnel to perform the work.

One very sensible approach had already been tried in a few instances where both the Navy and the Signal Corps were buying the same or very similar articles from the same plant and had agreed to let one service perform the inspection for both. The Signal Corps encouraged the inspection zones to enter into as many such arrangements as possible. By March 1943, under such arrangements, the Signal Corps was inspecting radio transmitting tubes, sonic buoys, belts, converters, and numerous other items for the Navy in individual plants all over the country, as well as clock mechanisms, switchboards, and telephones for the Marine Corps, small motors for the Air Forces, and radio tubes for Ordnance and the Corps of Engineers. Air Forces inspectors performed inspection for the Signal Corps on plywood parts and meters, Ordnance inspectors performed chassis inspection on Signal Corps trucks, and the Navy and the Signal Corps pooled forces on many radio items.[66] Such arrangements applied only to particular plants, not to given geographical areas or to types of equipment. The arrangement was to consider the situation in each plant on its merits, and to let the service having the primary interest handle the entire inspection procedure for its sister services.

By one method and another, the Signal Corps steadily built up its corps of inspectors to 4,419 officers and civilians by the end of 1942, to 5,663 by March 1943, and finally to a peak strength of 7,507 by the end of June 1943.[67]

Industry was being called upon to accomplish production miracles, and at times felt a certain amount of irritation because the military organization insisted upon such rigid control of the methods by which the miracles came into being. Industry accepted government inspection as a bothersome but necessary procedure—even a welcome one where new items were concerned. But in the matter of stock items, that is, items of ordinary commercial use, many manufacturers felt that inspection ought to be waived completely. In December 1942, for example, the Western Electric Company complained that Signal Corps inspectors in its Kearny plant were being too picayunish in the inspection of certain telephone equipment being furnished on a rush order. The Inspection Agency investigated, but came to the conclusion that the inspectors could not do less than they had been doing, and that in fact they had been requiring only a minimum of inspection.[68] Nevertheless, some manufacturers, or at least some plant managers, continued to feel that a product which was good enough for the public certainly ought to be good enough for the Army. The whole matter of inspection procedures, or lack of them,

[66] Memo, Dir of Resources and Prod Div SOS for CSigO, 27 Feb 43, sub: Inspec staffs and procedures, and 1st Ind, Chief of Sig Supply Sv to CG SOS, 5 Mar 43. SigC 400.163 Inspec 1, Jan–Jul 43.

[67] Hist of SigC Inspec Agency, Supplement A, Pers Stat, p. 2.

[68] Ltr, O/C Newark SigC Inspec Zone to O/C SigC Inspec Agency, 9 Dec 42, sub: Inspec at Western Electric Co. SigC 400.163 Inspec 7, Oct–Dec 42.

came to a focus in the Anaconda Wire and Cable Company case early in 1943.

The Anaconda case came to light largely through the alertness of a civilian Signal Corps inspector, Cyrus Shipp. Shipp had been assigned to the Marion, Indiana, plant of the Anaconda Wire and Cable Company in the early part of 1942, then transferred to another manufacturing plant in the same town in April. While on duty there, he became acquainted with two former employees of Anaconda, who told him it was the general practice of contractors to "put things over" on the Signal Corps inspectors, and illustrated the ease with which it could be done by describing conditions at the Anaconda plant. They asserted that in testing field wire W–110–B for dielectric strength and insulation resistance, Anaconda used the same reels over and over again, changing the tags at night when Signal Corps inspectors were not present in the plant. Furthermore, a switch device had been rigged up, hidden in a panel on the side of the testing desk, and accessible to the operator, but unsuspected by the witnessing inspector. By manipulation of this switch, the operator could change the test voltage so as to secure any desired reading. Also, the informants said that samples of wire from picked reels, selected because they would pass all the necessary tests, were kept handy in a separate storage place. These were the samples that were presented to the inspectors for test, although the inspectors believed that they were testing run-of-the-mill samples. It was also alleged that fictitious reports had been turned in on a spark test which Signal Corps inspectors had insisted on after the Navy Department had instigated an investigation, apparently because it, too, had heard rumors of irregularities.[69]

Inspector Shipp sent a detailed report of these allegations and unconfirmed reports in a confidential letter to Maj. Frank Prina, his superior at the Philadelphia Signal Corps Procurement District. Major Prina promptly sent Shipp back to the Anaconda plant, with instructions to try to find out whether or not the situation was as described.

Bit by bit more evidence came to light, to the consternation of the Signal Corps, which was very loath to believe it. The Signal Corps had placed contracts totaling well over a million dollars for assault wire, field wire, power cable, and subterranean cable with the Marion plant, and had other contracts with Anaconda's plant at Pawtucket, Rhode Island.[70] Business relations with the company had been very satisfactory, and there had been no known instances of failures of the equipment in field use. Indeed, the Marion plant proudly flew the Army-Navy "E" pennant for excellence in production, which had been awarded to it in May 1942, at the initiation of the Navy, which held the preponderance of contracts at the plant.[71] In August the Soviet Government had complained to the Signal Corps through its purchasing commission in the United States that field wire W–110–B furnished it through lend-lease was unsatisfactory because of poor abrasion

[69] Ltr, O/C SigC Inspec Agency to CSigO, 4 Nov 42, sub: Investigation—Anaconda Wire and Cable Co., Marion, Ind., and 1 Incl, Rpt of Lt Thomas Swan, 4 Nov 42. SigC EO 095 Anaconda Wire and Cable Company, 1942.

[70] OCSigO R&W Action 1, ANEPA to Purchases Br, 15 Dec 42, sub: Anaconda Wire and Cable Company, Marion plant, production delay. SigC 095 Anaconda Wire and Cable Co., 1941–43.

[71] (1) Msg, H. Donn Keresey, president, Anaconda Wire and Cable Co., for Colton, 11 Jun 42; (2) Msg, Colton to Keresey, 12 Jun 42; (3) Ltr, Keresey to Elder, 9 Jul 42. SigC 095 Anaconda Wire and Cable Co., 1941–43.

characteristics, but that complaint concerned wire furnished by another company.[72]

During September and October 1942, investigations, conferences, allegations, charges, and countercharges obscured the situation. Officials of the Anaconda Wire and Cable Company denied any irregularities and were confident that the local management of the Marion plant was without fault. They were inclined to blame overzealousness on Inspector Shipp's part, and initially the Signal Corps itself was not sure what was happening or where the fault lay.[73]

About the first of November the Signal Corps learned that there were still more elements in the case which apparently had not been disclosed until this time. The Federal Bureau of Investigation had two agents in Marion, and was conducting an investigation of the "production and inspection methods being presently used by the Anaconda Company in the production not only of Field Wire W–110–B but also other types of field wire for service use" being produced at the plant.[74] They were willing to be quoted as saying that "all charges contained in the reports of Mr. Shipp . . . were amply supported by substantial evidence" as shown by more than twenty sworn statements of employees of the Anaconda Wire and Cable Company.[75]

By this time Anaconda officials were convinced that things were indeed wrong at the plant, and called Signal Corps officials in Washington to tell them so and to inform them that they were starting action to remedy the situation insofar as possible. The Signal Corps Inspection Agency for its part was concerned about the evidence of faulty inspection procedures used at the Marion plant which had permitted the situation to exist before Inspector Shipp came on the scene. It again overhauled its inspection procedures in an effort to be sure that no other such case would arise. It also took steps to see that none of the faulty field wire it had accepted got into the hands of troops overseas.

The Anaconda Wire and Cable Company of Marion and five of its officers and employees were indicted for fraud. In federal court, on a plea of *nolo contendere*, the company received the maximum fine of $10,000, while the five individuals received other fines along with prison sentences which were to be suspended upon payment of the fines. Judge Thomas W. Slick, in sentencing the general mills manager of Anaconda and the local plant manager, said, "I believe these men can better serve the

[72] (1) Ltr, The Soviet Government Purchasing Commission in the U. S. A., to Lt Col A. E. Brundage, 3 Aug 42; (2) Ltr, Brundage to Soviet Government Purchasing Commission, 21 Sep 42, sub: R–118; Order 2588-Phila-42; (3) Ltr, Capt C. R. Brearty, OCSigO, to O/C Philadelphia SigC Proc Dist, 24 Aug 42, sub: Wire W-110-B, Order 2588-Phila-42, and Incl, Rpt on Conf re Order 2588-Phila-42, to 3d Ind, Asst Exec Officer Philadelphia SigC Proc Dist to Mat Div OCSigO, 9 Sep 42. SigC 095 Anaconda Wire and Cable Co., 1941–43.

[73] For a detailed account of the Anaconda investigations, see the following: (1) Memo, Lt Col Paul Hannah for Dir of Mat Div, 16 Jan 42, sub: Anaconda Wire and Cable Co. SigC RP 095 Anaconda Wire and Cable Co., 1942–43. (2) Incl 1, Report of Major [Eldon] Koerner, 5 Nov 42, with Ltr, O/C SigC Inspec Agency to CSigO, 11 Nov 42, sub: Anaconda Wire and Cable Co.; (3) Incl, Report of Lt Thomas Swan, with Ltr, O/C SigC Inspec Agency to CSigO, 4 Nov 42, sub: Investigation—Anaconda Wire and Cable Co.; (4) Incl 2, Report of A. B. Busch, 6 Nov 42, with Ltr, O/C SigC Inspec Agency to CSigO, 11 Nov 42, sub: Anaconda Wire and Cable Co. SigC EO 095 Anaconda Wire and Cable Co., 1942. (5) Excerpts from Diary of Maj Kenneth Johnson, 31 Oct 42; 4 Nov 42. SigC 314.7 Legal Officer's Diary 2. (6) Ltr, Julius H. Amberg, Spec Asst to SW, to Tom Clark, Chief of War Frauds Unit Dept of Justice, 30 Dec 42. OUSW 095 An-Aq.

[74] Rpt Maj Koerner, 5 Nov 42, cited n. 73(2).

[75] Rpt of Lt Swan, 4 Nov 42, cited n. 73(3).

war effort by getting back to work," and added that he believed the case would stop anything of a similar nature anywhere else.[76]

This hope apparently was not to be fully realized, however, for in the meantime, on 15 January 1943, the government brought a second criminal suit against the Anaconda Wire and Cable Company in its Pawtucket plant; on 4 May suit against the Collyer Insulated Wire Company, with plants in Providence, Pawtucket, and Central Falls, Rhode Island—all on similar charges; and on 1 December 1943 another against the Acorn Insulated Wire Company, Incorporated, of Brooklyn, New York.[77] In each case the company involved and the indicted employees and officials were found guilty, fined, and the individuals concerned given prison sentences, except in the Collyer case, where the three top officials indicted were cleared of fraud. The Anaconda Wire and Cable Company in the meantime had replaced for the Signal Corps all of the defective wire which could be traced and returned to it. It also settled a civil suit against it on terms considered favorable to the government.

Quite aside from the moral and legal aspects involved, the loss of production of field wire and cable was significant. At a time when the country was building up strength for its first major offensive, and unprecedented quantities of field wire were needed by combat troops, a severe blow had befallen the wire industry as a whole. The production rate of wire W–110–B during 1943 never equaled that for the fourth quarter of 1942. As for the Anaconda plant at Marion, it did not regain full production until the third quarter of 1943.[78]

The wire fraud cases resulted in a general tightening of inspection procedures in the Signal Corps Inspection Agency. Actually, insofar as inspection jobs in wire plants were concerned, the effect was bad. Inspectors became uneasy, and inspection jobs became hard to fill. Signal Corps inspectors in wire plants became overexacting, much of the good will that had existed previously between the Army and the industry was lost, and many manufacturers became reluctant to accept new Signal Corps contracts.[79] On the other hand, the inspection activity as a whole benefited from the increased attention to inspection procedures. This was demonstrated on 2 July 1943, when the ASF released its report on inspection procedures in the various technical services. The Signal Corps and the Chemical Warfare Service were rated as the best of the technical services on nearly every point considered by the survey: uniformity of method; responsibility of inspectors; control of inspection practices; training; co-ordination of inspection and testing; and collaboration between development, engineering, production, and inspection units in simplifying equipment design and specifications.[80]

The Increasing Importance of the Distribution System

When war came, the initial emphasis naturally fell on procurement, the first

[76] *The New York Times,* June 13, 1943.

[77] *Ibid.,* January 15, May 4, and December 1, 1943.

[78] Drake and Thomas, Industrial Summary: Signal Corps Procurement of Wire and Cable, p. 52.

[79] *Ibid.,* p. 53.

[80] Report of Inspection Survey for Inspection Section, Facilities and Materiel Branch, Production Division, Hq ASF, by the Trundle Engineering Company. ASF Prod Div File, DRB AGO.

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broad phase of supply. But equipment was of little value in the factories, or in depots, or on the docks, or in warehouses, or anywhere else except in the hands of the fighting men who used it. Thus as procurement became more stabilized and increased quantities of signal equipment became available, the second phase of supply, distribution, began to receive more critical attention. A reorganization of General Colton's Signal Supply Service in the Office of the Chief Signal Officer in December 1942 created a Distribution Division, thus underlining the growing importance of this aspect of supply. To head the new division, Colton felt lucky to have David H. O'Brien, vice president of the Graybar Electric Company.[81]

Moving the material from the factory to the battle front was the responsibility of the distribution system. Interrelated in this effort were the depots—into which supplies flowed directly from the manufacturing plants for storing and packaging, and out of which they moved to troops—and the agencies which maintained the records that provided means of cataloguing and identifying equipment and of controlling the flow of supplies.

Stock Control: The Storage and Issue Agency

The stock control function at the end of the summer of 1942 was centered in the Storage and Issue Branch of the Materiel Division, just where it had been at the beginning of the war. But Storage and Issue had suffered growing pains no less acute than those of the other sections of the Office of the Chief Signal Officer, and now with the increasing emphasis on distribution was the most sensitive spot in the supply body. The single teletype machine linking the branch with the Philadelphia Signal Depot had grown into a battery of four machines connected with the large depots.[82] Every day its 1,200 employees processed a small mountain of requisitions, stock records, and other papers and forms, with an efficiency somewhat impaired by the fact that they were housed in several buildings scattered over Washington. It was a logical step in the progression toward decentralization to gather up these scattered employees, and transplant them to Philadelphia, where the depot, already acting as gratuitous landlord to several other Signal Corps agencies, could offer them house space.

On 8 October the move was made, the actual transfer taking place all in one night, with an office force already set up and operating in Philadelphia while the bulk of the personnel reported for work. The Storage and Issue Branch had hoped that most of its employees would go with it to the new location, but as it turned out almost 30 percent of them chose to stay in Washington and had to be replaced, a serious blow at a time when the work load was very heavy and getting heavier.[83] The movement of supplies to North Africa was still not complete and would be a continuing operation for several months to come. Storage and Issue initiated movement of equipment to units prior to their activation, to task forces, and to organizations already overseas. It prepared all the maintenance parts lists, maintained suspense files for future ship-

[81] (1) Signal Corps Administrative Log, 1939–1945, OCSigO Orgn Chart 19, 14 Dec 42, p. 64. SigC Hist Sec File. (2) Supply Sv OCSigO, Review of Production Plans, 12 Dec 42.

[82] Morton H. Ullery, History of the Storage and Issue Agency (1946), Vol. I, p. 42. SigC Hist Sec File.

[83] *Ibid.*, pp. 44–45.

ments, prepared all depot requisitions, shipping, marking, and packaging instructions, and maintained all stock records. To lighten its burdens, all distribution functions relating to radar, meteorology, fixed installation equipment, and airborne matériel had already been taken away from it and allocated to other agencies. The business of assigning stock numbers and nomenclature had also gone elsewhere.[84] But a very large amount of important work remained. To a considerable degree, success or failure of the signal supply mission hinged upon the success or failure of the Storage and Issue Branch.

On 1 January 1943 the Signal Corps formally recognized the importance of Storage and Issue by making it a separate agency. Now the chain of command moved from the Office of the Chief Signal Officer through the Signal Supply Service to the Distribution Division, then through the Storage and Issue Agency to the depots. The number of requisitions continued to rise: in January the agency issued 8,016 of them; in March, 10,858; in May, 14,280; and in June, 16,517.[85] To handle the work, the civilian staff increased from 1,017 in January to 1,317 in March, and then to 1,525 in June 1943.[86] Yet, by June, the agency was staggering. Personnel, space, and equipment all were overtaxed. There was a tremendous backlog of work: unposted records, unanswered correspondence, unfiled reference material, stock requirements for which no purchase requests had been written, and 6,000 unprocessed requisitions.[87]

[84] *Ibid.*, p. 56.
[85] *Ibid.*, Tab 7, Vol. II.
[86] *Ibid.*, Tab 8, Vol. II.
[87] *Ibid.*, Vol. I, p. 62. For a discussion of storage and issue functions after mid-1943, see Thompson and Harris, The Outcome, *passim*.

Storage: The Signal Depots

While the Storage and Issue Agency struggled to keep some sort of control in its stock control functions, the depots which were the repositories of the stock continued to grow, in number and in volume. After July 1942 the signal sections of depots were termed simply "signal depots." [88] By November 1942 there were 10 signal depots, either wholly Signal Corps establishments, or within general depots, at Philadelphia, Lexington, Dayton, Atlanta, Chicago, San Bernardino, Memphis, New Cumberland, San Antonio, and Ogden. Before the end of the fiscal year 3 more were added at Boston, Sacramento, and Seattle. To deliver airborne radio equipment to west coast airplane manufacturers faster, the Dayton Signal Depot on 31 May 1943 opened a Western Branch, with 200,000 square feet of space at Los Angeles and another 80,000 at San Pedro. The 13 depots altogether occupied more than 100 buildings, with a total floor space of almost 8,500,000 square feet. In addition, there was over 3,000,000 square feet of open storage space. The need for more storage space of all types was expected to increase for at least the next six months.[89]

Each of the depots had its special problems, but the need for more space was common to all of them. The Chicago Signal Depot furnished an example. Measured on the peacetime scale of military meagerness, the depot between wars had been a fair-sized installation, occupying three large ware-

[88] OCSigO R&W Action 1, S&I Br to Mil Pers Br, 29 Jul 42, sub: Transfer of officers. S&I Agency Info File, Philadelphia.
[89] (1) OCSigO, Annual Report, 1943, pp. 284–85. (2) History of the Dayton Signal Supply Agency, Chronology, p. 14. SigC 314.7 Hist of Proc Dist, USAF Mat Comd Central Files, Wright-Patterson Air Force Base, Dayton, Ohio.

house buildings, and staffed by two or three officers and about 25 civilians. By 1943 the depot had expanded enormously. It occupied 829,375 square feet of open and closed warehouse space, and required 51 officers and 2,784 civilians to keep it operating continuously. The depot, located strategically in the nation's most extensive transportation center, sent 75 percent of its shipments overseas, handling 3,000 requisitions for 6,000 tons of incoming shipments and requisitions for about the same outgoing tonnage monthly. To handle the message traffic, there were 700 lines of automatic switchboard, with 300 more soon to be installed; 5 Bell printers, including 2 perforator transmitter sending and receiving printers equipped with a distribution switch; 3 teleprinters for Western Union; 1 for Postal Telegraph; and a direct line and printer from each teletype room to the corps area radio station.

Teletype, dry batteries, and the assembly of SCR–299 radio sets were three of the most important specialties handled by the Chicago Signal Depot. It was the designated storage point for all the Signal Corps' teletype equipment. As for dry batteries, the depot continued as it had in the past twenty years to handle all purchases and inspection of all dry batteries for the Army. In the fiscal year 1942 it bought 65,000,000 batteries; the requirement for fiscal year 1943 was set at 150,000,000 and it was expected that even more would be required in 1944. Two floors of one of the large warehouse buildings were devoted to battery storage.

To take care of the SCR–299 sets, the depot had acquired the former General Motors Building, containing about 200,000 square feet, and here depot workers assembled the SCR–299's and installed them in the trucks and trailers. By early 1943 the depot had shipped 1,300 completed sets to tactical units in this country and overseas, as well as 125 each to the British and to the Russians, and three each to China and Mexico. All those for lend-lease were boxed in waterproof boxes weighing 16,800 pounds. Outside the building was 180,000 square feet of open storage space, where 1,000 more trucks waited for SCR–299 installations.

The depot employed 216 people in its repair shops alone, where radios, telephones, teletype equipment, motor generators, typewriters, meters, and motion picture equipment were made serviceable. Both men and women were being trained in repair operations.

Besides its own activities, the Chicago Signal Depot early in 1943 acted as host for the Chicago Signal Corps Labor Office, the Chicago Inspection Zone, field offices of the Signal Corps Stock Numbering Agency, the Philadelphia Signal Corps Procurement District, and the Cost Analysis Section of the Office of the Chief Signal Officer, and for two training schools, a radio school for field artillery officers and a depot procedures training school for enlisted men selected from Camp Crowder. The commanding officer, Col. F. E. Eldredge, was a reservist who had been called back to active duty in October 1940 and who had served as executive officer under Brig. Gen. A. A. Farmer at the Philadelphia Signal Depot before coming to Chicago. Despite the space he had, Eldredge needed more. He wanted more warehouses, he hoped to install a cafeteria for his workers, and he had his eye on a garage building where he could install garage and repair shop facili-

ties for the trucks and motor vehicles belonging to the depot.[90]

The signal section at the San Antonio Army Service Forces Depot was one of the oldest, dating unofficially from 1876, when San Antonio received the new military telegraphy system which General Greely had brought to Fort Lancaster a year earlier. The World War I period had brought San Antonio a sharp increase in signal activity, along with the fledgling aviation service then under the Signal Corps' auspices. World War II brought bustling activity to San Antonio once more, and by June 1943 the signal section had 13 officers and 250 civilian employees who in May had processed 3,883 shipments, comprising 1,793 tons of material. San Antonio was a key depot for Stromberg-Carlson telephones and parts. It also supplied signal items to the many posts, camps, and stations of the 8th Service Command and operated a signal repair shop for the command. It occupied four warehouses, including a new processing section devoted to fungus-proofing and moisture-proofing equipment for overseas shipment. Altogether, it had 143,000 square feet of open and closed warehouse space, but it was 84 percent occupied, and the commanding officer was looking hopefully at new warehouses being built on the post, hoping soon to acquire more space and to be able to consolidate operations.[91]

The signal section of the New Cumberland Depot at New Cumberland, Pennsylvania, had come into being at the close of World War I, especially to store and dispose of signal equipment returned from overseas, an activity which had continued well into 1939. Through the years from 1918 until 1940, its duties had not changed very greatly. For awhile, from 1920 until 1939, it was the principal distribution depot for pigeon equipment. But its most important activity began in 1930, when it was named the principal storage depot for field wire, a mission which was to assume major importance in World War II. When Maj. Harold R. Jordan was recalled from the retired list in 1940, and assigned to duty as Signal Officer at New Cumberland, he found a depot not greatly enlarged since 1933, when it operated 61,975 square feet of storage space and 10,000 square feet of open storage space. Jordan had only one assistant, a warehouse foreman, and a few laborers, who had no mechanized equipment. He started building up a supply of modern warehouse handling equipment, and hiring and training workers to operate it. By the time war came, New Cumberland had a head start in the methods and procedures that would be necessary to handle the gigantic amounts of field wire that would be swallowed up by World War II.

In 1933 New Cumberland had handled 1,056 tons of incoming and outgoing equipment during the entire year. In 1943, in the peak month of August alone, it handled 5,037 tons. Besides field wire, New Cumberland was now handling about 1,500 other items. In addition, it was a key depot for lend-lease material, the repository and issue point for over 4,000 items. Another unique function was salvage of electron tubes for scarce precious metals.[92]

[90] (1) History and Current Activities of the Chicago Signal Depot, Jan 43, *passim*. SigC Hist Sec File. (2) Shute, Industrial Summary: Signal Corps Procurement of Dry Batteries.

[91] (1) History of the Signal Section of the San Antonio ASF Depot, *passim*. SigC Hist Sec File. (2) ASF Monthly Prog Rpt, Sec 2–H, Storage Opns, 30 Jun 43, pp. 39, 54. ASF Files, DRB AGO.

[92] History of the Signal Section New Cumberland ASF Depot, New Cumberland, Pa., *passim*. SigC Hist Sec File.

All the depots had common problems stemming from the lack of any strong control at staff level over warehouse procedures and operating activities.[93] Until the advent of the Distribution Division in December 1942, the depots had been left very largely to themselves, except for such supervision as the overburdened Storage and Issue Branch could give them. The result was that procedures varied from one depot to another, particularly in warehousing. Some depots were wasteful of storage space, and others economical; some handled stock at far less cost per ton than others; some had modern warehousing equipment such as fork lifts and trucks, and others had none. All of them operated under a system of maximum and minimum stock levels, set individually by the Storage and Issue Agency, which also determined the depot to which equipment on any given order would be sent. When stock was received, it was stored according to class, each depot attempting to store material in the same general fashion, so that depot officers and workers could be moved about from depot to depot and still be able to find any item in any depot. This did not always work out; not all the depot buildings were alike, and first consideration had to be given to the size and weight of certain items, rather than the class into which they happened to fall. Signal items were further classified as controlled and restricted items, issued only on orders from the Chief Signal Officer, or as requisitioned items, which could be issued to any post, camp, or station signal property officer.[94]

To some extent, depots specialized in the stock they carried, but in general by this time they carried stocks of all ordinary signal items. Although each depot sent in daily reports listing its surpluses and shortages, some were continually overstocked on some items, understocked on others. If a requisition called for an item not in stock, the depot could do one of three things: tell the requisitioning agency to reorder it from another depot, ship a substitute item, or simply hold up the order.[95] Any one of these courses of action was time-consuming, and, to the organization waiting for the supplies, completely frustrating.

The situation was not confined to the Signal Corps—the ASF headquarters was deeply concerned over operating inefficiencies in all the technical services' depots. Early in 1943 the ASF's Operations and Control Divisions undertook a joint study of the operating and storage methods of typical depots of the seven supply services. The findings issued in March found much to criticize. It was charged that all the supply services had set up too many intervening levels of command between the depots and the chiefs of supply. The cumbersome clerical and administrative procedures that resulted required far too much paper work. According to the report, methods of handling material were not uniform, there were too few training programs for depot personnel, and improper stock catalogue numbers and nomenclature accounted for more wasted time and manpower at depots than did any other single factor.[96] The report spoke approvingly of the system just put into effect by The Surgeon General at all

[93] Capt Charles R. Novick, The Story of Supply in the Signal Corps in World War II, Pt. IV, Distribution (1945), SigC historical monograph B–1d, p. 23. SigC Hist Sec File.

[94] Ullery, History of the Storage and Issue Agency, Tab 43, Statement of Storage and Issue Agency Functions, 11 Sep 42.

[95] Novick, Story of Supply in the Signal Corps, Pt. IV, p. 24.

[96] Summary of Conclusions and Recommendations, Rpt 67. Depot Operations, Control Div SOS, Mar 43. DRB AGO.

medical depots. This so-called "key depot plan" divided the country into three geographical areas and provided for storing medical supplies of a given kind in only one depot within an area, so that requisitions for a certain item would always be addressed to one depot, which was expected to be amply supplied with the particular item at all times. Only after the key depots were stocked would others be supplied with the particular item. Thus an agency making a requisition could be sure that the key depot would have the material requested if it were available anywhere.

The key depot plan could not be adopted for all signal items, which differed vastly in bulk and character, and were infinitely varied as to delicacy, complexity, and the areas of use. Some specialization already existed. The Dayton Signal Depot, for example, stocked all nonclassified airborne and all meteorological equipment; Lexington carried radar and other classified radio equipment; the Chicago Signal Depot, dry batteries and teletypewriter equipment; and Philadelphia, the photographic stock. To further the plan, fifteen types of signal equipment were classified as key depot items, to be carried at one depot only.[97]

The recommendations of the Operations and Controls Divisions were mandatory; they provided for a complete reorganization of the depot system by 1 July. Although the Signal Corps had already put many of the recommendations into effect, or had made a start on them, the time allowed to effect the "complete reorganization" was exceedingly short. For one thing, the plan required mechanization of warehouses, including the use of pallets and fork lifts, which the Signal Corps had only begun to use in a few of its depots.[98] Hand trucks, warehouse trailers and tractors, stackers, lifters, elevators, jacks, and conveyor belts had their place in the mechanization program as well. The pallet system was obviously a saver of both space and manpower, but at first the Signal Corps found that it was not an unmixed blessing. Because material could be moved about much more rapidly and frequently, the system permitted material to be placed in any available space in the warehouse instead of in a predetermined order. This in turn meant installing a locator card system to show where the material might be at any given time. Theoretically, each time the material was moved, the new location was entered on the locator card. In practice, the untrained workers of rather low wage classification who did the moving seldom bothered to make the notations on the locator cards.[99]

Throughout the early summer the depots worked feverishly to put their procedures into acceptable form. The rate of mechanization in the four months between

[97] Novick, Story of Supply in the Signal Corps, Pt. IV, App. E. The list included batteries, teletype, meteorological and photographic equipment, pigeons and pigeon supplies, instruction books, airborne equipment, spare parts for ground electronics and fighter-control equipment, automatic central-office switching equipment and spare parts, commercial telephones and spare parts, and Army Airways Communications System fixed station equipment and major plant items.

[98] Pallets were rectangular platforms about two or three feet square, constructed in two layers of boards separated by 2 x 4's on edge. Containers were stacked one on top of another, with pallets in between. Fork lifts were squat machines equipped with a mast consisting of two vertical steel tracks on which traveled a protruding part having two fingers, or forks. The truck inserted its forks between the pallet's two platform layers, and thus moved the loaded platform. Fork lifts could stack equipment ten or twelve feet high quite easily, thus saving both space and manpower. Novick, Story of Supply in the Signal Corps, Pt. IV, p. 28.

[99] History of the Philadelphia Signal Corps Depot, Vol. II, p. 152. SigC Hist Sec File.

January and May was impressive, despite the initial reluctance of depot employees to use the new devices. For example, during the period the number of fork-lift trucks in use at depots increased from 14 to 80, pallets from 269 to 26,594, two-wheeled hand trucks from 617 to 1,447, and warehouse trailers from 956 to 1,131.[100] Depots reported progress measured in other statistics: unfilled requisitions on hand at the end of the month had dropped from 31,992 in January to 16,090 in May; requisitions filled had risen from 28,716 in January to 40,690 in May. The number of personnel had also risen, however, from 14,873 in January to 17,491 in May, and the number of requisitions filled by each civilian employee had not made a very impressive gain.[101] The Storage and Issue Agency, which issued the requisitions in the first place, still had a large backlog. The tonnage of equipment coming into the depots continued to rise, and demands from the theaters of operation to increase. There were numerous complaints of signal supply failures and deficiencies overseas. It was obvious that the Signal Corps distribution system still had a tremendous job ahead of it, and that it would have to improve a good deal more before there would be anything to boast about.

Overseas Complaints of Distribution Deficiencies

It was not enough to get equipment to the theaters of operation; it had to arrive in good condition and give the best possible service for the maximum length of time. From signal officers in the field, from special observers and inspection teams sent from Washington, and from returning combat officers and men the Signal Corps received reports that permitted a constant check on the quantity and quality of equipment.

The reports from all fronts were remarkably consistent. With only a few exceptions the performance of Signal Corps equipment was excellent, and combat soldiers and field commanders alike praised it highly. Nevertheless, there were complaints, and they fell into three categories. Theaters felt that signal items did not reach them quickly enough. Often when items did arrive, they were damaged as a result of poor packaging or waterproofing. Finally, there was almost universal complaint about the lack of spare and repair parts.

Some of the deficiencies of distribution resulted from factors beyond Signal Corps control. For example, until the procurement lag was overcome and deliveries caught up with requirements, the Signal Corps could not immediately furnish all the theaters with all the material needed. Most theater commanders had little conception of the length of time required to produce electronic equipment. Whether for military or civilian use, electronic items on the average required from two to four years to develop, one or two years from development until production began, and ordinarily another one to two years to complete production on a specified contract.[102] The War Department policy of putting items on tables of allowances as soon as they were developed and adopted for military use, without regard as to whether or not they were actually in production, naturally led commanders to ask for items which were not yet delivered from the manufacturer.

Furthermore, theater commanders de-

[100] Ullery, History of the Storage and Issue Agency, Tab 43, Report of Signal Corps Depots, 1 Jul 43.
[101] *Ibid.*
[102] MS Comment, Brig Gen R. B. Colton, USA, Ret., 14 Sep 53. SigC Hist Sec File.

manded a great many items not on the tables of allowances, and not even included in the Army Supply Program (ASP).[103] The ASP covered requirements for the Army on a troop basis, but tactical operations such as the North African invasion showed that there had to be additional equipment over and above that required by the troop basis, to take care of what might be termed theater operational requirements. Tables of equipment were designed only to keep troop units operating on a minimum basis in an average situation. They did not provide for unusual situations—amphibious operations, mountain warfare, or theater needs beyond the minimum level of reserve.[104]

The War Department, therefore, instituted the "operational project." It authorized the theaters to estimate their requirements for future operations, and the technical services to put the material under procurement and make delivery against theater requisitions as it was needed.[105] By May 1943 a great deal of additional signal equipment was being requisitioned for future operations. Much of it was required for fixed installations in the theaters, or in areas expected to be occupied soon. Equipment for such uses was not provided for in the Army Supply Program, which ceased to reflect accurately the real needs of the Army for signal equipment, as the Chief of Staff, ASF, pointed out.[106] Signal equipment differed from other kinds of material in that more and not less of it was needed in situations where the greatest tactical success was achieved; when armies were advancing rapidly and headquarters moved often, they needed huge reserve stocks of fixed and semipermanent communication installation equipment.[107]

Furthermore, even had sufficient material been available, there was a scarcity of ships to bring supplies to such areas as the South Pacific,[108] and Signal Corps material carried a low priority. Very often, therefore, it was crowded off the cargo ships. When it was put aboard, the Signal Corps had no direct control over the loading and discharge, and delicate communications equipment might be ruined by careless handling.

But packaging, tropicalization, and the provision of spare parts were direct Signal Corps responsibilities. In the early months of 1943 it was these matters that were getting the most concentrated attention.

Packaging and Waterproofing

Proper packaging of signal equipment involved many considerations, not the least of which was the distance which supplies must travel to reach the battle fronts. From the United States, the China-Burma-India theater, for example, was literally at the end of the world. Once within the theater, after a 12,000-mile water journey, supplies had to be shipped to points as widely separated as San Francisco is from Buffalo, over primitive roads or by rail that varied from standard to narrow gauge and back again. This required moving material from one freight car to another, without aid of machinery, by laborers who could not be expected to obey "Fragile—Handle With

[103] For a discussion of ASP see Smith, Procurement and Industrial Mobilization.

[104] Hq MTOUSA, G–4, *Logistical History of NATOUSA-MTOUSA*, p. 60.

[105] WD Cir 220, 1943.

[106] Memo, CofS ASF for ACofS for Opns, 11 May 43, sub: Provision for additional equip in the ASP to meet operational rqmts. ASF ACofS Reading File, May–Jun 43 DRB AGO.

[107] Memo, CSigO AFHQ for CofS, 31 Jan 43, sub: Sig lessons of Operation TORCH. SCIA File 13 (see Bibliographical Note), Matejka Rpts.

[108] Ltr, Sig Officer USAFISPA to Lanahan, 6 Feb 43. SCIA File 8, Ankenbrandt-Newhouse Rpts, 1.

Care" signs they could not read. China-bound supplies had to survive the dangerous journey over the Hump, and the loss of a few airplanes could mean that a month's planning had gone for nought.[109] It was no wonder that the men in the theater often found the equipment that reached them "pretty well beaten up." [110]

About 5 percent of all signal equipment received in the first landings in North Africa was damaged, partly as the result of faulty packing, shipping, and improper stowage. Comparatively large pieces of equipment which were carried on deck without full protection and sets which were stowed in leaky holds suffered the most from salt spray.[111] Carrier equipment was so severely mishandled in transit that signal officers had to set up test and repair facilities to rehabilitate the equipment before issuing it to the troops. "The abuse . . . was far worse than anything that had been anticipated in the design or that would be at all likely . . . in the hands of troops." [112] The very first reports after the landings had unanimously stressed the inadequacy of packaging, not only to avoid breakage, but to keep out moisture. General Matejka, AFHQ signal officer, said flatly that "the signal equipment issued was satisfactory, but the waterproofing was not." [113] The SCR–536 handie-talkies were very poorly waterproofed, and frequently became inoperable, and the SCR–284's needed moisture-proof cords, plugs, and insulators.[114] The "waterproof" canvas coverings provided for signal equipment were not in fact waterproof.

Packaging had received scant attention in the first year of war. Contracting officers handed manufacturers the packing instruction, U.S. Army Specification 100-14, and assumed that it would provide all the necessary information. Quite often, they granted a waiver of the specification, sharing the contractors' feeling that it was unnecessarily costly in money, time, and trouble, and that equipment was ready for shipping after it had been wrapped in tar paper and crated.[115] Specification 100-14 provided that the first destination of a shipment would determine the method of packing to be used, and since most of the early stock was accumulated in depots for later shipment overseas, this meant domestic packing only. The depots were disturbed when they realized that almost all equipment would require repacking for overseas shipment, for they possessed neither adequate facilities, materials, nor trained personnel to do the job. Neither did the large industrial concerns, the Signal Corps discovered when the first overseas reports started flowing back. Their experience with methods of peacetime export packing had not prepared them for the problems presented by global warfare. There were such considerations as the wide range of destinations, from sub-zero arctic to the tropical Pacific islands; transportation by air, ocean, rail, motor, or animal pack; the length of time goods might

[109] History of Signal Corps Activities in China-Burma-India, Ch. I, pp. 20–21. SigC Hist Sec File.

[110] Interv, SigC Hist Sec with Sgt John E. Duffy (formerly 835th Sig Sv Bn, CBI theater), 16 Nov 44. SigC Hist Sec File.

[111] Ltr, Sig Officer AFHQ to CSigO, 18 Apr 43, sub: Questions desired answered by OCSigO, and Incl 1, Answers to 156 Questions. SCIA File 13, Matejka Rpts.

[112] Memo, Maj M. M. Bower for CSigO, 10 Aug 43, sub: Rpt of special mission to North Africa to introduce spiral-four cable carrier and temporary pole line material. North Africa 2, SigC Hist Sec File.

[113] Memo, Sig Officer AFHQ for CofS, 31 Jan 43, sub: Sig lessons of Operation TORCH. SCIA File 13, Matejka Rpts.

[114] Ltr, Sig Officer I Armored Corps to CSigO, 11 Jan 43, sub: Rpt of Operation TORCH 8–11 Nov 42. SCIA File 1, Hammond Rpts.

[115] Novick, Story of Supply in the Signal Corps, Pt. IV, pp. 36–38.

be in transit; and conditions at the end of the journey, when supplies were likely to be stored in the open for long periods of time for lack of warehousing and handling facilities.[116]

In July 1942, with the invasion of North Africa only four months away, the Signal Corps took the first short step toward putting its packaging activities into organized form, with some degree of staff authority. It organized a packaging unit as a subsection of the Storage and Issue Branch of the Office of the Chief Signal Officer, and staffed it with one civilian. His stated duties constituted a fairly large order: to solve the packaging problem at the initial point of purchase, at assembly plants and depots, and at the laboratories, to assure the "proper use of lumbers and other materials . . . and also their preservation during the process of uncrating," and to "assure that all parties concerned with packing and crating are carrying out instructions and performing their work in the proper manner." [117] In October, the packaging subsection moved with the Storage and Issue Agency to Philadelphia. By January 1943 the pressure of work forced the addition of two packaging experts and two secretaries to the staff. Still this was not enough. Reports of damage continued to flow in from theaters; procurement districts, inspection zones, and manufacturers were asking for specifications to cover export packing; the industry was sending samples of packing materials for appraisal; and there was pressure from ASF staff level to do something.[118]

Now came belated recognition of the size and complexity of the packaging problem. The Signal Corps asked for advice and assistance from other services and organizations which had packaging problems: Ordnance, the Quartermaster Corps, the Corps of Engineers, the Canadian Mission, and the Navy. To centralize activities and fix responsibilities, the Signal Corps raised the packing subsection to section status, assigned officer and civilian specialists, and gave the green light to elaborate expansion plans. A conference in June 1943 brought together representatives of Army Service Forces, the Chief of Chemical Warfare Service, The Surgeon General, and all Signal Corps depots, engineering groups, procurement districts, inspection zones, and laboratories to discuss the problem.[119]

Throughout the early summer Packing Section personnel worked feverishly, writing packaging specifications for individual items of equipment. But there were thousands of items; the war would be won or lost before individual specifications could be produced for all of them. And specifications were not enough. As Lt. G. Mark Strohecker explained late in June, there ought to be greatly expanded facilities to expedite replies to complaints and inquiries; standard marking and packing clauses for contracts should be written; men should be available to teach proper packing methods to inspectors and depot personnel; and there was a vast amount of research and co-ordination that needed attention desperately.[120] It was quite evident that it was very late indeed to be building a packaging organization, and that measures taken so far fell short of what was needed. Eventually the Signal Corps

[116] Ullery, History of the Storage and Issue Agency, I, 385–86.

[117] *Ibid.*, II, App. 33.

[118] Memo, CofS for ACofS for Mat ASF, 24 Feb 43. ASF CofS Reading File, Dec 42–Feb 43. DRB AGO.

[119] CSigO, Annual Report, 1943, pp. 286–87.

[120] Ullery, History of the Storage and Issue Agency, II, App. 35, Memo, CO Packing Sec S&I Agency to Exec Officer, 25 Jun 43.

solved the problem with notable success, but not until another year had passed.[121]

Tropicalization

Wherever signal equipment was in use in hot, wet climates, it deteriorated quickly, corroding, sprouting fungus, and accumulating rust. Tropicalization — protecting equipment from these conditions—was partly a packaging problem, but to a greater extent one of equipment design. Signal Corps equipment was built to specifications drawn up by the using arms. These services had expressed little interest in tropicalization until the first months of war brought reports of equipment failure under heat and moisture in New Guinea, Australia, the Middle East, the Philippines, and remote spots in the China-Burma-India theater.[122]

The climate of Guadalcanal, for example, was hard on communication equipment. From sundown to sunup, everything was very wet, and at midday it was hot and dry. Since none of the equipment was moisture-proofed or fungus-proofed, the men fought constantly to keep communications working. They constructed heating cabinets of electric lamps and scrap lumber; covered dry-cell terminals with candle wax; and, after dumping thousands of poorly packed and therefore useless batteries into the ocean, discovered that packing batteries in discarded ration tins assured them longer life.[123] Field wire in the South Pacific Area deteriorated so quickly that it was in trouble most of the time.[124]

In New Guinea the signal troops with the 41st Infantry Division hoarded their equipment, because in outlying sections everything had to be packed in or flown in over the Owen Stanley Mountains. The moisture soon incapacitated the walkie-talkies, and even field wire lasted no longer than several weeks. Ants attacked the insulation on telephone wires and radio connections; salt water and spray corroded metal parts, and jungle heat and moisture caused the leather parts of telephone EE–8 to mold and drop off the frame.[125]

When the using arms realized that their specifications for signal test equipment ought to include waterproofing and tropicalization, they besieged the Laboratories for modifications. Camp Coles and Fort Monmouth divided the work. Beginning about the middle of May 1943, Coles concentrated on modification kits containing varnish, brushes, spray guns, infrared lamps, and other items, to enable the troops in the field to treat the equipment already on hand. Monmouth investigated means and methods for moisture-proofing and fungus-proofing items in the course of production.[126] Contracting officers modified as many as possible of the existing contracts to include a requirement that the items be

[121] See Thompson and Harris, The Outcome.

[122] ASF Mil Intel Study 8, 26 Sep 42. DRB AGO.

[123] (1) Interv, SigC Hist Sec with Capt Robert C. Danser (formerly a telegraph and telephone officer with the 25th Inf Div), 7 Oct 44; (2) Interv, SigC Hist Sec with T/5 Allan M. Buck (formerly 25th Inf Div, 25th Sig Co), 30 Nov 44. SigC Hist Sec File.

[124] Ltr, Sig Officer USAFISPA to Lanahan, 6 Feb 43. SCIA File 8, Ankenbrandt-Newhouse Rpts, 1.

[125] (1) Incl, Chronological History of Signal Corps Operations of the Sunset Division in the Southwest Pacific Theater of War, with Ltr, Lt Col Irwin C. Stoll, Div Sig Officer 41st Inf Div to CSigO, 13 Aug 43, sub: Official rpt of Sig Officer, 41st Inf Div, Opns in Australia and New Guinea, and App. covering com of marines at Guadalcanal. SCIA File 71, Stoll Rpts. (2) Incl 1 (Sec. 16), Rpt of Col Willis J. Tack and Lt Col Frank J. Lawrence, with Memo, ACofS AGF G-2 for Ground Gen and Spec Staff Secs *et al.*, 25 Aug 43, sub: Observations in Southwest and South Pacific theater, 5 Apr 43 to 14 Jul 43. SCIA File 46, Misc Observers Rpts, 1.

[126] OCSigO Engineering and Technical Sv, History of the Signal Corps Research and Development in World War II, Vol. XI, Pt. 1, proj. 2008.

tropicalized, and provided for it in new contracts. Many of the processes, however, required special machinery and materials, and personnel trained to use them. The techniques were new; it would take time to get them into operation at all the factories making signal equipment destined for use in tropic regions. In the meantime, the Army Communications Board was studying the matter as well, but it would be several months more before its report would be issued.[127] This problem, too, yielded to time and experience, and by the end of the war all signal items destined for tropical use were moisture- and fungus-proofed as a routine matter.[128]

Spare Parts

Overshadowing all other complaints from overseas were the vigorous outcries over lack of spare parts. Small parts were particularly scarce in the CBI theater. The vacuum rectifiers on the teletypewriters blew out because of overloading, since there were not enough machines to go around and no replacements for repair.[129] Shipping space was short, theater priorities were low, and the depot stocks in India were very limited. In midsummer of 1943 the shortage of signal supply was so critical that no reserves at all could be built up by units in the field, and radio stations were frequently off the air for emergency repair by crews who improvised as best they could without vital tools and spare parts.[130] Compounding the difficulties of repair were the vagaries of the climate. In the monsoon season, the heavy rains descended, and the atmosphere became hot and steamy; in the dry season the weather remained hot, but the air was filled with dust. This was particularly hard on equipment with any moving parts, such as typewriters and teletypewriters.[131] In the South Pacific there was an extreme shortage of radar parts; in fact, as the Signal Officer, Colonel Ankenbrandt, pointed out, there were shortages of everything: ships, supplies, harbor facilities, and storage space.[132]

Spare parts constituted the most pressing need in North Africa also, as Colonel McCrary, a special representative from the Office of the Chief Signal Officer, learned on a trip to the theater early in 1943. Colonel Williams, formerly signal officer of the 1st Armored Division and by February its chief of staff, said:

> We have had an awful time as far as spare parts are concerned. Every place this Division has been we left requisitions covering our requirements for supply parts, expendable supplies for 60 days. . . . We expected to get automatic issue, but have received none so far. We have to go to the depots and yell and scream and steal to get even the few spare parts we have. The worst part is to get tanks and other vehicles with no radio equipment at all. The mountings, plates, brackets, and cabinets are even harder to get than the radios themselves. Some sets put in without cabinets soon wear out. Tanks and vehicles are not much good without radios . . . and a poor installation is better than none at all.[133]

Colonel Williams added that he lacked adequate repair facilities. Ordnance had taken

[127] Army Communications Board Case 72, Signal Communications Equipment for Jungle Operations, Aug. 43.

[128] Thompson and Harris, The Outcome.

[129] Interv, SigC Hist Sec with Capt Harold E. Welsh (formerly assigned cryptographic duties in CBI theater), 8 Nov 44. SigC Hist Sec File.

[130] (1) History of Signal Corps Activities in China-Burma-India, Ch. I, p. 22. (2) Interv, SigC Hist Sec with CWO George W. McVickers (formerly radio officer in the CBI theater), 14 Oct 44. SigC Hist Sec File.

[131] Interv with Capt Welsh.

[132] Ltr, Sig Officer USAFISPA to Lanahan, 6 Feb 43.

[133] Comments of CofS 1st Armored Div, 24–25 Feb 43, to McCrary, Spec Observer OCSigO. SCIA File 28, McCrary Rpts.

over the repair of motor vehicles, and "if the Signal Corps does not do a better job of repair of radio sets within the Armored Force, it is quite possible that Ordnance will take this over also." Lieutenant Bloodworth, commanding officer of a detachment of the 175th Signal Repair Company, reported an "acute shortage of spare parts and transportation," and added wistfully that if he had all the authorized equipment and a few spare parts he could do a fine job, but that as it was "most of our work is makeshift."

The signal officer of the Mediterranean Base Section, understandably a little bitter because he had submitted eight requisitions in the period from 22 October to 6 March with almost no success, thought that "spare parts are more important than new equipment, and they should be sent at once." This was the crux of the matter. The zone of interior could not fill the requisitions for the very reason that spare and repair parts were also components used in new sets, and War Department policy had been to supply complete sets at the expense of spare parts. The maintenance officer of the 34th Infantry Division was "woefully short of spare parts . . . practically all we have is what we brought with us." His supply consisted of some resistors and condensers for the BC–312 and 342, a few tubes for some sets, and a scattering of parts for the SCR–299. He had no spare parts at all for the much-used SCR–608, 610, 511, 536, 288, or 284 sets, or for the teletypewriters. The II Corps' signal officer, Colonel Tully, who had spoken optimistically of supply in general, admitted that "there is and has been ever since we arrived in North Africa an acute shortage of spare parts for repair of Signal Corps equipment, especially radio equipment." He cited his own detachment of the 177th Signal Repair Company, consisting of two radio repair sections, two wire sections, and one small arms section. In the whole detachment there were no spare parts at all, and one of the radio repair sections had no tools.[134]

Colonel Tully sent Washington a plea for spare parts for the SCR–299 in April. He praised the performance of the 299, but said that he feared that 35 generators which had been running continuously for over two months would give out simultaneously. With no spare parts, and only one spare generator PE–95 available for replacement, what would happen, he asked, when all of them reached the 3000-hour service period at the same time? [135]

Radar spares were especially short. The commanding officer of a communications battery in an antiaircraft unit of the 68th Coast Artillery reported to Colonel McCrary in February that he had been using the SCR–268 to track airplanes with good results, but that he had been unable to get any spare parts at all and his stock was almost exhausted.[136]

General Matejka reported in April that spare parts for radar were practically nonexistent. He suggested that not only maintenance but also breakage as a result of faulty packaging be considered when setting up maintenance plans for supplying radar spare parts. Lack of spare parts and replacement components had resulted in

[134] Rpt of McCrary, Feb–Mar 43, following extracts: (1) Comments of CofS 1st Armored Div, 24–25 Feb 43; (2) Comments of CO Detachment 175th Sig Repair Co, 25 Feb 43; (3) Comments of Sig Officer Mediterranean Base Sec, 8 Mar 43; (4) Comments of Maint Officer 34th Div, n.d. SCIA File 28, McCrary Rpts.

[135] Ltr, Sig Officer II Corps to CSigO, 9 Apr 43, sub: Use of radio sets SCR–299. SCIA File 23, Tully Rpts.

[136] Comments, CO Battery B 68th CA, Feb 43, McCrary Rpt. SCIA File 28, McCrary Rpts.

abandonment of complete units or important parts of units during combat, he noted. He added that now there was also a serious shortage of spare parts for tactical radios, and that he had to cannibalize some sets in order to repair others.[137]

The Aircraft Radio Laboratory's director, Colonel Yeager, visiting North African air bases in April and May, had found a "very serious shortage of test equipment and spare parts." Among Air Transport Command ferry route bases, he found Natal, Brazil, especially short of spare parts. At Atkinson Field, British Guiana, SCR–517 equipment was working only 50 percent of the time for lack of parts.[138]

Back in Washington, near the end of 1942, three things had happened which together blasted the question of spare parts wide open.[139] The firm of management engineers, Wallace Clark Company, issued a series of comprehensive reports on spare parts; the complaints of shortages started rolling in from the North African theater; and the Army Service Forces, worried about the matter not only in the Signal Corps but in all the other supply services, stepped in to take control.[140]

The Wallace Clark report covering spare parts for airborne radio and radar sets was issued 27 November 1942. It reviewed current contracts for a number of important sets, compared the actual rates of delivery of spare parts with those called for, and found them disappointing. Delivery of spare parts groups was lagging, and contracts with General Electric for BC–191 and BC–375 failed to specify any spare parts at all. Contractors had used up all their component parts to make complete assemblies so that the assembly lines would be kept in full production, partly in order to meet airplane assembly schedules, but also because of "the belief that some of the spare parts requirements are exaggerated, and that the parts if delivered would not be of any immediate value." [141]

The second report covered spare parts for ground and vehicular sets, and was even more devastating. Of the 87 outstanding contracts, 74 provided for concurrent delivery of spare parts. Of the remaining 13, several called for delivery of spare parts groups two to four months after delivery of the equipment, but 7 contracts with General Electric (the sole manufacturer of transmitter BC–191, a major component of several sets) "not only do not call for concurrent delivery, but [are protected by] a blanket waiver of all spare parts deliveries, signed by the contracting officer." [142]

Of 63 orders on which deliveries were due, assembled equipment was complete on 19, but no spare parts had been accepted, and in 62 out of 66 cases in which sets were in various stages of completion, the spare parts were behind the sets on the basis of delivery. The report cited reasons for the lag: the necessity of supplying initial equipment to task forces; the shortages of materials which led to the slighting of spare parts in favor of complete sets; and the fact

[137] Ltr, Sig Officer, AFHQ to CSigO, 18 Apr 43. SCIA File 13, Matejka Rpts.

[138] Ltr, O/C ARL to CG AAF, 12 Jun 43, sub: Rpt of visit of Yeager to NATO, Ninth Air Force, and ETO, 6 Apr 43–7 Jun 43. SCIA File 75, Yeager Rpts.

[139] For discussion of spare parts policy and problems, 1941 to late 1942, see above, pp. 324–28.

[140] For Ordnance difficulties with spare parts, see Harry C. Thomson and Lida Mayo, The Ordnance Department: Production and Distribution, a forthcoming volume in this series.

[141] Wallace Clark Rpt 29, Spare Parts for Airborne Sets, 27 Nov 42. SigC 413.44 Spare Parts No. 4, Dec 42.

[142] Wallace Clark Rpt 30, Spare Parts for Ground and Vehicular Sets, 28 Dec 42. SigC 413.44 Spare Parts No. 4, Dec 42.

that spare parts groups could not be inspected and shipped until all items comprising a group were on hand. This factor illustrated the "for-want-of-a-nail" nature of much of signal supply. One small part in critical supply could hold up delivery of a much-needed piece of equipment or spare parts group for weeks or months. The Wallace Clark report recommended among other things that this method of contracting for spare parts groups be changed, and that the Inspection Agency be authorized to accept and certify for payment such parts as were fabricated and ready for shipment, although the whole spare parts group might be incomplete.

General Colton was quick to follow up the Wallace Clark recommendations. He had already emphasized to all signal supply agencies that a change of policy was in effect, that equipping task forces initially was no longer as important as maintaining equipment already in the field. On 28 November he notified the Wright Field Signal Corps Procurement District to get busy immediately reviewing all airborne sets to find out what spare parts the men in the field required for repairing their equipment, taking the most-needed sets first; to find out what had been done to supply the parts, and, if it had not yet been done, to do it at once; and to report to him within one month what had been accomplished.[143] On 31 December he told the directors of the Signal Corps Ground Signal Service, the Signal Corps Aircraft Signal Service, and the Philadelphia Signal Corps Procurement District to "give this matter your personal attention," the military method of informing them that it was urgent and that he had to have results. Colton pointed out that neither contracting officers, contractors, nor expediters had been as much concerned to obtain delivery of spare parts as of complete equipment, and added that undoubtedly directives from his office in the past had led to that attitude. However, the time for that was past. Over $900,000,000 worth of equipment had already been delivered—it was essential to keep it in service.[144]

The Wallace Clark researchers had pointed out that there was no single place in the Signal Corps where they could get a complete picture of the spare parts problem, and had listed five agencies involved: the Laboratories, the Procurement and Engineering Section of the Philadelphia Signal Corps Procurement District, the Storage and Issue Agency, the Signal Corps Shops Branch, and the Maintenance Section of the Signal Corps Ground Signal Service.[145] They might well have added that there were too many agencies outside the Signal Corps having a proprietary interest: for example, the manufacturers, the commanding generals of the theaters, the Army Service Forces, and numerous top-echelon planners and requisitioners.

Meanwhile, the ASF directed the Signal Corps to participate with the other technical services in a spare parts study, covering procedures used for estimating requirements, storing, and distributing parts.[146] The Signal Corps set up a special project within

[143] Ltr, Chief of Sig Supply Sv to CG Wright Fld SigC Proc Dist, 28 Nov 42, sub: Spare parts groups rqmts. SigC 413.44 Spare Parts No. 4, Dec 42.

[144] Ltr, Chief of Sig Supply Sv to Dir of SigC Ground Sig Sv, Dir of SCASS, and CG Philadelphia SigC Proc Dist, 31 Dec 42, sub: Spare parts for SigC equip. SigC 413.44 Spare Parts No. 4, Dec 42.

[145] Wallace Clark Rpt 30, p. 17.

[146] (1) Memo, Gen Styer, CofS ASF, for CSigO, 28 Dec 42, sub: Spare parts. SigC 413.44 Spare Parts No. 4, Dec 42. (2) Gerard, Story of Supply in the Signal Corps, Pt. II, p. 40.

its control division which started preparing the report called for by the ASF. It found twenty-two factors which had to be considered in requisitioning spare parts.[147] Before it could forward its report, new directives from the Army Service Forces broadened the base of inquiry to include stock control. The ensuing three months were a grueling period, with every Signal Corps agency even remotely concerned with the matter pressed on every side for answers to a problem which was rapidly assuming nightmarish proportions. The files grew thicker with surveys, suggestions, and counterproposals.

That there were as many points of view on the spare parts problem as there were interested agencies had been demonstrated in February 1943, at conferences held in the Office of the Chief Signal Officer and attended by representatives of the Services of Supply, the Army Ground Forces, the Antiaircraft Command, the Antiaircraft Artillery Board, the Camp Evans Signal Laboratory, the Fort Monmouth Signal Laboratory, and the Monmouth Procurement District. The specific subject under discussion was the spare parts and vehicle programs for radars SCR–268, 545, 547, and 584. From the Signal Corps maintenance viewpoint, it was desirable to have as many spare parts as possible in the field with the operating sets. For example, each gun battery and each searchlight platoon ought to have complete maintenance equipment accompanying each set, assuming of course that there were enough maintenance men trained to use it. On the other hand, as the Army Ground Forces and the Antiaircraft Command pointed out, tactical considerations demanded that units be kept mobile, carrying as little maintenance equipment as possible. The distribution representatives wanted a spare parts program that would achieve the objectives sought by both the maintenance and tactical planners. Obviously, this was very difficult, and the best approach they could suggest was to provide each radar set initially with the minimum amount of spares for first- and second-echelon maintenance, and to place all remaining spares and maintenance equipment either in a rear echelon or in depot stock.

The procurement representatives offered still another view. From the standpoint of facilities and materials, spare parts ought to be reduced to the very lowest point consistent with minimum adequate maintenance, because of the many critical items and materials required in their manufacture. And finally, from the production point of view, any revisions either upward or downward meant a disruption of production. Once a basis of decision was reached, procurement officials begged that it be allowed to stand, because constant changes cost much money, time, and trouble.[148]

In March the ASF issued its consolidated

[147] Gerard, Story of Supply in the Signal Corps, Pt. II, pp. 45–46. They were: catalogue of spare parts, with positive identification to avoid duplications; inclusion of same parts used in two places in same unit, or used in more than one unit; accuracy of record showing stock on hand; minimum and maximum lists; quantity used; quantity on hand all over; present shortages represented by back orders; information from laboratories; information from manufacturers; information from repair shops on experience; information from Air Forces; information from Ground Forces; supplying of new depots; quantity of complete units contemplated to be put in operation; filling the pipeline (distribution lag); breakage; shipping losses; losses in theaters (combat factors); usage in different climates and/or temperatures; wearing out of equipment; salvage; and British experience.

[148] 8th Ind, Actg Chief of Electronics Br OCSigO to CG SOS, 2 Mar 43, on Ltr, CofS Hq AAC to CG AGF, 10 Nov 42, sub: Change in T/BA 44. SigC 413.44 Gen 4, 1943 (RB 1926).

report on spare parts for all the technical services. It noted that the Signal Corps, insofar as it was concerned, had already taken steps to alleviate many of the difficulties. For example, it noted that the Signal Corps maintenance parts annexes formed a part of the contract specifications, which in turn were the basis for determining parts requirements. These annexes were lists of maintenance parts which, in the judgment of the laboratory engineers and the manufacturers, were considered necessary for one year's maintenance. They represented the most expert guesses available until field experience reports could come in. In January 1943 the Signal Corps had directed the repair shops to prepare quarterly reports, and had instructed each signal unit having a repair section and each depot performing repairs on signal equipment to send in temporary reports on items requiring excessive maintenance. From these, the laboratories would be able to tell, for example, whether the dynamotor armatures and bearings they ordered as spares were actually used by the field repair organizations or whether repairmen simply replaced the entire dynamotor, and whether ordering three sets of every fixed capacitor used in a radio set was necessary, or whether certain capacitors failed more quickly than others, resulting in excesses of some kinds and shortages of others.

The most important finding of the ASF report struck hard at the lack of standardization, both of individual items of equipment and of components to permit interchangeability of parts between various items of equipment. It called this lack of standardization "the one major factor impeding the successful accomplishment of the supply of spare parts." [149]

[149] ASF Control Div Rpt 98, Spare Parts for Signal Equipment, Mar 43, p. 1. ASF File, DRB AGO.

It was at this point that the Signal Corps dilemma—the conflict betwen technical specialization and the "frozen-design" concept necessary for mass production—came into sharp focus once more. There could be no argument about the desirability of standardization. The only question was how far it could go without colliding head on with some other equally desirable objective. Certainly such badly bungled cases as that of headset HS–30 could be cured. The HS–30 was a relatively simple device. In a zealous attempt to spread the work among small contractors, Signal Corps contracting officers had divided the order for the headsets among ten different manufacturers, who produced ten different electroacoustic elements, each of which met the specifications but none of which was interchangeable with any other. This meant that ten different types of maintenance parts groups had to be obtained and distributed to all using units in the field.[150]

To prevent such absurdities of duplication, the Signal Corps had set up the Signal Corps Standards Agency, which was working with the War Production Board, the American Standards Association, the Navy, and industry, to standardize components. The agency had already completed a preferred list of vacuum tubes and mica capacitors and was at work on lists of fixed and variable condensers, ceramic, paper and electrolytic capacitors, and meters. From now on, before any new items of signal equipment were put into production, the contractors' samples of components would be submitted to the Standards Agency for approval.[151] Commendable though these ef-

[150] *Ibid.*, pp. 1–2.

[151] Incl, Comments on Report 98, with Ltr, Colton to CG ASF, 8 Apr 43, sub: Spare parts for Sig equip. SigC 475.7 Sig Equip.

forts were, they could accomplish only limited reforms. The roadblocks erected by the desire of the using arms for flexibility of design were based upon sound tactical reasons, but they illustrated once more the problems the technical services faced in trying to reconcile the basic incompatibility between the two points of view.

The ASF report did not specifically discuss this point, but by inference it acknowledged its existence by the proposal it advanced for solution of the spare parts problem. The remedy sought to "put the contracting officer, supplier, distributor, and user of maintenance parts upon a basis of mutual understanding" by publishing a tabular list of replaceable parts which became a maintenance list when edited, approved, and stock-numbered, and which provided the basis for estimating requirements, initiating procurement, and requisitioning parts in the field at various echelons.[152] It appeared to be a workable arrangement, and actually it or something very like it was used thereafter throughout the war, becoming the basic element upon which maintenance planning depended.[153] But by itself it was still not enough.

At about the same time that the ASF report reached General Colton's desk, he had before him a fifty-page report from the Wallace Clark management engineers which reviewed the many programs under way. The Signal Corps was attacking the spare parts problem on all fronts, with varying degrees of success. Identification—proper description, stock-numbering, and published lists of spare parts—was proceeding well. Efforts to obtain better estimates of requirements were far less successful. The Signal Corps Aircraft Signal Service agencies at Wright Field had made good progress, both in determining what parts were needed and in building up a supply of them. But the organizations under the Signal Corps Ground Signal Service at Fort Monmouth seemed to be lagging.[154]

Some weeks earlier, Colton had set some of his best officers to work on a comprehensive "Maintenance Plan" to establish policies for procurement, distribution, and use of repair parts. On 1 May this plan was published. It embodied the best suggestions from the Signal Corps' Control Division study, the various Wallace Clark reports, and the ASF study. It went to the Signal Corps Aircraft Signal Service, the Signal Corps Ground Signal Service, the Signal Corps Eastern Signal Service, and the various branches and divisions of the Office of the Chief Signal Officer, and it stated specifically what each agency should do.[155] As the weeks slid by and the spare parts situation improved only slightly, the fires that were being built under every organization straight down the line were growing hotter.

But it was becoming apparent that the spare parts problem involved factors that could not be controlled on the home front by the technical services alone. It was as if a merchant had set out to furnish trade goods for an exploration party without advance information as to whether beads, knives, or bolts of calico were required.

[152] ASF Rpt 98, Incl, Proposed Plan for Spare Parts Determination and Issue.

[153] Cerruti, Historical Narrative of the Philadelphia Signal Corps Procurement District, p. 443.

[154] Wallace Clark Rpt 35, Mar 43, pp. 20, 30, 39–40. SigC 413.44 Spare Parts No. 5, Jun–Jul 43.

[155] Memo, Chief of Sig Supply Sv for All Concerned, 1 May 43, sub: Gen Maint Plan (for equip supplied by SigC), and the following Incls: (1) Gen Maint Plan, Sec. I. (2) Gen Maint Plan, Sec II. (3) Memo, sub: Maint lists for SigC equip. SigC BC 475 Spare Parts (Maint Equip, Vol. 1).

The ultimate consumers of spare parts were the overseas forces, yet the technical services had little idea of how parts were used or distributed overseas. The Wallace Clark report had called this lack of detailed knowledge of activities in the overseas base depots and repair echelons the great deficiency in the distribution system. "It is not known what organizations are doing in practice, how they are being set up to receive stock and to distribute repair parts, and what the real needs and problems are." Field requisitions were made "not on the basis of spare parts groups or maintenance factors, but on the judgment of the supply officer as to his need," and 30-, 60-, or 90-day supply needs of task forces were also computed "on a basis differing from the procurement computations." [156] Thus no matter how carefully the Signal Corps supply system at home might calculate the "probable" needs, the "actual" overseas needs, real or imagined, could throw the complete system into chaos. Obviously, more inspection teams and more carefully compiled overseas reports were needed.

The Army Service Forces and the War Department moved to fill the breach. On 15 May the ASF issued Circular 31, which covered in detail the policies for spare parts lists.[157] It followed this with a series of letters to the technical services devoted to special aspects of the problem.[158] On 6 July the War Department issued Memorandum W700–32–43.[159] It provided for "continuously analyzed" reports from the field as to the actual end use of spare parts. It also enunciated an official policy: spare parts "easily broken, rapidly worn, or otherwise required for frequent replacement" would be furnished integrally with each item of equipment, and spare parts for all echelons of maintenance would be delivered simultaneously with equipment deliveries.

No one was naive enough to think that a mere enunciation of policy could solve the spare parts problem. But at least it set up the ground rules and, more importantly, made it clear that they applied to everybody. From now on, the conflicting viewpoints and practices of overseas commanders and zone-of-interior supply organizations could be channeled into the same lines of action.[160]

The Fiscal Year Summary

Thus, as the fiscal year ended on 30 June 1943, the fever chart of the Signal Corps supply organization told little about the actual state of the patient's health. Looking well, looking ill, it fluctuated from crisis to crisis, and could be evaluated as either very good or relatively poor, depending upon the criteria used. On the one hand there were the persistent reports of shortages overseas, and the production lag in certain important classes of equipment. But the vigorous efforts to overcome these difficulties were encouraging, and seemed to be about to pay off.

The last half of the fiscal year had begun on a highly optimistic note. The Signal Corps had not only met the current require-

[156] Wallace Clark Rpt 35, p. 47.

[157] (1) Gerard, Story of Supply in the Signal Corps, Pt. II, p. 48. (2) ASF Cir 31, 15 May 43, Spare Parts Lists.

[158] (1) Memo, Maj Gen LeR. Lutes, Dir of Opns ASF, for CofOrd *et al.*, 4 Jun 43, sub: Info pertaining to maint of equip. (2) Ltr, Maj Gen Lucius D. Clay, Dir of Mat ASF, to QMG *et al.*, 11 Jul 43, sub: Proc, storage and distr of spare parts. Both in SigC 413.44 Spare Parts 5, Jun–Jul 43.

[159] WD Memo W700–32–43, 6 Jul 43, sub: Spare parts policy for all U.S. Army troops equip except equip proc by AAF. SigC 413.44 Spare Parts 5, Jun–Jul 43.

[160] For discussion of the spare parts problem in 1944–45, see Thompson and Harris, The Outcome.

ments of the Army Supply Program (ASP), but had exceeded its November procurement objective of $141,000,000 for a total of $174,000,000.[161] A few days later came even better news. The War Department announced that between January and November 1942 the Signal Corps had far outstripped all other components of the Army Service Forces in percentage increase of dollar volume. The figure for the ASF as a whole was 337 percent, for the Signal Corps, almost four times as much: 1,328 percent.[162] From October to November the Signal Corps percentage of increase was 30.5 percent, compared to an average increase of 13.4 percent for the technical services as a whole.[163]

Taken at face value, these statistics made Signal Corps supply look very good. But percentages reckoned in dollar value were deceptive. In terms of Army needs and objectives, the picture was spotty; in some places, dark indeed—especially in regard to spare parts, radar parts above all. The fact that production in late 1942, in terms of dollars, approximately equaled the dollar value of the demand then existing meant little when much of the equipment in the depots and in the hands of troops could not be used because it lacked essential components.[164] Furthermore, the November 1942 drive for production was an artificial stimulus that created a temporary upsurge in dollar volume of deliveries without curing the basic difficulties. These troubles lay partly in the multiplicity of types of equipment and their growing complexity, partly in the questionable policy of keeping supply and development combined under Colton's command in the headquarters organization.

Thus General Colton, who was in a better position than anyone else to assess the real value of the statisticians' reports, warned on 12 December 1942 that although from an over-all standpoint the Signal Corps program appeared to be progressing very well, the same could not be said of schedules for all items. In particular, ground radio equipment and radar were trailing. In the case of ground radio, the Signal Corps was behind schedule by $15,000,000, most of it for SCR–188's. This set employed a transmitter used also in airplanes and tanks, and since both these items had higher priority than ground equipment, the transmitters for the SCR–188 were falling behind. Also, until August, the Signal Corps had supposed that it would be required to have by December only the 2,407 SCR–188's already scheduled, but in August the scheduled number was boosted by over 50 percent.

Radar was a different story, one which pointed up the inequity of comparing ASP "requirements" with the amounts of equipment a technical service could provide. Put another way, the ASP was a long-term forecast of Army needs, which took no account of the factors impeding or accelerating production of individual items. In terms of dollars, the 1942 ASP called for radar items in the amount of $270,146,000. Up till 30 November only $146,903,000 worth had been delivered. Of the $82,000,000 deficiency, almost half was for the SCR–584, a gun-laying radar which had not yet been

[161] (1) Memo, [Styer] for Somervell, 7 Dec 42. ASF Control Div, CG Reading File. (2) For the discussion of the November 1942 production drive, see above, pp. 335ff.

[162] Signal Corps Information Letter, No. 14 (January, 1943), p. 42.

[163] WD Monthly Progress Rpt, Sec 1, Procurement, Nov 42, p. 5. ASF File, DRB AGO.

[164] MS Comment, Col Byron A. Falk, Ret., in Memo for Deputy Chief Historian, OCMH, 27 Mar 52. OCMH.

fully developed, but which the using services had demanded the moment they saw the first test model. Tooling for production alone involved $10,000,000 worth of machine tools. The ASP requirement had been figured at 461 sets, although there had never been any possibility of getting any of them in 1942. The remainder of the ASP deficiency was largely in the SCR–270 and 271 radars, although by January 1942 the Signal Corps had supplied all the sets then scheduled for delivery during the entire calendar year. Later, the using arms had clamored for a great many more sets, but by that time the production lines were down and it took time to get them started again. Thus on the face of it, the Army Supply Program showed by December that the Signal Corps had supplied only three fourths of the number ultimately and belatedly required for the year. Colton said, "That is no criticism of anybody, but when these requirements were set up, few people had seen radar, and many of them who had seen it didn't believe it." [165]

Six months later, at the end of June 1943, the radar picture had brightened considerably, although only the earlier models were in full production, distributed, and in use by troops. Later models were in production, and still more recent ones were in the development stage.[166] Radar and radio shipments had increased twelvefold over the early 1942 figures, and now averaged $250,000,000 a month.[167] Nearly all items were apparently in good supply: airborne communication equipment for the Air Forces, for example. Radar was more abundant, especially for airborne use. Radios for tanks were in excellent supply, and the situation respecting plant equipment was sound. But there were weak spots in ground signal equipment and in photographic supplies, the latter because estimates had been too conservative and manufacturing facilities hard to obtain. Ground signal equipment was lagging for several reasons, the most important being that tables of equipment did not reflect all the items that theater commanders were demanding.[168] Such extra items did not appear on the Army Supply Program.

Although the Signal Corps led all the other technical services in the increased amount of equipment made available for distribution during June 1943 (with a percentage increase of 21.6 percent, representing a dollar value of $100,896,000),[169] General Somervell was not pleased with the trend of progress. The May monthly progress report indicated large decreases in the amount of items issued to the using arms, and increases in the number of items going to storage. This meant that no matter what the tonnage rates and dollar-value statistics seemed to indicate, the using arms either were not getting the kinds of equipment they needed, or the assemblies coming off the production line and going to the depots

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[165] Supply Sv OCSigO, Review of Production Plans, 12 Dec 42, pp. 3–4, 17–19, 20, 25, 30. SigC DS 400.192 Prod, 1942–43.

[166] Memo, Col Lanahan, Planning Dir OCSigO, for ACSigO, 20 May 43, sub: Résumé of status of supply of Sig equip, U.S. Army. SigC EO Memo for CSigO.

[167] Special Committee, 77th Cong, 2d Sess, *Hearings before the Special Committee Investigating the National Defense Program*, Pt. 19, p. 77531. By summer about 200 SCR-268's had been delivered in excess of tactical requirements. Memo, Conf on Spare Parts for Radio Set SCR-268, 13 Aug 43, signed by Capt C. M. Hutchins, Supply Coord Br, 16 Aug 43. SigC 413.44 SCR-268-12F, Jun 43, No. 25 (RB-2011).

[168] Memo cited n. 166.

[169] WD Monthly Progress Rpt, Sec. 2-A, Distribution, 30 Jun 42. ASF File, DRB AGO.

were not complete.[170] The Signal Corps was embarassed in May when some organizations were unable to move overseas as scheduled because of shortages of Signal Corps equipment. They included Company C of the 62d Signal Battalion; the 210th Signal Depot Company; the 233d Signal Operations Company; the 909th Signal Depot Company, Aviation; the 898th Signal Depot Company, Aviation; and the 7th, 11th, and 14th Airdrome Squadrons. This list did not include other units whose readiness dates had been deferred because of unsatisfactory T/BA and training status reports, which could not be submitted until enough equipment was on hand for training purposes. Items in short supply consisted principally of telegraph central sets, terminal equipment, and maintenance and tool equipment.[171]

Procurement, too, was falling off again rather seriously as the fiscal year closed in mid-1943. War factories serving the Signal Corps were laying off workers and discontinuing night shifts. Much of the fault could be traced to delay in placing contracts. The Signal Corps had a large backlog of unobligated funds—until the first of May it "had not spent a dime of the money received the previous July"—and delay in translating funds into contracts would inevitably mean a slowing down of deliveries. It still took forty days to process an order through the Philadelphia Signal Corps Procurement District.[172]

All these incidents pointed up the fact that General Olmstead's many reorganizations had not yet succeeded in providing a completely efficient and co-ordinated headquarters supply staff, but there is no indication from the records that he was aware that his career was about to founder, ostensibly upon the rock of supply.

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[170] Incl 4, Memo, Somervell for CSigO, 13 Jun 43, sub: May prod, with Memo, CSigO for CG ASF, 18 Jun 43, sub: May prod. SigC 400.12 Proc 1943.

[171] (1) Memo, Lanahan for CSigO, 19 May 43, sub: Orgns on movement orders deferred due to shortage of Sig equip. SigC EO Memo for CSigO. (2) Log entry, 29 May 43. Deputy CSigO Folder, 1942–45, pp. 183, 197. SigC Hist Sec File.

[172] Log entries, 21 May and 17 Jun 43. Deputy CSigO Folder, 1942–45, pp. 183–84.

CHAPTER XVI

Signal Corps Position in Mid-1943

(May-June 1943)

The Situation at Home and Overseas

When General Olmstead was appointed head of the Signal Corps in the late summer of 1941, the Secretary of War realized that the Chief Signal Officer was receiving an almost superhuman assignment. "You have had to start behind scratch," he told Olmstead, knowing that Signal Corps' manpower and budget ran relatively behind the allotments to the other services.[1] But by the spring of 1943, with the extreme emergencies of the first year and a half of the war behind him, General Olmstead could feel reasonably satisfied with the progress that his administration had made. Despite the still acute procurement and supply problem, despite the many other difficulties, the Signal Corps, shot through and through with severe growing pains, was filling its mission relatively well.[2]

Working since March 1942 under General Somervell's Services of Supply, the Office of the Chief Signal Officer in the War Department in Washington had continued to function along the same lines as before the March 1942 reorganization of the Army with its creation of the over-all service forces headquarters. General Olmstead had himself carried out some drastic reorganizations since 1941. Dramatic growth had been imposed by the war effort. Operating and staff agencies of the Signal Corps had been separated. There were more agencies, especially under the staff, and they were bigger. But it was in the field that the largest expansion had occurred: in the schools, in the laboratories, and in the whole range of procurement activities. The handful of prewar field agencies had ballooned. Numerous new laboratories, new schools, new depots, and new field procurement installations now appeared on the Signal Corps organization chart.[3]

Everywhere Signal Corps men and Signal Corps equipment were doing their work with increasing effectiveness. North to south, east to west, the Signal Corps Army

[1] Proceedings of Board To Investigate Communications, Tab P, p. 11. AG 311 (5-10-43) (1) Bulky Pkg, Army RG 207.03, Job A50-55.

[2] The four main functions of the mission were summed up in General Olmstead's report for fiscal year 1943 as follows: (1) to develop, procure, store, issue, and repair communication equipment and supplies in such quantities and at such times as required to meet the Army Supply Program; (2) to train and furnish specialized signal troops and units to all requiring elements of the Army; (3) to operate the Army's communication network; and (4) to perform photographic work for the Army Ground Forces and Army Service Forces. CSigO, Annual Report, 1943, p. 1.

[3] (1) CSigO, Annual Report, 1943, pp. 1 ff. (2) Terrett, *The Emergency*, p. 72, Orgn Chart, June 1943.

Command and Administrative Network bound all the Army together, solidly and satisfactorily. The schools were at their peak. The Pictorial Service, in both its training-film production at home and its combat photography in the field, was enlarging and improving. Supply and distribution were improving, too, even in the troubled field of radar, and more specialists trained to maintain and operate the sets [4] were becoming available. New equipment was coming out of the laboratories and off factory production lines—better wire components, better radios and radars. Newer radios, such as the SCR–694 (replacing the 284) and the new walkie-talkie, SCR–300, would be furnished waterproofed and tropicalized. Packing and packaging were improving so that equipment might reach the troops intact. Supply of spare parts and arrangements for maintenance presented especially severe problems. But even here, although the responsibility and lines of control remained fuzzy (divided three ways, between the Army Service Forces, the using arms, and the Signal Corps), the situation was improving.

The crucial test of the men and the equipment, the ordeal in the fires of combat, had been met in the Pacific and in North Africa. The month of May saw the successful ending of the war in Tunisia. Already in that theater Signal Corps men had begun to prepare for further invasions, taking steps to avoid mistakes which had been made in the North African assault. One step was waterproofing all susceptible electronic equipment. Another was establishing an American equivalent of the British "J" or "Phantom" service to monitor friendly radio nets in order to provide commanders with immediate and accurate information upon the progress of their own troops.[5] Still another important step was taken when the Navy converted for Army use the *Ancon*, a 20,000-ton combination passenger and freight ship of the Panama Line, into America's first communication ship, equipped wholly and solely to transmit and receive vital information and intelligence, the reports and commands of combat.[6]

These steps, and very many more, had to be taken and were taken, culminating during the last weeks of June 1943 in a surge of effort which readied Signal Corps men and equipment against Sicily. The success of Army communications in the island campaign that followed spoke well for the entire Signal Corps organization, all the way from the outposts in the field back to the roots at home. Yet the Chief Signal Officer, General Olmstead, while taking satisfaction in what his organization had accomplished, nonetheless knew well that much room remained for improvement—in supply, for example, and in Signal Corps control over its multifarious and far-reaching operations. The supply problem, in the eyes of the War Department, was the more obvious and the more insistent. But the control problem was the more basic, the more troublesome, to General Olmstead and his staff officers in the Washington headquarters. They did not have all the authority they desired. Nor could they keep themselves adequately informed about signal

[4] See, for example, Ltr, Sig Officer USAFISPA to Planning Div OCSigO, 3 Mar 43. SigC Opns Br 111, Ankenbrandt Rpts.

[5] (1) Hammond, "Signals for Patton," *Signals* II:1 (September–October 1947), p. 7. (2) SIAM Manual, Tentative Operation and Training Manual for the Signal Information and Monitoring Service, n.d. SigC Hist Sec File. The American equivalent of the J service became known as SIAM.

[6] See Tab T–13, Theaters Sec, SigC 319.1 (SPSOD–46) Prog Rpts, Office of the Planning Director, Dec 42–Jul 43.

matters in the theaters overseas. Between the Signal Corps roots at home and the branches abroad the connecting trunk seemed at times tenuous, at times twisted and knotty, at times, indeed, almost severed. Defects repeatedly appeared in the flow of signal supplies and in the exchange of signal information between the field and Washington.

Additional problems developed out of the fact that the communications scene was changing from month to month almost faster than men could comprehend. As counterparts to the new developments in the laboratories and factories at home, there were now springing up in the field surprising applications—in radar, in radio relay, in carrier communication, in electronic countermeasures. The impact of mechanized mobile war on the ground and in the air, the effect of new and better electronic signal equipment upon the new mode of warfare, the countereffect of new combat conditions upon the application of the equipment—all led to new needs and new demands, sudden and unanticipated. Observing officers who could make themselves believed when they got back to Washington were needed in the field, as Colonel Tully pointed out after the North African campaign.[7]

In the summer of 1943 Colonel O'Connell commented that there were basic organizational reasons why both the supply of Signal Corps items and the exchange of information were so difficult. "There are so many layers of different organizations," he said, "between the man in the front in the theater and the complex organization in this country which must take cooperative action that the remoteness is almost complete." He added that there was "lack of understanding and appreciation of Signal Corps problems in the higher staff levels because no Signal Corps officers are made available for duty on the General Staff." O'Connell cited in particular the North African theater staff with no Signal officers, but with several Ordnance officers. In Washington the War Department General Staff agencies, such as OPD, had very few Signal Corps officers assigned to them. Because of a lack of signal-minded officers in OPD and because of the fact that Signal Corps units were broken up into three categories (Army Ground Forces, Army Air Forces, and Army Service Forces), Maj. E. McDonald, Chief of General Olmstead's Supply Operations Branch, asserted that it had become "virtually impossible for one agency to know the whole story about a Signal Corps unit requested by a theater." Pursuing this example in support of O'Connell's remarks, McDonald explained further:

> . . . the theater commander's request for an Army Ground Force unit is never referred to the Chief Signal Officer, nor is a request for a Signal Corps unit with the Army Air Forces. Requests for Signal Corps casuals may never be referred to the Signal Corps, and in some cases requests for Signal Corps Army Service Force units are never referred to the Office of the Chief Signal Officer but are referred to the Army Service Forces headquarters, which makes the final decision without reference to any agency in the Office of the Chief Signal Officer.

Thus other agencies, such as the ASF often took action in signal matters while the Signal Corps itself remained uninformed. To bypass such organizational blocks, which some may say inhere in the complexities of modern life and modern

[7] Ltr, Tully to Meade, 21 Sep 43. SCIA File 23, (see Bibliographical Note), Tully Rpts, 1. Tully, who had been II Corps Signal Officer during the North African fighting, became Deputy Chief Signal Officer, AFHQ, in mid-1943.

warfare, O'Connell urged a direct exchange of officers to keep the Signal Corps at home and the Signal Corps in the field better informed. "Bring back key staff officers from the theater," he recommended, "for short tours of duty to familiarize them with organizations and methods of procedure in [the] U.S.," and use "trained liaison officers on a bi-monthly or quarterly basis to keep theater staffs informed of personnel and equipment plans." [8]

Since the first of the year, after signal communications in North Africa became stabilized, a procession of Signal Corps officers had been traveling to that theater to report home on signal matters. By the summer's end so many observers had come that overworked officers in the field were getting "fed up with visitors," as Colonel Tully put it. Tully added that their tendency to report chiefly the troubles which undeniably harassed the field organization should be weighed against the fact "that there are a lot of things that are going all right." [9]

The visitors included Colonels O'Connell and Rives (both from the Signal Corps supply organization in Washington) and General Olmstead himself. Colonel Rives surveyed the signal situation touching the Army Air Forces in England and North Africa during May and June. He had agreed to concentrate on the air view since O'Connell was spending two months to look into the state of signals in the Army Ground Forces and the Army Service Forces. What struck Rives most was the dual supply system in the Army: on the one hand, the Army Service Forces supplying the Army Ground Forces; on the other, the Air Service Command supplying the Army Air Forces. Units of the Signal Corps operated in both, happily in the Army Service Forces, unhappily in the Air Service Command. Those serving in the latter were orphans, he declared, their parent branch, the Signal Corps, having no control over them, and their adopted parent, the Air Forces, looking upon them very much as stepchildren. Such units, he recommended, should be transferred outright to the Army Air Forces.[10]

Colonel Rives found no very dire defects, however. Neither did Colonel O'Connell nor his companion, Dr. R. S. Glasgow, a radio consultant with the Army Air Forces. The comments of O'Connell and Glasgow touched chiefly matters of supply and maintenance, training, organization, and chains of command. "There has been a very definite development of communication consciousness on the part of tactical commanders and their staffs, as to the vital nature of fast, reliable signal communications," O'Connell reported. But "uncertainty and indecision," he added, "were observed generally among theater signal staffs as to the proper channels of correspondence and action on technical matters and channels, and command or policy matters and channels." Communications were working, thanks not so much to the system as to the "zealous devotion to duty . . . of all signal personnel," said Dr. Glasgow, who commented that "it is my opinion that their initiative

[8] (1) Memo, O'Connell for CSigO, 12 Aug 43, sub: Observations and conclusions on certain matters of policy and orgn as a result of temporary duty in North Africa; (2) Memo, Maj McDonald for Col Guest, 26 Aug 43, sub: Present procedure and responsibilities of CSigO with regard to complaints noted in O'Connell rpt to CSigO. SCIA File 113, O'Connell and Glasgow Rpts.

[9] Ltr, Tully to Meade, 21 Sep 43. SCIA File 23, Tully Rpts, 1.

[10] Ltr, Rives to CSigO, 21 Jul 43, sub: Observations in England and North Africa. SCIA File 84, Rives Rpts.

and effort did much to offset some of the limitations and inadequacies" which O'Connell described.[11]

On the evidence of these observations, therefore, it appeared that there were some faults in Army signals. Signal Corps officers since the March 1942 reorganization chafed at their situation, especially at the consequences of that reorganization, which placed their Corps under the ASF. The Chief Signal Officer could not approach directly either the Air Forces or the Ground Forces; he had to communicate with them by way of an indirect channel, through the ASF headquarters. Quick action and authoritative control in matters of air or ground signal operations Olmstead found to be hampered at best, impossible at worst. Olmstead and his Signal Corps officers were not alone in the dour view they took of their situation. Maj. Gen. George V. Strong, Assistant Chief of Staff, G–2, recognized that there was trouble in signals when he said in late 1942 that the Corps' difficulties lay in "the system they are working under." [12]

Dr. Edward Bowles, electronics specialist and adviser to the Secretary of War, vigorously underscored the lack of communications leadership in the Army and especially in its Air Forces. The communications of the latter arm had been poor in the North African campaign.[13] An AAF spokesman, Colonel Marriner, who was the Director of Air Communications during the first two years of the war, himself admitted in the spring of 1943 that there was need for a Chief Signal Officer of the Army with superior powers and control. This lack, he asserted, "is one of the biggest faults of the whole Army organization." [14]

If to some these pleas sounded monotonously like similar cries from the chiefs of such Corps as Medical and Ordnance, who sought direct control over their bailiwicks also,[15] to others the Signal Corps needs seemed unique. For example, Dr. Bowles informed the Secretary of War: "It is my belief that sooner or later the Army will be forced to recognize communications not only as a service but a state of mind that must pervade all planning, as well as operations, and consequently as a field of such importance that it warrants unique recognition." [16] Brig. Gen. John A. Hull, of OPD, made the same point in presenting his views to a board appointed to study army-wide communications problems in the spring of 1943: "The Medical Corps is a service; the

[11] Memo, O'Connell for Deputy CSigO AFHQ, 28 Jul 43, sub: Observations of SigC orgn and opns in NATO by O'Connell and Glasgow. Tab D, SCIA File 113, O'Connell and Glasgow Rpts.

[12] Log entry, 21 Oct 42. Deputy CSigO Folder, 1942–45, p. 79. SigC Hist Sec File.

[13] (1) Memo, Bowles for Arnold, 16 Jun 43, sub: AAF Com. OCS (WDCSA) 676 (28 Dec 43). (2) Craven and Cate, *The Army Air Forces in World War II:* II, pp. 127, 169.

[14] Proceedings of Board to Investigate Communications, Tab S, p. 5. Commenting on the lack of strong signal control, Marriner said further, "It is pretty near unbelievable that of all our enemies and of all our allies, even including our Navy, they have, in fact, a director of communications or director of signals, or what not, who is responsible on a very, very high level." But in the U. S. Army there was no signal authority above the ASF; and the AAF, Marriner added, objected on principle to submitting to communication directives from the ASF.

[15] The Chief of the Medical Corps did in fact win, toward the war's end, a fight he had made to obtain direct access, independent of the ASF, to the Chief of Staff and the Secretary of War on certain matters touching the medical care of troops and the employment of professional medical people. Maj James A. Huston, Time and Space, Ch. II, "Reorganization for Logistics," pp. 86, 155. Draft MS prepared in OCMH.

[16] Memo, Bowles for SW, 26 Jun 43, sub: AAF Com. OCS (WDCSA) 676 (28 Dec 43).

Quartermaster is a service; the Signal Corps has a dual function. It is an operating agency and a service. It is the operating side that I am interested in. . . ." [17] To this Signal Corps officers could say "amen," praying too that it not be forgotten that the Signal Corps was an arm as well, sharing that distinction with the Engineers alone of the other services.

Having in mind the impediments hindering the direct operational control which he desired over Army communications, the Chief Signal Officer and the chief of his Signal Troops Division, Brig. Gen. Frank C. Meade, had taken off on 20 March 1943 for a grand tour of inspection. They traveled 28,000 miles to many of the theaters—North Africa, the Middle East, China-Burma-India. "In spite of the vision we had of these problems," General Olmstead said, "it was necessary to go out and see the situation to realize how great the problems actually were." [18] More specifically Olmstead remembered the reply he had received the year before when he objected to the March 1942 reorganization—the reply that the Army must try out the reorganization and that, if it proved unworkable, adjustments might be made. When adjustments seemed indeed needed, Olmstead had told restive General Staff and Signal Corps officers, "I don't want to make an issue of the matter until I go out and see how it [the reorganization] affects the troops that are fighting." This was the central purpose of his trip in the spring of 1943.[19]

[17] Proceedings of Board To Investigate Communications, Tab W, p. 5.

[18] CSigO, Annual Report, 1943, pp. 65–66.

[19] Proceedings of Board To Investigate Communications, Tab P, p. 2. For General Meade's comments relative to the trip, see also Tab M, p. 20. See also p. 59, above.

Headquarters Crisis over Supply and Control Problems

The Problem of Supply

General Olmstead set out on his inspection in March 1943. Problems unquestionably existed in the Signal Corps, particularly in the field of supply. In procuring the right kinds of equipment, in sufficient quantity and on time, the Signal Corps too often continued to lag. "Signal Supply was perhaps the most critical problem of the Chief Signal Officer [Matejka] throughout the Tunisian Campaign," concluded the officers who served as the historians of the AFHQ Signal Section.[20]

In Washington the drive for production late in 1942 had produced gratifying results, but only for a while, principally in the last weeks of that year. The utmost efforts to improve supply under the existing organization did not maintain a consistently satisfactory level of production. They did not clear away basic difficulties. One of these was the fact that Signal Corps supply did not receive the full-time attention of its chief. It had remained harnessed with research and development since late 1941. For one of General Olmstead's first acts in office a year and a half earlier had been the combining of supply and development under General Colton.

Colton was a research and development specialist, and a good one. But supply, the Army insisted, was the dominant demand. It is of course questionable whether a good research director can be expected to combine his talent and preference for development with the driving, mountain-moving

[20] Sig Sec, AFHQ, History of the Signal Section Allied Force Headquarters, 24 July 1942–10 November 1945 (1945), p. 40. SigC Hist Sec File, A47–200 Drawer 15.

GENERAL OLMSTEAD *(seated) discusses signal operations in North Africa, April 1943.*

proclivities of an effective production chief. Rapid mass production inevitably clashes with the slow refinements of perfected research and development. The previous Chief Signal Officer, General Mauborgne, had encountered just the same problem and had to some degree fallen a victim of it. He knew research. He knew the business of designing intricate military equipment, and he was sympathetic with doing the development well and getting a fine product on the production lines. But his rate of production dissatisfied the Army in 1941.[21]

During 1942 and early 1943 Signal Corps experience continued to indicate that there might be intrinsically sound reasons for separating supply from research and development, putting the latter task into the hands of a research-minded officer and giving supply to one who was familiar with and favorable to the conditions of mass procurement, one who did not especially sympathize with the niceties of perfected development. Besides, Signal Corps supply and Signal Corps research had grown much too big for one man to handle. These matters Col. David Sarnoff and the other members of the Signal Corps Advisory Council well understood and stated when, in the autumn of 1942, they advised General Olmstead on Signal Corps procurement.

[21] His largest supply problem, in 1941, had been the provision of radar equipment for the AAF. See Terrett, *The Emergency*, pp. 164, 255, 258–74, especially p. 272. See also Watson, *The War Department: Chief of Staff, Prewar Plans and Preparations*, p. 49. See also pp. 58–59, 335–37, 532–35, above.

In December 1942 Olmstead had taken the Council's advice to the extent of naming an assistant chief signal officer to relieve him of much of the detailed supervision over supply matters. Maj. Gen. James A. Code, who had been Deputy Chief Signal Officer since March 1942, got the post, to remain the assistant throughout the remainder of World War II. Col. Carroll O. Bickelhaupt moved up to become the deputy. General Colton continued as chief of the Signal Supply Service, under whom Research and Development remained a large object of attention alongside of Supply.[22]

What the Advisory Council had contemplated was a much more thoroughgoing reorganization than this. Its proposal that an assistant chief signal officer be appointed had been predicated upon a vigorous revamping of the Signal Corps—a revision upon a functional basis. The Council urged that the Corps undertake a reorganization which would recognize the difference in character between its operations in a military field and those it performed as a supply service, a reorganization which would "clearly define and sharply delimit the functional responsibilities within these two different areas of operation." [23]

A shake-up in the Signal Corps supply function definitely seemed necessary. Yet no action was taken until General Ingles became the Chief Signal Officer in mid-1943. Colton himself opposed the division of his double responsibility. He believed that he best understood both supply and development. He regarded them as so interrelated that they should not be split. But his chief concern was good development. This, it seemed to him, was more important than mass supply, especially if mass supply meant hurrying imperfectly developed equipment off the production lines. He had said in December 1942, speaking of radar, that electronic production was not like making nuts and bolts; that if the Signal Corps had adopted such a crude view instead of seeking to produce the very best, American armies in the field would have suffered, would have lost battles.[24]

Olmstead agreed with Colton. "Supply begins with Research and Development," Olmstead told a board of inquiry in May 1943. When asked if research and development and supply and procurement should be linked closely, he replied, "I do." [25] He did not therefore wish to introduce basic organizational changes in this matter. Even if he had wished to assign procurement to another man, he did not have in the Signal Corps any officers who were specialists in mass production. He would have had to look around for someone with experience in private business, such as William H. Harrison, former vice president and engineer with the American Telephone and Telegraph Company, whom General Ingles subsequently appointed as Signal Corps' supply chief.[26]

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[22] Signal Corps Administrative Log, 1939–1945, pp. 35 and 64, OCSigO Orgn Charts No. 14, 9 Mar 42, and No. 19, 14 Dec 42. SigC Hist Sec File. See also p. 336, above.

Since late 1942 Colton's Supply Service embraced the Research and Development Division under Colonel Rives; the Materiel Division under Col. Eugene V. Elder; and the Distribution Division under Mr. David H. O'Brien. The Distribution Division became the Field Service Division in March 1943, still under O'Brien. Chart No. 19, in Log cited above, and No. 22, 1 Mar 43, p. 76.

[23] Memo, Col David Sarnoff *et al.*, for CSigO, 24 Oct 42. SigC 334 Signal Corps Advisory Council, 1942. [Deputy CSigO File].

[24] Log entry, 28 Sep 42. Deputy CSigO Folder, 1942–45, pp. 94, 177. SigC Hist Sec File.

[25] Proceedings of Board To Investigate Communications, Tab P, pp. 6–7.

[26] Harrison had been commissioned a brigadier general in the ASF. It was he whom General Somervell put in charge of the Army Pictorial Service when the ASF temporarily took over Signal Corps photography in March 1943. See pp. 422–23, above.

Olmstead did take steps to the extent of seeking out David H. O'Brien, vice president of Graybar Electric Company, and assigning him in December 1942 to the Distribution Division under Colton's Supply Service.[27] But he failed to take any further or more drastic steps to meet the lack of experienced production officers. Subsequently, late in 1943 Brig. Gen. Frank Meade expressed the opinion that Signal Corps' failure to meet its production program in its entirety "could have been avoided had the Signal Corps had any production experts in its officer corps." Such officers, Meade added, should be "not merely contracting or distribution specialists but men skilled in factory management and control and in the techniques of establishing and maintaining factory production and control of the flow of material and labor." [28]

The Problem of Army-Wide Signal Control

The control of communications throughout the Army had been a sensitive point with the Signal Corps since World War I.[29] Now in World War II Signal Corps control at home stopped at the division and the Corps had no direct control of its troops abroad. Even so, the overseas Signal Corps machinery was functioning with considerable success because of the excellence of the equipment, the zeal of the personnel, and the determination of officers and men to get the job done despite organizational confusion. As for the situation in Washington, it was General Olmstead's opinion, shared by many of his officers, that the efficiency and effectiveness of the Corps suffered from the Chief's lack of strong authority and central control, particularly in operational functions as distinct from supply matters.[30]

Lacking the high-level position of control it desired, the Signal Corps hitherto, in order to accomplish things which called for over-all co-ordination, had had to work co-operatively through numerous organizations such as the Joint Communications Board and the Army Communications Board with their many committees. Progress in matters submitted to boards and committees was slow and devious, passing through tortuous channels. Early in the war, just when the Signal Corps would have liked more Army-wide authority, the effective radius of its influence and power had been shortened, drawn into the sphere of the Army Service Forces, in consequence of the

[27] In the autumn of 1942 Colonel Sarnoff and the Deputy Chief Signal Officer, General Code, gave some thought to possible candidates in the electronics industry for appointment to Signal Corps supply. Log entry Sep–Oct 42, Reorganization. Deputy CSigO Folder 1942–45, p. 177. SigC Hist Sec File.

[28] Post War Signal Corps Demobilization Study. Deputy CSigO Folder, 1942–45, pp. 200–201. SigC Hist Sec File.

[29] Terrett, *The Emergency*, pp. 23–25, 133–35.

[30] Indicative of Signal Corps beliefs was the following list drawn up in Olmstead's office in April 1943 and described as "certain features of Signal Communications which can be coordinated only under the authority of the Chief of Staff":

Assignment of types of equipment
Communication countermeasures
Enforcement of standard procedures and authentication methods
Control over assignment of call signs and frequencies
Co-ordination of tactical communication operations
Allocation of existing commercial communications facilities among the several components
Signal Intelligence
Signal Security
War Department communications system

Draft Memo, unsigned, for CG ASF, 9 Apr 43, sub: Co-ordination of Sig com with Army as a whole. SigC 676 Gen Coordination of Sig Com Within the Army as a Whole, 1943 (OD–38).

reorganization of the Army in March 1942.[31]

General Marshall, determined to improve his staff relations and to relieve his General Staff officers of some of the tasks they had been trying to handle, had sought to put the service activities of the Army under General Somervell's ASF. The move assisted the supply function of the Signal Corps but it hampered its ability to operate and control communications throughout the Army. General Strong, Assistant Chief of Staff, G–2, said in May 1943, "The use and control of communications is essentially a Command function. Under the present set-up it is merely an adjunct to a Supply agency. That, fundamentally, is wrong." "We have buried the Signal Corps way down in the Army Service Forces," said the Air Forces' General McClelland.[32]

Signal Corps' struggles with the Air Forces and the General Staff had been difficult enough before the March 1942 reorganization. Now the Signal Corps had to reckon with ASF headquarters also. General Olmstead had disliked the new organization from its start. But he had accepted it on higher orders, as a good soldier must, and had tried to make it work. Now, after a year's trial, evidence was accumulating which indicated that Army signals suffered under the new structure. Olmstead felt it was his duty to assemble the facts and seek a better organizational solution. His dissatisfaction over Army signals was shared by officers responsible for communications in the General Staff, in the Air Forces, and in the Navy. This was abundantly substantiated by numerous officers summoned before a board which the Chief of Staff appointed in May 1943 to investigate Army communications.[33]

At the same time, Olmstead believed that the moment had arrived to improve Signal Corps' place in the framework of the Army's organization. He wished to become the Admiral Hooper of the Signal Corps, doing for the Army what Admiral Stanford C. Hooper had done for the Navy when he strengthened naval communications, charging that activity with the operation of all Naval signals and with direct control over all Navy communication installations and their operators.[34] Olmstead had good reasons for his effort to put a strong communications organization above the ground and air forces, but he did not succeed. The rational arguments for a Signal reorganization became entangled in a crisis which developed in the Signal Corps headquarters during early

[31] For Signal Corps papers on this reorganization, see especially the contents of SigC 020 War Department (Reorganization of the WD) 1942. [Deputy CSigO File.] For Olmstead's query and rebuff at the time, see above, p. 59.

[32] Proceedings of Board To Investigate Communications, Tab U, p. 1, and Tab CC, p. 1.

[33] Memo, Col Otto L. Nelson, Jr., Asst to Deputy CofS, for TAG, 10 May 43, sub: Bd to investigate com. AG 311 (10 May 43) (1) Army, RG 207.03, Job A50–55. The testimonies of the officers are contained in some 30 tabs, totaling about 370 pages, in the Proceedings of Board.

[34] Naval communications had been made strong and single largely through the efforts of Hooper, whom a Signal Corps officer described in 1933 as follows:

"Captain Hooper has been identified with Navy radio communications for about 25 years. He *is* Navy radio communication. If he has any personal interest other than (1) remaining in charge of Naval communications, (2) advancing the interest of Naval communications, it is not discernible . . . Captain Hooper wishes to run the Army off the air and then handle all Army long distance communications, particularly overseas communications. He desires Navy operation of practically all government radio and Navy control of all other radio. He was formerly in favor of a Government (Navy) monopoly of all radio and possibly still is."

Notes in Connection with President's Communication Committee, unsigned, 7 Oct 33, p. 4. SigC (AY) 676 President's Com Committee (1933), A&N Committee "N."

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1943. In June the situation exploded. Or rather, instead of an explosion, it was an implosion, which burst in upon the Chief Signal Officer, General Olmstead himself, destroying him.

Since the spring of the year before, the Signal Corps under the energetic impetus of the Deputy Chief Signal Officer, General Code, had pressed for a place on the War Department General Staff, in order that the Chief Signal Officer might serve in a position where he could grasp lines of control to (1) a signal officer in the Army Ground Forces, to (2) a signal officer in the Army Air Forces, and to (3) a signal officer in the Army Service Forces, wherein the bulk of signal work (all that pertained to procurement, research, and so on) might continue to be carried out. On 11 June 1942 General Code had appointed three Signal Corps officers, Brig. Gens. Charles M. Milliken and Frank E. Stoner and Col. David M. Crawford, to report to Olmstead "on the necessity for and composition of signal sections" to be placed in the War Department General Staff and in the staffs of the Commanding Generals, AGF, AAF, and SOS.[35]

Early in July 1942 these officers had announced that the reorganization of the Army the previous March "seemed to overlook the fact that the Signal Corps is both an Arm and a Service; that without adequate trained signal personnel and field signal systems the war can easily be lost; that signal communication is one of the major functions of Command, hence requires a trained Signal Officer on the Staff of all Commanders, including the Chief of Staff." They pointed to the high place which signal control enjoyed in the structure of other armies: British, German, and Japanese. They concluded that the Chief Signal Officer should serve directly under the Chief of Staff, that he should have immediately under him in his high general staff function both the Army Communications Service and the Executive Control Division, and that he should have control over three Deputy Chief Signal Officers, one each in the Army Ground Forces, the Army Air Forces, and the Services of Supply.[36] These officers may have been opinionated. But their opinions were the honest beliefs of specialists. They had merit. Dr. Bowles, troubled over Air Forces electronics in 1943, wrote to General Arnold, the Air Forces chief, in a similar vein: "Our German enemy has long had a keen appreciation of the vital character of these technical fields and has given them thorough application. Both the British Navy and our own recognize that communications are of direct concern to the highest commands." [37]

No action was taken in mid-1942 when Crawford, Milliken, and Stoner submitted their report to the Chief Signal Officer. General Olmstead was absent on a trip to England. He did not return until late July of that summer.[38] The report was laid aside,

[35] OCSigO R&W Action 1, Gen Code, Deputy CSigO, to Gen Milliken, Gen Stoner, and Col Crawford, 11 Jun 42, sub: Sig officers for AGF, AAF, SOS, and WDGS. SigC 319.1 Staff Signals (Signal Officer for AGF, AAF, SOS and WDGS), 1942.

Milliken was chief of the Signal Operations Service; Stoner, of the Army Communications Service; Crawford, of the Communications Coordination Division.

[36] Report of Proceedings of Board of Officers, Services of Supply, Office of the Chief Signal Officer, Washington, D. C., 10 Jul 42, signed by Milliken, Stoner, and Crawford, with Incls, Exhibits A-1. SigC 319.1 Staff Signals (Signal Officer for AGF, AAF, SOS and WDGS), 1942.

[37] Memo, Bowles for Arnold, 16 Jun 43, sub: AAF com, p. 1. OCS (WDCSA) 676 (28 Dec 43).

[38] (1) Ltr, CSigO to CG SOS, 20 Jun 42, sub: U. S. Com Mission to Great Britain; (2) Ltr, Code

apparently without being circulated outside the Signal Corps. But the idea which it contained would appear again. New and still newer needs for signal control were daily arising, concomitantly with the developments and applications which accompanied the fantastic growth of wire, radio, and radar in World War II—radar gunlayers, radio and radar countermeasures, radio and radar intelligence. The supply and service obligations of the Signal Corps had carried the whole Corps into General Somervell's Services of Supply. But signals could not be nailed down as a purely supply or service function. "I do not feel," wrote Dr. Bowles in mid-June 1943, "that a field as broad as communications, so basic in all operational plans, of such tremendous potency as a weapon, and so essential to command can be treated in the same manner as photography and comparable detail services." [39]

Pressure for better signal control, for better operation of communications, especially in the Army Air Forces, increased daily. In every theater of the war chiefs of staff found that they must have signal officers on their staffs, familiar with their plans and operations and able to control with a strong hand every detail of signal installation, operation, and procedure within their theaters. Just now in North Africa, the exigencies of combat were making commanders communication-conscious as never before, and on a scale which was enveloping all the armed services and all the Allies. An amphibious operation, for example, called for positive control over signals—a height of control which towered above the former lines of authority within the Army and the Navy and within that soaring Army offshoot, the Air Forces. Combined operations by American, British, and French armies working together called for still higher central control—control over more and wide-spread activity, over co-ordinated wire, radio and radar operation, over co-ordinated radio and radar countermeasures, over co-ordinated intercept and analysis of enemy signals. To the extent that these higher needs were developing, the reorganization of March 1942, which had subordinated Signal Corps operations to the Services of Supply, appeared to have been a step in the wrong direction. It can be pointed out, of course, that the SOS embraced far more than merely supply and that since it included services it could properly encompass everything the Signal Corps did. But the fact remains that many officers regarded the SOS as a supply agency primarily.[40]

In short, inclusion in the SOS had spotlighted the supply aspect of the Signal Corps, and, as many Signal Corps officers viewed the scene, had cast a shadow over the very different and very important other aspect of the Signal Corps, its operational functions. In the Navy these two aspects of communications were entirely separate. Research and development, procurement and supply, fell to the Bureau of Ships. Operation of naval signals fell wholly to the Director of Naval Communications, who was Rear Adm. Joseph R. Redman during most of World War II. He and he alone with his small strongly knit organization controlled all naval communications down to every communicator in every ship and station.[41]

No remotely comparable control over the operations of signals existed in the Army.

to Somervell, 22 Jul 42. Hq ASF File, SigC 1942–44, Drawer 6 (RG 200–ASF–Somervell).

[39] Memo, Bowles for Arnold, p. 4, cited n. 37.

[40] Proceedings of Board To Investigate Communications, Tabs B–FF inclusive, *passim*.

[41] *Ibid.*, Tab T.

Further, the Army Air Forces had become increasingly independent, and now even the Ground Forces were far removed from the Chief Signal Officer since the latter had been placed under the Army Service Forces. For example, it was lamented, possibly with some exaggeration, that:

> . . . The Chief Signal Officer is virtually powerless in directing action on Tables of Organization, Tables of Equipment, doctrine, procedures, allocation of critical equipment and trained personnel and establishment of requirements . . . The Chief Signal Officer under the Commanding General, Army Service Forces, is constantly at a disadvantage because of the attitude that his is basically a supply function. To carry out the imperative operational staff functions, the Chief Signal Officer should be in position in the organization permitting operational direction.

Such were the words with which one officer in Olmstead's office expressed his views of the matter in 1943, whatever the view others might take of the Army Service Forces.[42]

Dissatisfaction over Signal Control in the AAF

The state of communications in the Army Air Forces greatly concerned the Signal Corps, which supplied the equipment, signal units, and many services. During the first two years of World War II, Air Forces communications remained a good deal less than satisfactory.[43] Operational control, in the hands of the airmen, did not receive adequate consideration and guidance until General Arnold finally reorganized the activity late in the summer of 1943 under General McClelland, who took for his deputy Colonel Rives of the Signal Corps. Earlier in the war Arnold had relied upon Colonel Marriner, charged with a Communications Office which was bandied about like the hot potato that it was.[44] "Arnold will listen to no one on communications, not even the Chief Signal Officer, except one Colonel Marriner." So Maj. Gen. George E. Stratemeyer, Arnold's Chief of Staff, had told the Deputy Chief Signal Officer, General Code, in September 1942.[45]

Code also learned from Stratemeyer that Air Forces officers "want none of us within their organization, but only air-minded communicators who understand their air problems." However reasonable this may have seemed to the airmen, it was not an argument that Code would accept. "These are words," he informed the Chief Signal

[42] Reasons Why the Chief Signal Officer Cannot Exercise Staff Control over Communications in the Army under the Present Organization, unsigned, undated. SigC 676 Gen Coordination of Sig Com Within the Army as a Whole, 1943 (OD–38).

[43] See, for example, pp. 283ff., above. Dr. Bowles castigated Air Forces signals in mid-1943 as follows: "Such communications responsibilities as have not been entirely overlooked in the recent reorganization plan are widely dispersed, obscure and for the most part completely submerged. There being no head, there is no energetic leadership. . . . The result is confusion of responsibility, demoralization and discouraging delay." Memo, Bowles for Arnold, p. 2, cited n. 37.

[44] The office, later a division, was located till late 1941 in the Training and Operations Division; from December 1941 to March 1943, in the Directorate of Technical Services; and from March to August 1943, under the Assistant Chief, Air Staff, Materiel, Maintenance and Distribution. M. P. Claussen, Development of Radio and Radar Equipment for Air Operations, 1939–1944, Ch. I, p. 13. AAF historical monograph, photostatic copy in SigC Hist Sec File.

The shifts and confusion in AAF signals during that period are made most evident in the testimonies of Col. Charles H. Dowman, Colonel Marriner, and General Stratemeyer, Tabs F, S, and DD, respectively, in the Proceedings of Board To Investigate Communications.

[45] Memo, J. A. C. for CSigO, 10 Sep 42, stayback copy. Deputy CSigO Folder, 1942–45, pp 17, 26K. SigC Hist Sec File.

Officer at the time. "Communications know no particular service," he generalized, "nor recognize any restricted field. The operation," he argued, "whether from air, ground, or what, is similar. There are no unique problems in the Air Corps not readily recognizable by communications personnel." Code pressed Olmstead that "as technical advisor to the Chief of Staff you cannot afford to permit this portion of the Army to be self-sufficient unto themselves. No war and especially this one in which communications play such a vital part can be sufficiently waged by fractional elements operating under independent leadership but only by completely synchronized bodies." He made it emphatic: "The chain of command must start at the top." [46]

Communication control in the Army Air Forces remained weak and confused all through 1942. In June of that year General Code had complained, "The present distribution of Signal Corps officers on the staff of the Commanding General, Army Air Forces, makes it extremely difficult to coordinate Signal Corps matters with that staff." In July 1942 Col. Jay D. Lattin, Chief of the Signal Corps Military Training Division, had complained specifically that there was "no one Army Air Force office to which members of the Military Training Division, OCSigO, can go for consultation and coordination on training matters." What was needed, he urged, was "a signal officer on the Staff of the Commanding General, Army Air Forces, charged with the planning of all matters pertaining to signal communication for the Army Air Forces." [47] General Olmstead had summarized the Signal Corps view in August 1942, recommending that General Arnold "authorize and immediately create a signal section on the 'policy level' in the Army Air Forces; such section to be headed by a Signal Officer who will be a member of the Staff of the Commanding General, Army Air Forces." [48]

General Arnold had done nothing. As Stratemeyer had told Code at the time, Arnold wanted "air-minded communicators," not Signal Corps men, and he would not heed the Chief Signal Officer. Meanwhile, communications in the Army Air Forces had continued unsatisfactory right on into the North African campaign. In 1943 Brig. Gen. Gordon P. Saville, AAF director of Air Defense, returned from the African scene dissatisfied. He attributed poor air communications there to the absence of a signal officer on the AAF staff, according to General Meade, who commented on the matter to Code in January 1943. Further, Saville wanted a Signal Corps officer assigned to the job. Colonel Marriner agreed. Both Saville and Marriner discussed the matter in May 1943 with General Colton, who was the acting Chief Signal Officer during Olmstead's world tour. They stressed the need for a Chief Signal Officer with over-all powers. They emphasized that the "absence of a Chief Signal Officer

[46] (1) *Ibid.* (2) Log entries, 11, 12 Nov 42. Deputy CSigO Folder, 1942–45, p. 37. SigC Hist Sec File.

[47] (1) OCSigO R&W Action 1, cited n. 35. (2) Memo, Lattin for Milliken, Dir Sig Opns Sv, 10 Jul 42, sub: Necessity for a Sig officer and Sig Sec on the staff of the CG AAF with Report of Proceedings of Board of Officers, SOS, OCSigO. SigC 319.1 Staff Signals (Signal Officer for AGF, AAF, SOS and WDGS), 1942.

[48] Ltr, CSigO to CG AAF, 29 Aug 42, sub: Recommendation to include a Sig officer on the staff of the CG AAF; this officer to be on a "Policy Level" and to direct com Policy and Planning. SigC 020 Air Forces, 1942. [Deputy CSigO File.]

of the Army, in fact, was hampering development of Air Force communications and the situation," they declared, "was becoming more serious." Marriner added, "There should be a Chief Signal Officer of the Army with superior control of all communications." [49]

Several weeks later, in June 1943, Dr. Edward Bowles, in the office of the Secretary of War, sharply criticized the state of communications in the Army Air Forces. "At present," he wrote "despite the vital importance of communications, the Army Air Forces have neither the organizational framework nor the integrated group of qualified military and technical minds which is necessary to derive the most from these important fields." He extended his indictment to all the Army when he added, "At the present time there is no strong consciousness of communications, radar and electronics within the Army as a whole. . . . High staff planning agencies lack the essential concept of communications as systems which are fundamental in tactical planning and in successful combat operations." He defined communications and signals as including wire, radio, radar, beaconry, countermeasures (both radio and radar) and related electronic fields.[50] Thus the ever-strengthening, ever-diversifying currents of U. S. Army communications were flowing fast and widely and, it seemed, almost without operational control, certainly without strong control in the Washington headquarters of the War Department.

[49] (1) Log entry, 11 Jan 43, Deputy CSigO Folder, 1942–45, pp. 4, 39. SigC Hist Sec File. (2) Diary of Events Relating to Informal OPD Proposal, Mar–Apr 43, entries dated 27 Apr, 29 Apr, 4 May 43. SigC 676 Gen, Army-Wide Coordination and Control of Com, 1943 (SPSOD–31).

[50] Memo, Bowles for Arnold, p. 1, cited n. 37.

Proposal that Army and Navy Signals Merge

The unsatisfactory state of control over Army-wide communications, when coupled with resurgent problems of amphibious operations, had already led to thoughts about an Army-Navy merger in signal matters. As early as 1 April 1942 General Somervell had passed down to Olmstead a directive from the Secretary of War asking that plans be evolved for co-ordinating communications and radar for amphibious task forces, in which units of the Army, the Navy, and the Army Air Forces would participate.[51] Some months later General Styer, in Somervell's office, asked Olmstead to "please contact appropriate officials in the Navy Department and proceed with a survey with them looking toward a merger of Army and Navy Communications Services into a Joint Communications Service." [52]

Members of an *ad hoc* committee, drawn for the purpose from the Joint Communications Board, together with officers in Olmstead's Office of the Planning Director, especially Colonels Lanahan and Guest, worked upon the survey, without benefit of

[51] Memo, Somervell for CSigO, 1 Apr 42. Hq ASF File, Sig Officer, Office of the Chief (CofS ASF Gen Styer, A 46–274, 2087).

In March 1942 General Marshall and Admiral King began exchanging memos toward setting up a Joint Communications Committee, to look into Army-Navy signals. According to a historian of the Joint Chiefs of Staff, the committee was more perfunctory than serious and was set up with intent to recommend "some modest amelioration sufficient to prevent more drastic action on the one hand, while preserving the essential autonomy of each service on the other." Vernon E. Davis, Hist Sec JCS, historical monograph, History of The Joint Chiefs of Staff, Organizational Developments, Vol II—Development of the JCS Committee Structure, pp. 439–43. OCMH.

[52] Memo, Styer for CSigO, 23 Dec 42. Hq ASF File, Sig Officer, Office of the Chief (CofS ASF Gen Styer, A 46–274, 2087).

the Navy. For Admiral Redman, the Director of Naval Communications and senior member of the Joint Communications Board, would not concur in the preparation of the survey, saying he would report separately and directly to Admiral King. Thus the eventual study was made independently of the Navy, as Olmstead explained to Somervell when he presented a copy on 9 March 1943, although it had the concurrence of General McClelland, Army Air Forces, and of the other Army members of the Joint Communications Board. At the same time, scarcely two weeks before he departed on his long overseas trip, Olmstead summarized his own conclusions. He believed that an over-all services of supply should be set up, embracing the present functions of the ASF with those bureaus of the Navy which involved related activity. He would, moreover, split supply from operations. Operations, he thought, should involve "some form of single national defense control with [a] superior staff over the Army and Navy and possibly an Air Force." [53]

Concluding his comments upon the committee's survey of an Army-Navy signal merger, Olmstead further informed Somervell, "The principle that communications are an attribute of command is adhered to throughout." That is to say, the Signal Corps committee members who participated in this merger study did not argue for control of Army communications all the way down to the front line. In France during World War I the Signal Corps had had such control. The Navy had it of course. Many Signal Corps officers hoped to recover such control. But the established Army policy since World War I was that commanders in the field should enjoy absolute command. As General McNair expressed the policy in the spring of 1943:

> . . . the Quartermaster Corps in the past has tried to take over the operation of all army messes; the Ordnance Department has tried to take over the supply of ammunition to include the front line, and the Signal Corps has tried to take over signals to include the infantry regiment. The decision uniformly has been that the integrity of the arms should be preserved in the interest of teamwork and unity of command. . . .[54]

These committee studies of the proposed merger of military communications, made at the turn of 1942–1943, had been exploratory only. There were many blocks at that early stage of collaborative operations by the several armed services. For example, in 1943 Admiral Redman, responsible for all naval communications and enjoying a place on the staff of the Chief of Naval Operations, complained that he encountered difficulties when he tried to co-ordinate naval communications with those of the War Department. The reason was that he had no opposite number with whom to deal in the Army. There was no officer on General Marshall's staff possessing powers comparable with his. "Don't you think we have got to put it [Army communications control] on a par with Admiral Redman in the Navy . . .?" asked Col. Carter Clarke, a member of the Army board investigating communications in the spring of 1943.

[53] (1) OCSigO R&W Action 1, Col Lanahan to Dir Com Coord Div, 16 Jan 43, sub: Consolidation of com Army-Navy. SigC 676 Gen, Consolidation of Com Services Army-Navy, 1942–43 (OD–29). (2) Memo, CSigO for Somervell, 9 Mar 43. SigC 676 Gen Coordination of Sig Com Within the Army as a Whole, 1943 (OD–38).

A separation of supply and operational functions, in short, a functional reorganization of the War Department, was considered briefly by the Chief of Staff in 1943, according to Huston, Time and Space, Ch. II, pp. 85–86, cited n. 15.

[54] Palmer, Wiley, and Keast, *The Procurement and Training of Ground Combat Troops*, p. 398.

"Then you've got a director," responded Lt. Col. James McCormack, War Department General Staff G–4, adding, "the Navy has much better centralized administrative control [of signals] than we have." [55]

This dissimilarity in the operation of Army and Navy signals constituted one block in the way of a merger. Another block lay in the fact that there was some disinclination on Navy's part to establish joint communications.[56] Furthermore, the scope, the mission, and the details of Army and Navy signals varied too widely to permit ready merger at the time. "The scope of the Army Signal Corps with respect to army communications," according to the survey by the *ad hoc* committee members, "is, except for operation, considerably broader than that of the Naval Communication Service with respect to Naval Communications." In operation it was narrower, because "the Army Signal Corps, unlike the Naval Communication Service, does not conduct the intra-communications of all branches of the Army," and scarcely for the Army Air Forces at all. In sum, according to the survey, "The functions of the two communication services are unlike fundamentally as a result of the differences in the primary missions of the services. Practicable consolidation," the committee members concluded, "is contingent upon unification of command." [57]

[55] (1) Diary of Events Relating to Informal OPD Proposal, Mar–Apr 43, entries for 27 and 29 Apr 43. (2) Proceedings of Board To Investigate Communications, Tab D, p. 10.

[56] Ltr, Code to CofS, 13 Apr 42, stayback copy, and log entry 20 Apr 42. Deputy CSigO Folder, 1942–45, pp. 11, 58. SigC Hist Sec File.

[57] A Survey Looking to the Merging of Army and Navy Communications Services Initially to Involve Removal of Duplication and Overlaps and the Performance by One Service of Certain Functions for the Other, as well as Any Other Ways and Means of Working Toward the End in View, p. 33. SigC 676 Army-Navy, 1943 (SPSOR–8–3).

High-Level Control by Communications Boards: JCB, CCB, ACB

Such operational control over Army communications as did exist in Washington at levels above the supply-laden Signal Corps was to be found in certain communications boards. One was the Joint Communications Board (JCB); another was the Combined Communications Board (CCB).[58] Both before the mid-1943 Signal Corps crisis and after it, the JCB, serving the Joint Chiefs of Staff, constituted the highest co-ordinating agency in U.S. Army signals. "The Joint Communications Board has inadvertently become the communications and radar brain for the Army," asserted Dr. Bowles in June 1943. It had acquired top-level control over electronics, he emphasized, precisely "because of the lack of well-defined leadership in these matters within the Army." [59] One reason the Army lacked well-defined leadership in signals was that its representation on the JCB and CCB was divided. The two Army members, who sat on both boards, were the Chief Signal Officer and the Director of Technical Services, Army Air Forces. Since these two officers were not always entirely of one mind, they did not present a unified point of view for the Army. The two Navy mem-

[58] Signaling difficulties between the Army and the Navy and between the U.S. military services and the British had led to a number of communications committees and boards, which by mid-1942 crystallized into the Joint Communications Board (Army-Navy) and the Combined Communications Board (U.S.-British) under the Joint Chiefs of Staff and the Combined Chiefs of Staff, respectively. Davis, History of the Joint Chiefs of Staff, pp. 426–49, cited n. 51. See also Dr. Courtney R. Hall, Signal Corps Participation in Boards and Committees (1946), SigC historical monograph D–2, *passim*. SigC Hist Sec File.

[59] Memo, Bowles for Arnold, p. 2, cited n. 37.

bers were united, being the Director of Naval Communications and his subordinate, the Communications Officer of the Staff of the Commander in Chief, U.S. Fleet.[60] An inevitable result in Army-Navy signal relations, as Bowles pointed out, was "the usurpation of leadership by a Joint Communications Board dominated by a wide awake Navy group and with no corresponding Army strength to balance interests." [61]

The four top-level communications officers who constituted the JCB established policies, while the great bulk of work which the board had to handle was processed by numbers of committees. The JCB was buttressed, as of mid-1943, by a Coordinating Committee and no fewer than twenty-four working committees. These committees provided "a means for coordination of plans, procedures, research, development, standardization and procurement precedence." The board itself was intended to be "the agency wherein the communications interest of the ground, air and sea forces are brought together and coordinated as a single organization. . . ." In short, during World War II the JCB brought the communications services of the Army and the Navy "as close together under a single directing agency—the Joint Chiefs of Staff—as is possible without a unified command." [62] Similarly, the CCB served to co-ordinate the communications of the United States Forces with those of their Allies, especially the British. There was also a Joint Radio Board, formed in November 1941, which sought to standardize aircraft radio equipment: Army, Navy, and British.[63]

Participation in these boards gave the Chief Signal Officer some degree of operational influence. He took action, in behalf of the Army, to implement the directives of both the JCB and the CCB. But the channels to the field remained many and devious, and the boards themselves acted slowly. Complaints arose "that extreme delay is usually experienced in receiving decisions through War Department channels. . . ." [64] When time can be afforded, discussion and co-ordination have great value, but they are luxuries which do not often adorn military action. Speaking of the need to get things done by command action, General Meade said, "In war time coordination is one of the most wasteful ways to accomplish things I have ever seen." That eminent commander, General McNair, reflected Meade's sentiments when he ejaculated, "I am a great loather of boards. . . ." [65] These high-level boards,

[60] Davis, History of the Joint Chiefs of Staff, p. 449, cited n. 51.

[61] Memo, Bowles for Arnold, p. 2, cited n. 37. Bowles specified, as another undesirable consequence of this unbalance, the "disproportionate utilization of research and development agencies for essentially Navy projects. For example, one of the strongest and most potent sources of radar ideas in the country, the Radiation Laboratory at the Massachusetts Institute of Technology, has been dominated by the Navy, while the Army has complacently stood by. . . ." *Ibid.*

[62] A Survey Looking to the Merging of Army and Navy Communications Services, p. 21, cited n. 57.

[63] *Ibid.*, pp. 22–24.

[64] Diary of Events Relating to Informal OPD Proposal Mar–Apr 43, entries for 20 Mar, 27 Apr 43. Much of the testimony before the board investigating communications in May 1943 related to the slow motion of the ACB, JCB, and CCB. See Proceedings of Board To Investigate Communications, Tabs D–K.

[65] Proceedings of Board To Investigate Communications, Tab M, p. 11, and Tab BB, p. 2. A historian commenting on the postwar Joint Chiefs of Staff and its great number of committees, saw danger in the "delay and rancour of long-drawn out arguments. . . ." Anxiety to avoid prolonged argument might lead, he believed, to the dangers of compromise where a compromise might be worse than either of the conflicting arguments, perhaps even worse than no decision whatever. Huston, Time and Space, Ch. II, pp. 59–60, cited n. 15.

then, certainly did not give the Chief Signal Officer the direct Army-wide control that he desired. He could not act with quick directness.

If in these boards or in the proposed merger of Army and Navy signals General Olmstead had thought he saw an opportunity to improve his operational control, he had been disappointed. For this purpose there remained yet a third board, the Army Communications Board (ACB), which served the General Staff and of which the Chief Signal Officer was the president. Early in 1943 the ACB had taken form out of the remains of the Army Communications and Equipment Coordination Agency (AC&EC). This agency went back to the days just before Pearl Harbor, when General Marshall had ordered Olmstead to combat the tendency of electronics to multiply into specialized applications seemingly without end. At Olmstead's entry into office in 1941, the Chief of Staff told him to simplify, co-ordinate, and reduce electronic equipment, and to attain these ends Olmstead had set up in his office the AC&EC Agency.[66]

This agency had been at first merely an advisory unit within the Signal Corps. In March 1942 it had been subordinated along with the rest of the Corps under General Somervell's SOS. What was wanted was a more powerful agency, on a higher level, to co-ordinate and control communications Army-wide. Consequently, early in 1943 the AC&EC Agency became the ACB, technically a supporting agency of the General Staff. Composed of not more than five officers from each of the three major commands of the Army, with liaison officers from the Navy, the Marine Corps, and the Allied powers, the board was headed by the Chief Signal Officer himself. The ACB, as it replaced the AC&EC Agency, looked as though it might be potent and an answer to Olmstead's hopes. The duties of the Board, as set forth in a War Department Circular in January 1943, were "to take such action as may be necessary to coordinate, for the Army as a whole, communication methods, procedures, operation, equipment (including the recommendations for the coordination of research, development, procurement, and allocation to meet operational needs), and all communication matters applicable to the United States Army. It will formulate directive recommendations on Army communication policies which will be forwarded to the Chief of Staff, G–4, War Department General Staff." [67]

Like other General Staff subagencies the Army Communications Board under G–4 could merely advise. It had no real power to do things directly. In common with most boards and committees, it tended to work with creaking slowness. Therefore the board did not provide the type of higher control over Army signal policy and operations which General Olmstead and other Signal Corps officers thought they should exercise from General Staff level.

But officers in General Somervell's headquarters did not think so. For example, a few months earlier, the Control Division, SOS, had opposed any suggestion that centralized control of communications operations be established unless evidence could be produced that the current organization

[66] Terrett, *The Emergency*, pp. 294ff.

[67] (1) Signal Corps Technical Information Letter No. 15 (Feb 43), p. 38. (2) A Survey Looking to the Merging of Army and Navy Communications Services, p. 31, cited n. 57. (3) WD Cir 23, 18 Jan 43. (4) CSigO, Annual Report, 1943, pp. 49–50. See also papers in SigC 676 Gen Coordination of Sig Com Within the Army as a Whole, 1943 (OD–38).

was breaking down. "The excellence of present communications makes it extremely unlikely that such evidence could be produced," they asserted in January 1943.[68] But in the very next month they spoke with less assurance when they commented darkly upon the communications of the Western Task Force in TORCH. In a report from SOS headquarters they referred to "a glaring deficiency" in signals, and to "the almost complete breakdown of communications in certain instances. . . ." [69]

Whatever the view in Somervell's headquarters, Signal Corps officers did not stand unsupported in their wish for a higher control centered in Washington. Others expressed the same desire. Dr. Bowles, watching the scene from Secretary Stimson's office, was troubled over so much committee work by the boards. He believed that the Chief Signal Officer should be taken out of the Army Service Forces and put, minus his supply functions, into the General Staff. Admiral Redman, Navy's communications chief, thought it logical that the Chief Signal Officer be moved into the General Staff, too.[70]

Proposal To Put Signal Control in War Department General Staff

Meanwhile, despite such occasional failures as had occurred in the Western Task Force late in 1942, Army communications in the field were improving. Field signals had become quite good by the spring of 1943. "Strangely enough," said General Meade, after his world tour with Olmstead, "in the combat theaters where there should be most trouble, they are having least." [71] It was in the Washington headquarters where most of the difficulties centered.

On 20 March, the day Olmstead and Meade left to inspect signals in the overseas theaters, a high-level move was undertaken to improve operational control over Army communications. Officers in the Operations Division and in G–4, War Department General Staff, initiated the move as an "informal proposal." Together with Brig. Gen. David M. Crawford, a Signal Corps officer and executive of the ACB, they conferred to see what could be done to facilitate action on the directives of the JCB and the CCB.[72]

Upon meeting again a week later, the group agreed that OPD officers, insufficiently acquainted with signal matters, had hesitated to act on board directives and had depended upon the Chief Signal Officer, going to him directly and bypassing the Army Service Forces. "OPD depends upon the Chief Signal Officer for determining the method of implementation of JCB and CCB decisions," reads a contemporary Signal Corps diary. "Of late, decisions have been transmitted to the Chief Signal Officer

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[68] OCSigO R&W Action 2, Col Guest to Miss Callaghan, 21 Jan 43, sub: Items for daily rpt. SigC 319.1 Daily Rpts, All Secs of Planning Div, Jan–Jun 43.

[69] Hq SOS Rpt, Lessons Learned from Recent Amphibious Operations in North Africa, 12 Feb 43. Appendixes to Preparations for TORCH. OCMH. See above, pp. 357–60.

[70] (1) Log entries, 12, 14 May 43. Deputy CSigO Folder, 1942–45, pp. 46–47. SigC Hist Sec File. (2) Diary of Events Relating to Informal OPD Proposal Mar–Apr 43, entry, 29 Apr 43.

The need for strong central control over the assignment and use of radio and radar frequencies was again and again cited in support of placing signals on General Staff. See, for example, Diary of Events, entry, 13 Apr 43, sub: Discussion between Col Guest and M. E. Strieby, Asst Expert Consultant to SW. See also Proceedings of Board To Investigate Communications, Tab R, p. 7, and Tab S, pp. 5–6.

[71] Proceedings of Board To Investigate Communications, Tab M, p. 4.

[72] Diary of Events Relating to Informal OPD Proposal, Mar–Apr 43, entry, 20 Mar. The other conferees were Colonels Ritchie and Woolnough from OPD and Colonel McCormack and Captain McIver from G–4.

with authority to direct the Adjutant General to take necessary action. Agencies in the Army Service Forces," the diary continues, "have challenged this procedure as being out of channels. Normal channels," the diary concludes, "would introduce intolerable delays." [73]

If some ASF officers frowned upon such irregularities, General Somervell himself, on at least one occasion, sensed that the coordination and operation of Army signals might not be altogether a proper activity of his headquarters. Late in 1942, when he had urged that the AC&EC Agency be moved from his domain up to the General Staff, he had said, "Communications know no bounds." He had even asserted, "There are things in the Signal Corps which do not rightfully belong to me." [74] Thus the Chief of the ASF had agreed to relinquish the AC&EC Agency, which became the ACB on the General Staff level. Further acts independent of ASF were now occurring in the spring of 1943, as whenever a directive implementing high-level board decisions was issued by the Chief Signal Officer, without his taking the action through ASF channels. For a moment, the OPD group proposed granting the Chief Signal Officer an ex officio staff status by making him the head of a new communications unit which they hoped to create in the General Staff. But objections at once cropped up against giving Olmstead a dual status. It would be an intolerable situation, the OPD officers thought, if the Chief Signal Officer should be in a position to give orders to the commander of the ASF while remaining also the head of the Signal Corps, which was subordinate to the ASF. Yet some means had to be discovered, they believed, to make competent Signal Corps action in communication matters possible at General Staff level.[75]

The OPD group then proposed informally that the entire ACB be converted with all its members (except the ex officio president, General Olmstead) into a Communications Division on the War Department Special Staff.[76] The proposed Communications Division would receive the power to implement the decisions of the JCB and the CCB. To head this new division the Chief of Staff would appoint a general officer, who would be someone other than the Chief Signal Officer. All this the Acting Chief Signal Officer, General Colton, rushed in a radio message overseas to Olmstead on 12 April 1943. At the same time a study was drafted in the Office of the Planning Director (Colonel Lanahan) summarizing for General Somervell Signal Corps' grievances and solutions touching Army-wide signal problems and control. But the study was not delivered to the chief of the ASF because the Deputy Chief Signal Officer, General Code, decided it was not "sufficiently strong to justify transmittal to the Commanding General, Army Service Forces." [77]

General Olmstead, now halfway around the world in the Middle East, answered posthaste. The whole matter he naturally regarded as very urgent, so urgent that he would, if need be, cut short his trip and come

[73] *Ibid.*, entry, 27 Mar 43. Colonel Guest from OCSigO also participated in the 27 March conference.

[74] Log entry, 24 Dec 43. Deputy CSigO Folder, 1942-45, p. 38. SigC Hist Sec File.

[75] Diary of Events Relating to Informal OPD Proposal, Mar–Apr 43, entry, 27 Mar. No other mention of these informal discussions can be discovered in either OPD or ASF files.

[76] *Ibid.*, entry, 8 Apr 43. The conferees on this occasion were Wedemeyer, Roberts, Lanahan, Guest, Lincoln, and Woolnough.

[77] *Ibid.*, entries, 8, 13 Apr 43, and especially 12 Apr 43, the last with copies of the draft study and of Colton's message to Olmstead, Msg 72060, 12 Apr 43.

home at once. Otherwise, he charged his subordinates that they defer decision, or comment, until he returned in due season. His observations on the trip made it clear to him, he replied to Colton, that the ASF should not sit over Army communications. Following the pattern of the report which Milliken, Stoner, and Crawford had made in July of the year before, Olmstead now repeated their prescription. The Chief Signal Officer, he believed, should head the proposed top-level Communications Division, having under him subordinate chief signal officers serving in the AGF, the AAF, and the ASF. He believed too that he should also head both the Combined Communications Board and the Joint Communications Board in order to co-ordinate and control effectively and efficiently all signal operations. In short, the Chief Signal Officer of the Army must, Olmstead repeated, serve the Chief of Staff directly if he were to carry out his duties as the law prescribed them (he regarded the 1942 reorganization as clashing with the law in some respects). Any other arrangement Olmstead arbitrarily ruled out, for in any other arrangement Army communications would be confined within boundaries which, he believed, the universal nature of signals inherently transcends.[78]

Concluding the reply to Colton with an order that his officers submit no informal comments unless authorized by specific approval from himself, General Olmstead drew the reins tight on his Washington headquarters. Signal Corps action on the OPD proposal would therefore have to await his return, although General Staff officers were anxious to make a move. Nearly a month passed while G–2 "nonconcurred" over the informal proposal and while Olmstead continued to tarry abroad.[79]

On 6 May Brig. Gen. Patrick H. Tansey, chief of the Logistics Group of OPD, spoke with Colonel Lanahan about the need for a Communication Section in the War Department General Staff. The need was pressing. The communication problem within the General Staff was "one of the most critical problems facing the Staff," Tansey told Lanahan, adding that "it appeared impracticable for him to work out the problem through the staff of the Army Service Forces." Lanahan made no comment, "in view of the gag established by the Chief Signal Officer." Meanwhile, the OPD proposal, which G–2 had kept in a pigeonhole, was brought out and returned to active status for processing through the War Department General Staff.[80]

Important signal decisions now seemed in the making. The informal proposal by the OPD group merged into a larger, more formal investigation. General Joseph T. McNarney, Deputy Chief of Staff, was appointing a board which would hear witnesses and review the entire communications problem as it concerned the whole Army, touching especially operational control and the implementation of ACB, JCB, and CCB rulings. The letter establishing the board was dated 10 May and hearings began at once.[81]

[78] *Ibid.*, entry, 15 Apr 43, with a copy of Olmstead's reply to Colton, Msg WVMA 6, unsigned, Tehran to AGWAR, 15 Apr, 14272. See also Proceedings of Board To Investigate Communications, Gen Meade's testimony, Tab M, p. 18.

[79] *Ibid.*, entries, 4, 5, 7 May 43.

[80] *Ibid.*, entries, 6, 7 May 43.

[81] Memo, Col Otto L. Nelson, Asst to Deputy CofS, for TAG, 10 May 43, sub: Bd to Investigate Com. AG 311 (10 May 43) (1) Army, RG 207.3. Job A50–55.

The Board members were Col. Arthur E. Burnap, IGD; Col. John H. Stutesman, GSC, G–4; Col. Carter W. Clarke, GSC, G-2; and Lt. Col. Harold L. Richey, GSC, OPD.

Less than a week earlier, on 6 May, General Olmstead had returned to Washington. Now, it seemed to him, was his chance to obtain the powers he wished to win for the Signal Corps.[82] He coached his officers upon the strategy to be adopted. He instructed Code, Stoner, Meade, Crawford, Lanahan, and Guest. His deputy, General Code, was to be "master of ceremonies." Code would "review testimonies to be given by the Signal Corps members," and he would be "prepared to step into the breach as an emergency witness upon call." (He was not, in fact, called before the board, but the others all testified at length.) Support was expected from General Staff officers, General Tansey and Col. Frank N. Roberts; from Air Forces officers, Colonels Marriner and Smith; and from Admiral Redman of the Navy.[83]

Further support was sought from a former Chief Signal Officer and friend of the Chief of Staff, Maj. Gen. George S. Gibbs. Two years earlier General Marshall had called upon Gibbs for advice in communication matters. Gibbs had argued then for a stronger Signal Corps, with direct, unequivocal control over signal operations. Now he argued similarly in a letter addressed to the Chief of Staff: "The one best solution," Gibbs urged General Marshall, "is to place the Chief Signal Officer in position of direct access to and by the Chief of Staff and the heads of the major Army Forces, retaining under him all of the resources and establishments that are necessary to him in the performance of his mission. Any other solution would be a compromise—harmful in proportion to the degree of its departure from the 'best solution.'" [84] So Gibbs emphatically believed, restating Signal Corps' long-standing contention.

Upon Colonel Lanahan, his Director of Planning, Olmstead relied heavily. Lanahan prepared careful comments to offer before the board, lending support to a Communications Division in the General Staff, with the Chief Signal Officer in charge and commanding subordinate signal officers in the Ground, Air, and Service Forces. Lanahan readied a review of the signal situation in the Army: in the Ground Forces, a signal officer with too small a staff to cope with all his problems; in the Air Forces, no agency at all charged with over-all coordination, direction, and supervision ("With the result," he asserted, "that chaos exists in Air Force communications,"); in the Service Forces, the large entire apparatus of the Signal Corps available for both supply and operations but unable to control operations adequately; in the War Department General Staff, the Army Communications Board under G–4 impotent to implement its decision because it was a deliberative body only. Obviously, one agency, Lanahan argued, was needed on the General Staff level to direct and supervise (1) radio frequency assignments, (2) co-ordination of procedures within all components of the

[82] When Olmstead presented his views to the board investigating signals on 25 May, he stated, "I would like to say that in my thoughts there is no personal consideration. I have really tried to figure out what is the best thing for the Army. . . . I would say he [the CSigO] should have authority comparable to that of the Director of Naval Communications. . . ." Proceeedings of Board To Investigate Communications, Tab P, p. 10.

[83] Memo for file, unsigned, 11 May 43, with attached Witness List "A." SigC 676 Gen, Army-Wide Coordination and Control of Com, 1943 (SPSOD–31). Neither Tansey nor Roberts actually testified, but numbers of other General Staff officers did.

[84] Incl 2, Ltr, Gibbs to Marshall, 25 May 43, with Memo, Handy, 16 Jun 43, sub: Personal ltr for CofS from Gibbs, respecting com. OCS 210 G Open Files (OPD 320 5–23–42).

Army, (3) operational direction of radio countermeasures to insure proper co-ordination of strategic and operational plans and to insure effective deception of the enemy, (4) co-ordination of equipment types for all the Army, (5) operational direction of radio intelligence, and so on, for a dozen more matters which Signal officers believed pressed for better control. While Lanahan worked over these comments, Colonel Guest drew up charts showing the proposed War Department Communications Division enjoying a box alongside the four G's and OPD of the General Staff.[85]

General Olmstead expressed his own views most fully in a memorandum which he prepared for the Chief of Staff. It read:

> My recent tour to several theaters of operation has confirmed my opinion that a strongly authoritative centralized agency is essential to co-ordinate the many and diverse problems of signal communication for the Army as a whole. This agency must have authority to establish policies, issue directives, and act, or prepare action, for the Chief of Staff. While charged with these responsibilities by law, I have been seriously handicapped in exercising them from a subordinate position in one of the three coequal interested components of the Army. My actions and recommendations frequently have been subject to approval by uninformed staff sections of the Army Service Forces and further delayed in implementation by Assistant Chiefs of Staff, again requiring concurrence of the Commanding General, Army Air Forces, or Commanding General, Army Ground Forces, or both. If, as I firmly believe, signal communications are vital agencies of command in this war by which commanders gain warning and information, and by which they exercise control of operations, then the War Department General Staff Sections charged with strategic and operational planning and the operational direction of the Army should have immediately available to them an agency capable of advising on the signal communication aspects of each strategic and operational plan. Conversely, an agency charged with the policies, plans, and broad operational direction of signal communication must be in continuous contact with these General Staff Sections.[86]

On 11 May, the day on which the hearings of the new board were scheduled to begin, General Olmstead informed General Somervell about his aspirations for himself and for the Signal Corps. "As a result of the reorganization of the War Department in March, 1942," Olmstead wrote, "essential coordination of Signal Communications with the Army as a whole has inadvertently suffered." It had suffered so severely, he continued, that "authoritative centralized coordination is not now being exercised." What was needed, General Olmstead contended, was a Communications Division on the War Department General Staff, headed by the Chief Signal Officer.[87]

Between 11 May and 8 June the Board to Investigate Communications took testimonies from some thirty high-ranking officers, who represented all branches of the Army, and from Admiral Redman, Director of Naval Communications. The findings of the board, published in detail on 21 June 1943, asserted, among much else, that "control and coordination of signal communica-

[85] Incl, Col Lanahan, Comments to Board on Proposed Communication Division, and other unnumbered papers, charts, etc., with Memo, unsigned, for CSigO, 11 May 43, sub: Army wide coordination and control of com. SigC 676 Gen, Army-Wide Coordination and Control of Com, 1943 (SPSOD–31). See also Proceedings of Board To Investigate Communications, Tabs N and N–1.

[86] Draft Memo, unsigned, for CofS, undated, sub: Staff supervision of Sig Com for the Army. SigC 676 Gen, Army-Wide Coordination and Control of Com, 1943 (SPSOD–31).

[87] Memo, unsigned, for CG ASF, 11 May 43, sub: Coordination of Sig com with the Army as a whole. SigC 676 Gen, Army-Wide Coordination and Control of Com, 1943 (SPSOD–31).

tions within the Army are inadequate, unsatisfactory and confused." The board recommended that there be established on the War Department General Staff a Communications and Electronics Division with broad powers and direct control.[88]

The board's recommendation was disapproved. The notion of lifting the Signal Corps or any part of it out of the ASF, transferring it to the General Staff to constitute an additional activity there, ran counter to the intent of General Marshall's purpose when he reorganized the Army in March 1942. The idea was repugnant to a number of Marshall's administrators. "McNarney [the Deputy CofS] is basically against other Staff sections," Brig. Gen. Raymond G. Moses, General Staff G–4, told the board, though Moses himself favored some changes, saying it was essential that communications "not be buried down below and through some complicated chain of commands as it is now. Where it belongs, I don't know." [89] Maj. Gen. Miller G. White, General Staff G–1, resisted the idea: "There ought to be some way to control it [communications]," he said, "without creating a new Division of the General Staff to do it." [90] The head of the Army Ground Forces, General McNair, when discussing the unsatisfactory control exerted by such communications boards as the JCB, said flatly, "Rather than put the Signal Corps into the War Department [General Staff], I'd go for a board. I think that would be the lesser of the two evils." [91] These were the views that prevailed. However real and pressing Army communication troubles were, the decision was against any change in the headquarters organization, except in respect to the Chief Signal Officer himself.

The Signal Corps Swaps Horses in Midstream

General Olmstead Retires

In early June, some days before the communications board submitted its recommendation, General Marshall and General Somervell had decided to ask General Olmstead to retire. There were various reasons for this decision—including Olmstead's personality, which had contributed both to low morale within the Corps and to a lack of confidence, not only in higher quarters of the Army but also among his own subordinates. In mid-1943 officer morale within the Signal Corps was reported as low, especially in the supply service.[92] In high places Olmstead had failed to win backers. Too often he was out of his office, ill, or away on long trips. However right he may have been on many points and however devoted to his work, to the Signal Corps, and to the Army, as he certainly was, yet he was gruff and careless of human relations and the social amenities. He had made many enemies. He had failed to compromise, perhaps, and to play the game; he was, perhaps, set in the rigidity which comes from too rigorous devotion. When an officer loses the confi-

[88] Proceedings of Board of Officers, 21 Jun 43, attached to Memo, Col Burnap, Pres of Bd, for CofS, 22 Jun 43, sub: Transmittal of bd proceedings. AG 311 (5–10–43) (1) Bulky Pkg, Army RG 207.03. Job A50–55.

[89] Proceedings of Board To Investigate Communications, Tab Y, p. 1.

[90] *Ibid.*, Tab X, p. 2.

[91] *Ibid.*, Tab BB, p. 2.

[92] The reasons given were too frequent organizational and procedural changes, shifting assignments, incapable supervisors, lack of confidence in the higher echelons of the Corps, lack of recognition and interest from above, and so on. OCSigO R&W Action 1, Dir Control Div to CSigO, 14 Jul 43, sub: Officer morale OCSigO, and R&W Action 1, Asst CSO to CSigO, 4 Aug 43, same sub. Deputy CSigO Folder, 1942–45, p. 199. SigC Hist Sec File.

dence of his fellows, whatever the reason, his position becomes untenable, as General Bradley said of the American II Corps commander, Maj. Gen. Lloyd R. Fredendall, after the disaster at Kasserine Pass in North Africa.[93] He had to be replaced.

For many months previously things had not been going well between Olmstead and his superiors. General Marshall, receiving reports in October 1942 that the Signal Corps failed to handle messages properly, failed to meet personnel requirements, failed to display vision and foresight in planning, had taken the charges to Somervell. In November of that year, Somervell had exclaimed to the Deputy Chief Signal Officer that just once he would like to see a letter that said something good about the Signal Corps.[94]

Olmstead's relations with Somervell deteriorated rapidly in early 1943. Somervell, visiting Caribbean areas, wrote that he had been "shocked" at communication conditions there, "after all the song and dance I have received from Olmstead and Code." [95] Twice in February Somervell criticized Olmstead, once touching unspecified problems of communication, and then again, specifying a Signal Corps radio station in Eritrea, in eastern Africa. "Our radio installations at Eritrea," he said, "appear to be too far to the rear. The same should be moved to the vicinity of Cairo at the earliest possible moment." Somervell added, "I understand that you have refused to give your consent to this and I wonder why." [96] Actually, the huge ACAN station at Asmara, Eritrea, occupied a strategic position in the equatorial belt of large Signal Corps radio stations where it could best maintain its link in Army's round-the-world connections.

An especially ominous memorandum came to Olmstead in mid-March. "All of the reports," wrote Somervell categorically, "which I have received on combined operations variously called amphibious operations, landing operations, indicate that the Army Signal System has fallen down during the operation. I want you to be sure to remember the Chief of Staff's admonition in regard to your responsibility for seeing that the equipment is provided and that the training is adequate for the job." Evidently, the breakdown of the radios serving General Patton's headquarters aboard the *Augusta* early in the North African landings drew Somervell's attention away from signal successes at other points along the beaches.[97]

In the end, Somervell's opinion of Olmstead sank impossibly low. He stated his judgment in stark terms when he testified before the communications board on 4 June. Replying abruptly to the first question, put to him by Colonel Burnap, who

[93] Omar N. Bradley, *A Soldier's Story* (New York: Henry Holt and Company, 1951), p. 41.

[94] Log entries, 21 Oct, 14 Nov 42. Deputy CSigO Folder, 1942–45, pp. 66, 79. SigC Hist Sec File. See also the comments of General Strong, General Staff G-2, regarding the Signal Corps early in the war. Proceedings of Board To Investigate Communications, Tab U, pp. 1–2.

[95] Ltr, "Bill" [Somervell] to "Fat" [Styer], attached to Memo, Styer for Handy, 18 Jan 43. OPD Exec 8, Bk 8, 4 Dec 42–12 Apr 43, Item 57. The conditions which especially irked him seem to have been in an AAF station at Borinquen, Puerto Rico. An item in a Signal Corps file indicates that Somervell was also troubled at communication conditions at Recife, Brazil. Log entry, 29 Jan 43. Deputy CSigO Folder, 1942–45, p. 70. SigC Hist Sec File.

[96] Memos, Somervell for Olmstead, 22, 26 Feb 43. Hq ASF File, SigC 1942–44, Drawer 6 (RG 200–ASF–Somervell).

[97] (1) Memo, Somervell for CSigO, 13 Mar 43. Hq ASF File, SigC 1942–44, Drawer 6 (RG 200–ASF–Somervell). (2) See above, pp. 353–63, *passim*.

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asked what might be done to improve Army-wide communications, Somervell snapped back, "Get a new Signal Officer." "Will that answer all the questions," was the next query. "Yes," said Somervell. "Of command and control?" Burnap asked further. "Yes," came the reply. Somervell professed to believe that the established organization could be made to work without changes. The trouble was in the men involved, or more precisely in General Olmstead. "I see no difficulties at all in the situation provided the Signal Corps is handled by a man with some imagination and get-up and go to him," declared Somervell. Another board member, Col. Carter W. Clarke, asked, "In other words, to get rid of the man you have there and get another man will solve the entire communication problem?" Somervell replied "Yes," and he added, "Did you ever hear of Napoleon's remark that there weren't any poor regiments, there were just poor Colonels?" [98]

Obviously the personal side of Army's communication problem was not the dominant one, despite Somervell's brusque emphasis of it. Army signals had been and continued to be a veritable Gordian knot. It was unfortunate that the personality of the Chief Signal Officer in the spring of 1943 happened to figure large in the situation. It provided what seemed an easy solution, which in reality bypassed the real organizational difficulties. The board recommendations were turned down and General Olmstead was turned out. As president of the board, Colonel Burnap, in his report to the Chief of Staff on 22 June, commented that the board unanimously agreed Army communication and electronic troubles could not be solved by personnel changes only. Burnap added that General Somervell's solution was not proposed by any other witness. "Drastic organizational change is mandatory," Burnap concluded.[99] It was accomplished within the Army Air Forces a few weeks later. But the only change within the Signal Corps was the swapping of horses in the midstream of the war.

On 11 June 1943 Chief of Staff General Marshall informed his Chief of the Army Service Forces, General Somervell, that he had dismissed the Chief Signal Officer. He had had a "lengthy talk with General Olmstead." The Chief Signal Officer "expressed a willingness to accept our decision in a soldierly manner. . . . I told him," wrote Marshall, "that the decision was taken for his relief and General Ingles' appointment in his place at the head of the Signal Corps." Olmstead, wishing to continue his service in the war effort, hoped he might remain on active duty as head of an important communications board which the State Department was about to set up. To this Marshall consented, saying to Somervell, "We could assign Olmstead to this job and allow him to remain on active duty at least for the time being." Somervell had readied a letter of resignation for Olmstead to sign. Marshall, though he had the letter at hand, forbore presenting it. "I am attaching your draft," he wrote to Somervell, "of a letter for him to sign which I did not use, pending consideration of the State Department affair." [100]

Yet it seems that Somervell confronted Olmstead at once with the draft letter and got him to sign it. For such a letter appears in the records, dated 11 June and signed by Olmstead, requesting retirement. This

[98] Proceeedings of Board To Investigate Communications, Tab Z, pp. 1–3.

[99] Memo cited n. 88.

[100] Memo, G. C. M. for Somervell, 11 Jun 43. WDCSA 201 Olmstead, Gen. OCS (WDCSA) 201, Obear, Capt Geo (2 Dec 43).

request hardly accorded with the desire Olmstead had just expressed to Marshall saying that he hoped to remain in active service. That this was the letter which Somervell had drafted is borne out by the reasoning it employed—professing weariness and urging a younger, more vigorous successor (actually, Olmstead, age 59, had returned from his trip invigorated, confident, and high in hopes for the future of the Signal Corps). The only papers touching the whole incident in the files retired from Somervell's office are a copy of this letter together with Somervell's indorsement, also dated 11 June, stating, "General Olmstead has devoted himself without stint . . . is entitled to relief from a responsibility which has been exacting to an extreme. . . . I am appreciative both of his accomplishments and of the spirit in which his request to retire has been made. I recommend approval. . . ." [101]

The War Department had selected, as Olmstead's successor, Maj. Gen. Harry C. Ingles. Ingles' long and varied career in the Signal Corps had recently culminated in important posts under Lt. Gen. Frank M. Andrews, commander in Panama and the Caribbean, where he had served first as Chief Signal Officer and then as Chief of Staff. The new appointee took full command of the Signal Corps on 30 June, the date of Olmstead's formal departure. "General Somervell," the Chief of Staff was advised, "recommends the nomination of Major General Harry C. Ingles as Chief Signal Officer of the Army, vice Major General Dawson Olmstead, who retires June 30, 1943, at his own request." [102]

But of course Olmstead did not actually "retire at his own request." The War Department had fired him. Yet he had done a good job, all obstacles considered. His administration had cleared the ground and sown the seed from which not he but his successors would gather a good harvest.[103]

General Ingles Inherits Problems of Signal Control

Olmstead's removal, by which General Somervell had apparently hoped to slash through the Gordian knot of Army communications, settled Signal Corps' position with respect to the General Staff for the remainder of World War II. Instead of expanding its sphere of communications control, the Corps would soon lose to the Army Air Forces all development and procurement of their electronic equipment, and it would lose to G–2 its signal intelligence activities involving intercept and cryptanalysis. The problem of Army-wide communications control remained with General Ingles. Another problem which he inherited

[101] Ltr, Olmstead to CofS through CG ASF, 11 Jun 43, sub: Retirement, with 1st Ind, Somervell to CofS, 11 Jun 43. Hq ASF File SigC 1942–44, Drawer 6 (RG 200–ASF–Somervell).

[102] Memo, Brig Gen Miller G. White, ACofS G-1 for CofS, 19 Jun 43, sub: Appointment as CSigO. OCS (WDCSA) 201, Ikner, J. (12 Nov 43).

[103] See, for example, the words of appreciation from the Secretary of War, in Ltr, SW to Olmstead, 1 Jul 43. OCS (WDCSA) 201, Obear, Capt Geo (2 Dec 43).

Some months later, touching on a Distinguished Service Medal for Olmstead, General Marshall had this to say: "The Secretary of War feels that General Olmstead took over the Signal Corps at a time when it was in the doldrums and that against heavy odds he brought it out of a very serious situation. Therefore, despite the fact that it was finally determined that he should be replaced, he had done an excellent job under great difficulties." Memo, G. C. M. for ACofS G–1, 9 Oct 43, sub: DSM for Olmstead. Same file.

General Olmstead was returned to active duty for some weeks in the summer of 1943 to serve on the Interdepartmental Telecommunications Committee, the State Department undertaking in which he had told Marshall he wished to participate. See papers contained in OCS (WDCSA) 676 (28 Dec 43).

was the continued shortage of qualified officers, especially in the higher ranks. Having lost more of these than it could afford to the Air Forces, the Corps had too few to do its own work, notably in procurement, let alone to provide able and persuasive officers to furnish the staff work which was everywhere needed. "Their [Signal Corps] personnel is spread thin," General Moses, General Staff G–4, told the board investigating communications in June 1943. "Damn few men know the game," he added.[104]

What the Signal Corps lost in these events of May and June 1943 became the Air Forces' gain, an outcome which Colonel Sarnoff had prophesied in late 1942.[105] Urged on by the efforts of Dr. Edward Bowles, trouble shooter in the Secretary of War's office, Army Air Forces communications were at last reorganized and improved. On 16 June, in a forceful letter to General Arnold, Bowles hewed to the line as he and many a Signal Corps officer saw it. Bowles' sharp criticism, while stinging the Air Forces especially, lashed all the Army as well.

> At the present time, there is no strong consciousness of communications, radar and electronics within the Army as a whole. Electrical communications are still regarded as a commodity to be provided immediately upon request, like goods from a shopkeeper's shelf. High staff planning agencies lack the essential concept of communications as systems which are fundamental in tactical planning and in successful combat operations.

The Air Forces, he emphasized again and and again, suffered from lack of communications leadership, there being no one man or staff "having the primary responsibility for tactical and technical planning, for co-ordination and supervision, and for establishment of over-all policy in communications, radar and allied fields." Before the summer's end General Arnold finally set up strong operational control over his air communications, borrowing another of Signal Corps' too few officers, Colonel Rives, to assist General McClelland in this task.[106] The new Signal Corps chief, General Ingles, would do some reorganizing too, touching supply and development. But he and his Corps remained hampered as to control over the operation of Army communications.

The sole high-level co-ordinating and controlling agencies remained the communications boards. How important their services were General Ingles realized as soon as he took informal command of the Signal Corps in mid-June. Within the first week of his new responsibility he corresponded with General Somervell on the subject. Lt. Gen. Joseph McNarney, Deputy Chief of Staff, had been annoyed at the slow inefficiency of the boards in getting important signal tasks accomplished. Somervell was similarly dissatisfied and believed further that the boards occupied the time of far too many officers and committees. "It is reported that there are some 40 or 45 of these [committees and subcommittees], and of course this number is entirely too many to handle business promptly," Somervell wrote to Ingles. He added, "It is also reported that there are some 245 officers engaged on the work of the boards. The speed with which the job has been done has been far below what is necessary." [107]

[104] Proceeedings of Board To Investigate Communications, Tab Y, p. 2.

[105] Log entry, 12 Oct 42. Deputy CSigO Folder 1942–45, p. 33. SigC Hist Sec File.

[106] Memo, Bowles for Arnold, pp. 1–2, cited n. 37. See also Ltr, Bowles to R. A. Lovett, Asst SW for Air, 26 Jun 43, and Memo, Bowles for SW, 26 Jun 43, sub: Army Air Forces Com. All in OCS (WDCSA) 676 (28 Dec 43).

[107] Memo, Ingles, Actg CSigO for Somervell, 17

Ingles answered with vigor on 25 June. McNarney and Somervell had been misinformed. Total membership was 143 officers and 22 civilians. The Combined Communications Board had 23 committees and 6 subcommittees. The same men and the same committees served in the Joint Communications Board also. Their work was part-time only, performed by men who were informed specialists in their fields: radar, frequency allocation, countermeasures, identification, codes and ciphers, and so on. They performed essential tasks and they could not be eliminated, or even much reduced. "In my opinion," Ingles declared, "none of these Boards can be discontinued." He made one exception, the Army Communications Board. And it could be eliminated, he added, on only one condition, namely, that the Chief Signal Officer inherit all the board's duties. General Ingles recommended "that the Chief Signal Officer be charged with the mission of coordinating communication procedure throughout the Army of the United States, that the Army Ground Forces and the Army Air Forces be so advised by authority of the Chief of Staff, and that the Army Communications Board be then discontinued." Though Ingles was not urging that he be moved out from under the Army Service Forces to the General Staff in order to receive these powers, he was asking for the substance of Olmstead's goal.[108]

General Somervell approved General Ingles' recommendation and passed it on to General McNarney. But beyond and above the ASF stood other obstacles—General Marshall's policies and General Arnold and his Air Forces ambitions. Ingles, in asking to be allowed to co-ordinate and standardize Army communication procedure throughout the Army had specified that he have authority in these matters over the AAF. This apparently presented a situation which the AAF, or more specifically its chief, did not want to entertain. In any event, General McNarney, himself an Air officer, shelved the entire proposition laconically with words that have crushed many a high hope: "No action, file." [109]

Jun 43, with 1st Ind, Somervell to Actg CSigO, 17 Jun 43. OCS (WDCSA) 676 (28 Dec 43).

Both McNarney and Somervell, like many other busy administrators in the Army, could not grasp or keep abreast of the ever-widening sphere of electronics. They understandably felt annoyed when confronted with the magnitude and complexity of the field. General Stilwell with characteristic frankness expressed what many officers must have felt, especially in the earlier years of the war. Speaking in May 1943 about CBI communications, Stilwell confessed that they had been "handled very poorly, principally due to my own ignorance. . . . I don't know anything about communications or signal work," he blurted. "I only wish," he told members of the board investigating Army communications, "I knew something about your game." Proceedings of Board To Investigate Communications, Tab B, pp. 1, 3, 4.

[108] The new Chief Signal Officer did not demand for himself the powers of the ACB. He merely suggested that if McNarney and Somervell wanted to eliminate as many officers and committees as possible, this was one way of doing it. He said:

"Since all parts of the Army must operate closely together in any modern campaign, coordination and standardization of communication procedure is essential. It is also essential from a supply point of view in order to reduce to the minimum the different types of equipment used and to assure that the three major divisions of the Army use the same types of equipment insofar as possible. If the Chief of Staff desires that the Chief Signal Officer effect this coordination and issues instructions to the Army Ground Forces and Army Air Forces to that effect, the Army Communications Board can be eliminated entirely. If the Chief of Staff does not desire to take such action, the Army Communications Board should continue to function, but it could be reduced in size to one or two members from each of the three major forces."

Ltr, Ingles to CG ASF, 25 Jun 43. OCS (WDCSA) 676 (28 Dec 43).

[109] *Ibid.*, with 1st Ind, Somervell to Deputy CofS, 26 Jun 43, and McNarney's note for file (penned by Col O. L. Nelson, Asst to Deputy CofS).

Bibliographical Note

The sources of this volume lie principally in the massive collection of Signal Corps files, classified and unclassified, within the Departmental Records Branch of the Adjutant General's Office and the Office of the Chief Signal Officer. By laboriously searching through thousands of these file folders, the historians obtained the documents upon which the major portion of this book is built. The files of the Office of the Chief of Staff and of the Army Service Forces provided numbers of pertinent papers, as did also certain files of the Army Air Forces, notably their electronic equipment files and the histories of Signal Corps units which served under the AAF. A wide range of other sources was employed as well. The extent of that range has been adequately marked out in the Bibliographical Note of Volume I of the Signal Corps subseries.

The sources employed for Volume I were put to use in the preparation of this volume whenever they applied to the limited time, December 1941–June 1943, to which Volume II is restricted. Some Volume I sources ceased publication before the opening date of Volume II, for example, the Signal Corps Bulletin. Its place was partly taken by the Signal Corps Information Letter, issued monthly throughout the war (it was renamed the Signal Corps Technical Information Letter in December 1942). A complete set is in the Signal Corps Historical Section File.*

Of general use to the historians in preparing Volume II were the unpublished Annual Reports of the Chief Signal Officer for fiscal years 1942, 1943, and 1944, existing in a few typed copies only So too were the weekly reports, variously called Progress Reports and Digest of Progress and Problems. General Olmstead initiated this system of weekly reporting by all his headquarters divisions in September 1941. The reports continued to be maintained throughout the war, constituting a running record of contemporary activity. A complete set is extant in the care of the Signal Corps Central Files, where there remains also a unique and valuable file, collected during World War II, known as the Code File or the File of the Deputy Chief Signal Officer. Another useful general file was the Signal Corps Administrative Log, 1939–1945, a collection of Office of the Chief Signal Officer organizational charts and changes. This last, and the Chief Signal Officer's unpublished Annual Reports, are maintained in the Signal Corps Historical Section File, where also are collections of the many interviews which the historians have had over a period of years with Signal Corps personnel and which have provided a mine of information, both general and specific. An especially valuable general file of Signal Corps activities and problems within the

*This often-cited file is a collection of all the heterogeneous historical material—diaries, interviews, reports, analyses, miscellaneous working papers, and the like, and completed monograph studies—which the Signal Corps historical office began collecting in 1943 and is still adding to. The file is a permanent collection in the Departmental Records Branch of the Adjutant General's Office.

time span of this volume was the Proceedings of Board to Investigate Communications, AG 311 (5-10-43) (1) Bulky Pkg, Army RG 207.03.

An extensive collection of great general value was the Signal Corps Intelligence Agency (SCIA) files. They include intelligence reports, observers' report, and other important documents which accumulated in the Plans and Operations Division, Office of the Chief Signal Officer, and which were turned over to the Signal Corps Intelligence Agency after World War II. They are preserved in the Departmental Records Branch, Adjutant General's Office, under job lot A51–135, with SCIA file numbers and titles added. Each SCIA item cited in this volume is designated as a SCIA File with appropriate number and title.

The Signal Corps files or studies that were prepared specifically for the historical record are small in number, but they seem of sufficient worth to list here. Although the following lists of titles may appear impressive, the several dozen compilations they represent were few by comparison with the great number of varied office files which provided the primary sources for the volume, as has been pointed out. Some of these specifically historical records, such as those of the Alaska Communication System and certain development and supply installations, were the result of Signal Corps field activities. The largest group of these specifically historical studies are the monographs prepared by the wartime Signal Corps Historical Section (1943–1947). They are on file both in the Office of the Chief of Military History and in the Signal Corps Historical Section. A list of these secondary sources which contributed in varying degree to the preparation of this volume appears at the end of this note under *Monographs*.

Of particular concern to the historian of Signal Corps research and development activity was the History of Signal Corps Research and Development in World War II, the R&D History, which was prepared in the Engineering and Technical Division at the end of the war. It is a compilation of laboratory reports and of Signal Corps actions on hundreds of new equipment items. The compilation runs to fifteen monograph volumes and parts, the ribbon copy of which is in the Signal Corps Historical Section File. In the same file a monograph entitled Historical Report of the Signal Corps Engineering Laboratories, the SCEL History, covering the period from 1930 through 1943, proved helpful. The retired files of the wartime Communications Coordination and Equipment Division in the Office of the Chief Signal Officer provided numbers of so-called C&E cases, dealing with various equipment items and with problems relating to their use. Of particular value in the treatment of radar were Dr. James Phinney Baxter's *Scientists Against Time* (Boston: Little, Brown and Company, 1946) and Dr. Henry E. Guerlac's extensive monograph history of the Radiation Laboratory (under the National Defense Research Committee) entitled Radar, prepared in the Historical Division of the Office of Scientific Research and Development. A photostat copy of the entire monograph in its several parts, each separately paginated, was obtained for the Signal Corps Historical Section File. The pages were renumbered consecutively from beginning to end, and it is to this particular copy of Dr. Guerlac's work that the many references in this volume are made.

Notable sources in procurement and distribution matters were the Weekly Statistical Reports, or Summaries, which were issued first by the Office of the Under Sec-

retary of War and later by SOS headquarters. A number of industrial summaries, prepared at the Philadelphia Signal Corps Procurement District office, were helpful, such as H. C. Shute's Industrial Summary: Signal Corps Procurement of Dry Batteries and W. P. Worrell's Industrial Summary: Signal Corps Materials and Resources. Further sources were several monograph histories, not included in the letter-number series prepared by the wartime Signal Corps Historical Section, such as accounts of the big Signal Corps depots at Philadelphia, Lexington, Chicago, Seattle, and elsewhere. In the same category fall still other Signal Corps historical efforts, such as Morton H. Ullery's typescript two-volume History of the Storage and Issue Agency, 1946, and James J. Cerruti's four-volume Historical Narrative of the Philadelphia Signal Corps Procurement District, 1945. All are in the Signal Corps Historical Section File, except the statistical reports.

Of value to photographic studies was The Summary Report on Photographic Activities of the Signal Corps Since August 4, 1941, in the Fields of Motion Pictures and Visual Aids, an extensive report dated 26 February 1943, which is referred to in this volume as the APS Summary Reports. Another useful source for the later months of the photographic story were the so-called Harrison files in AGO Departmental Records Branch. They comprise a collection of over one hundred personal file folders maintained by Maj. Gen. William H. Harrison, chief of the Army Pictorial Service, while it was on the Army Service Forces level. Valuable to the historian of Signal Corps' Alaskan responsibilities was the History of the Alaska Communication System, 1945. The bound manuscript copy entitled First Draft [Part I], Alaskan Communication System History, contains 17 chapters, 263 pages, and covers the period 1900 to 1 January 1943. Parts II and III are titled History of the Alaska Communication System and cover the period 1 January 1942 to August 1945. Part II is in 3 volumes and contains 18 chapters, 339 pages. Part III, in 8 volumes, contains 39 chapters, 913 pages. The ribbon copy is in the Signal Corps Historical Section File. In this volume Part I is cited as First Draft, History of ACS, with appropriate page numbers, and Parts II and III as Hist of ACS, with appropriate part and chapter.

Noteworthy among sources for theater studies were Sgts. John and Ward Hawkins' *History of the 835th Signal Service Battalion 1942–1945* in the China-Burma-India theater; the reports and papers of Col. T. T. Teague, Signal Officer, U.S. Forces in the Philippines, for the account of communications at the time of the fall of the Philippines; the many SCIA reports; and the History of the Signal Section AFHQ, 24 July 1942–10 November 1945. All are located in the Signal Corps Historical Section File, except the SCIA reports, which are in the retired files of the Signal Corps Intelligence Agency.

Finally, note must be made of the records of Congressional investigations, which provided useful sources. In photographic studies, the Truman Committee Report (Sen. Spec. Committee, 78th Cong., 1st Sess., *Hearings, Investigation of the National Defense Program,* Pt. 17, *Army Commissions and Military Activities of Motion Picture Personnel,* Jan–Apr 43) was used. Particularly valuable to any study of the Hawaiian theater at the time of the Pearl Harbor attack is the printed report of the Joint Committee on the Investigation of the Pearl Harbor Attack (which is printed

elsewhere as well and is also included in the MS File of the Pearl Harbor Hearings in the Departmental Records Branch of the Adjutant General's Office). The printed report constitutes 40 volumes, generally known by the short title, *Pearl Harbor Attack*. Of these, the first—unnumbered—volume is devoted to the reports of the Joint [Congressional] Committee on the Investigation of the Pearl Harbor Attack that brought the whole series to official publication. The other parts, numbered 1 through 39, comprise the hearings, exhibits, and reports of the eight several investigations to which the Japanese war action gave rise.

The complete description of the series is as follows:

Joint Committee, 79th Cong, 1st and 2nd Sess, *Investigation of the Pearl Harbor Attack* (Reports of the Joint Committee), Sen Doc 244 (Washington, 1946), 580 pp.

———, *Pearl Harbor Attack*, Pts. 1–11 (Hearings of the Joint Committee, 15 Nov 45–31 May 46), 5,560 pp.

———, *Ibid.*, Pts. 12–21 (Exhibits of the Joint Committee Hearings), 4,780 pp.

———, *Ibid.*, Pts. 22–25, *Proceedings of Roberts Commission* [Associate Justice Owen J. Roberts, U. S. Supreme Court, Chairman] *to Investigate the Japanese Attack of December 7, 1941, on Hawaii*, 2,173 pp.

———, *Ibid.*, Pt. 26, *Proceedings of* [Admiral Thomas C.] *Hart* [USN, Ret] *Inquiry*, 565 pp.

———, *Ibid.*, Pts. 27–31, *Proceedings of Army Pearl Harbor Board*, 3,357 pp.

———, *Ibid.*, Pts. 32–33, *Proceedings of Navy Court of Inquiry*, 1,397 pp.

———, *Ibid.*, Pt. 34, *Proceedings of* [Colonel Carter W.] *Clarke* [USA] *Investigation. . . Pursuant to Oral Instructions of the Chief Staff, U. S. Army, Testimony and Findings Concerning Handling of Certain Top Secret Documents*, 225 pp.

———, *Ibid.*, Pt. 35, *Report of Investigation by Lt. Colonel Henry C. Clausen, JAGD* [AUS] *for the Secretary of War, Supplementary to Proceedings of the Army Pearl Harbor Board*, 695 pp.

———, *Ibid.*, Pts. 36–38, *Proceedings of Inquiry . . . Conducted by Admiral Henry Kent Hewitt, U. S. Navy, in Accordance with a Precept Dated 2 May 1945, from the Secretary of the Navy*, 1,341 pp.

———, *Ibid.*, Pt. 39, *Reports, Findings and Conclusion of Roberts Commission, Army Pearl Harbor Board, Navy Court of Inquiry, and Hewitt Inquiry, with Indorsements*, 527 pp.

Monographs

Letter-number designation	*Author(s)*	*Title*
A-2	Capt Harry M. Davis	Signal Corps Development of U.S. Army Radar Equipment, Pt II, 1937–1941
A-3		Pt III, Long Range Radar, SCR-270-271
B-1	André E. Gerard	The Story of Supply in the Signal Corps in World War II, Pt I, Requirements
B-1b		Pt II, Procurement
B-1c		Pt III, Production
B-1d	Capt Charles R. Novick	The Story of Supply in the Signal Corps in World War II, Pt IV, Distribution
B-3	James V. Clarke	Contract Adjustment in the Signal Corps, 1 July 1939–15 August 1945
B-5	André E. Gerard	Activity and Participation of the Signal Corps in Foreign Procurement and Lend-Lease
B-14	Ralph H. Clark	Expediting Activities of the Office of the Chief Signal Officer, August 1941–June 1944
B-15	Mary-louise Melia	The Quartz Crystal Program of the Signal Corps, 1941–1945
B-16	Capt Charles R. Novick	The Signal Corps Policy of the Conservation of Critical and Strategic Materials
C-1	Capt Frederick Reinstein	Signal Corps Training in World War II: Background and First Six Months of War, 1917–1942
C-3	Marvin L. Ingram	The Civilian Training Program of the Signal Corps in World War II: Pt I, Pre-Service Training on the Vocational Level
C-3a		Pt II, Pre-Service Training on the College Level
C-4	Ruth F. Sadler	History of the Signal Corps Affiliated Plan
C-5		History of the Electronics Training Group in the United Kingdom
C-6	Capt Frederick Reinstein	Training Study of the Signal Corps Officer Candidate School, 1939–1944
C-8		Study of Signal Corps Enlisted Schooling, 1939–1944
C-9		Study of Signal Corps Replacement and Filler Training, 1941–1944
D-1	Dr. Courtney R. Hall	Development of the Office of the Chief Signal Officer
D-2		Signal Corps Participation in Boards and Committees
E-1	Capt Sidney L. Jackson	Stringing Wire Toward Tokyo: A Brief History of the Alaska Military Highway Telephone Line
E-1a		Fixed Wire, NATOUSA: Chapter I of Theater Fixed Networks
E-1d		Communications in the Persian Gulf Command: Chapter IV of the Theater Fixed Networks
E-2b		Radnese "100": Chapter II of International Radio Circuits

Letter-number designation	*Author(s)*	*Title*
E-3a	Capt Sidney L. Jackson	Tactical Communication in World War II, Pt I, Signal Communication in the North African Campaigns
E-4a	1st Lt Charles R. Novick	A Story of Signal Communications in Iceland
E-5a	Mary E. Boswell	The 17th Signal Service Company, A Component of the War Department Signal Center from World War I through World War II
E-5b	Pauline M. Oakes	The Army Command and Administrative Communications System, Pt II, Signal Corps Domestic Communications Network as Extended to Overseas Terminals FY 1941–15 August 1945
E-6	Dr. Donald O. Wagner	Army Command and Administrative Network, 1941–1945: Pt I, The Pacific; Pt II, China-Burma-India
E-7	Capt Frederick Reinstein	Signal Corps Fixed Communications in the European and Africa-Middle Eastern Theaters
E-10	Mary-louise Melia	Signal Corps Fixed Communications in World War II: Special Assignments and Techniques
F-1	Jacqueline M. Quadow	Training Films in the Second World War
F-2a	James V. Clarke	Signal Corps Army Pictorial Service in World War II (1 Sep 39–16 Aug 45)
F-2b	Robert L. Eichberg and Jacqueline M. Quadow	Combat Photography
F-4	Mary E. Boswell	A Study of Signal Corps Contributions to V-Mail through 1943
F-5		A Study of Signal Corps Contribution to V-Mail Through 1943, Suppl. Dec 43–Aug 45.

List of Abbreviations

AA	Antiaircraft
AACS	Army Airways Communications System
AAF	Army Air Forces
AAFSAT	Army Air Forces School of Applied Tactics
AAG	Air Adjutant General
AARS	Army Amateur Radio System
AB	Air Base
AC	Air Corps or alternating current
AC&EC	Army Communications and Equipment Coordination
ACAN	Army Command and Administrative Network
ACB	Army Communications Board
ACD	Army Communications Division, OCSigO
ACofAS	Assistant Chief of Air Staff
ACofS	Assistant Chief of Staff
ACS	Alaska Communication System
Actg	Acting
ADC	Alaska Defense Command
Adm	Administrative
AF	Air Forces or air force
AFACT	Assistant Chief of Air Staff, Training
AFCC	Air Force Combat Command
AFHQ	Allied Forces Headquarters
AFofL	American Federation of Labor
AFMIDPAC	Army Forces, Middle Pacific
AFRDB	Air Force Research and Development Branch
AFTSC	Air Force Technical Service Command
AG	Adjutant General
AGCT	Army General Classification Test
AGF	Army Ground Forces
AGL	Airborne gun laying
AGO	Adjutant General's Office
AI	Airborne interception (radar)
AM	Amplitude modulation (radio)
AMET	Africa-Middle East Theater
AN	Army-Navy
ANCPEA	Army-Navy Communications Production Expediting Agency

ANEPA	Army-Navy Electronics Production Agency
ANMB	Army and Navy Munitions Board
APD	Army Pictorial Division, OCSigO
APHB	Army Pearl Harbor Board
APO	Army Post Office
APS	Army Pictorial Service
AR	Army Regulations
ARL	Aircraft Radio Laboratory
ARO	Airborne range only
ASC	Air Service Command
ASF	Army Service Forces
ASG	Naval sets related to ASV
ASP	Army Supply Program
ASV	Air-to-surface-vessel (radar)
AT&T	American Telephone and Telegraph Company
ATC	Air Transport Command
Avn	Aviation
AW	Aircraft warning
AWS	Aircraft Warning Service
Bd	Board
Bn	Battalion
Br	Branch
BTO	Bombing-through-overcast (radar)
BWI	British West Indies
C&E	Coordination and Equipment
CA	Coast Artillery
CAA	Civil Aeronautics Administration
CAC	Coast Artillery Corps
CAF	Clerical, Administrative, and Fiscal (a category of civil servants)
CBI	China-Burma-India
CCB	Combined Communications Board
CCS	Combined Chiefs of Staff
CD	Coast Defense (radar)
CESL	Camp Evans Signal Laboratory
CG	Commanding General
CH	Chain Home
CHL	Chain Home Low
CIO	Congress of Industrial Organizations
CMP	Controlled Materials Plan
CNC	Chief of Naval Communications
CNO	Chief of Naval Operations
Co	Company

CofCA	Chief of Coast Artillery
CofE	Chief of Engineers
CofS	Chief of Staff
COL	Chain Overseas Low (British radar)
Com*	Communication or communications
Comd	Command
Comdr	Commander
Conf	Conference
Const	Construction
Coord	Coordination
CSigO	Chief Signal Officer
DA	Department of the Army
DC	Direct current
Dev	Development
DF	Direction finding (radio) or direction finder
Dir	Director
Dist	District
Distr	Distribution
Div	Division
Doc	Document
DRB	Departmental Records Branch (AGO)
EEIS	Enemy Equipment Identification Service
Engrs	Engineers
Equip	Equipment
ERC	Enlisted Reserve Corps
ESCRTC	Eastern Signal Corps Replacement Training Center
ESCS	Enlisted Signal Corps School
ETG	Electronics Training Group
ETO	European Theater of Operations
ETOUSA	European Theater of Operations, United States Army
EW	Early warning (radar)
Ex O	Executive Order
Exped	Expediting
FA	Field Artillery (Corps)
FCC	Federal Communications Commission
FEAF	Far East Air Force
Fld	Field
FM	Frequency modulation (radio)
FY	Fiscal Year

**Com* is used throughout this volume as the abbreviation for both *communication* and *communications* in accordance with Army practice during the war period, although Signal Corps men used the abbreviation *comm.*

G–1	Personnel Section of the War Department General Staff, or of any other headquarters on the division level or higher
G–2	Military Intelligence Section
G–3	Operations and Training Section
G–4	Supply Section
GCI	Ground-controlled interception (radar)
GCT	Greenwich Civil Time
GD	General Development
GHQ	General Headquarters
GL	Gun laying (radar)
GO	General Order
Gp	Group
GSA	General Services Administration
GSC	General Staff Corps
Hist	History or historical
HPG	High Power Group
HUSAFMIDPAC	Headquarters, United States Army Forces, Middle Pacific
I&M	Installation and Maintenance
IBM	International Business Machine Corp.
IFF	Identification, friend or foe (radar)
IGD	Inspector General's Department
ILS	Instrument landing system
Ind	Indorsement
Inf	Infantry
Inspec	Inspection
Instl	Installation
Intel	Intelligence
Interv	Interview
IRE	Institute of Radio Engineers
ISIB	Inter-Service Ionosphere Bureau
JAGD	Judge Advocate General's Department
JAGO	Judge Advocate General's Office
JANP	Joint Army Navy Procedure
JCB	Joint Communications Board
JCS	Joint Chiefs of Staff
Jt	Joint
KW	Kilowatt
LAB	Low altitude bombsight
LCP	Landing Craft Personnel
LRN	Loran (navigational radar aid)
Ltr	Letter
LW	Light warning (radar)

M Day	Mobilization Day
Maint	Maintenance
MAL	Multiairline (a type of British pole line construction)
Mat	Material or matériel
MESC	Middle East Service Command
MEW	Microwave Early Warning (radar)
Mil	Military
Min	Minutes
MIS	Military Intelligence Service
MIT	Massachusetts Institute of Technology
MRU	Mobile Radio Unit (a type of British radar)
Msg	Message
MTOUSA	Mediterranean Theater of Operations, U.S. Army
MWSCS	Midwestern Signal Corps School
NATO	North African Theater of Operations
NATOUSA	North African Theater of Operations, U.S. Army
NCS	Net Control Station (radio)
NDRC	National Defense Research Committee
NEI	Netherlands East Indies
NIBC	Northern Ireland Base Command
O/C	Officer in charge
OASW	Office of the Assistant Secretary of War
OCMH	Office of the Chief of Military History
OCS	Office of the Chief of Staff or Officer Candidate School
OCSigO	Office of the Chief Signal Officer
OCT	Office of the Chief of Transportation
Off	Office
OPD	Operations Division, WDGS
Opns	Operations
Orgn	Organization
OSRD	Office of Scientific Research and Development
OUSW	Office of the Under Secretary of War
P&D	Procurement and Distribution
P&T	Personnel and Training
PEA	Plant Engineering Agency
PERL	Pictorial Engineering and Research Laboratory
Pers	Personnel
Photo	Photographic
PL	Public Law
PMP	Protective Mobilization Plan
POE	Port of Embarkation
PPI	Plan position indicator (a type of radar oscilloscope)
Proc	Procurement

Prod	Production
Prog	Progress
Proj	Project
PSCPD	Philadephia Signal Corps Procurement District
PTT	Postes, Telegraphes et Telephones
Purch	Purchasing
R&AC	Radar and Air Communications
R&D	Research and Development
R&R	Routing and Record (sheet, in AAF office usage)
R&W	Routing and Work (sheet, in SigC office usage)
RAAF	Royal Australian Air Force
RAF	Royal Air Force
RCA	Radio Corporation of America
Rcds	Records
RCM	Radio/radar countermeasures
RDF	Radio direction finding (a term for radar before early 1942) or radio direction finder
Res	Reserve
Ret	Retired
Rqmts	Requirements
RI	Radio Intelligence
RL	Radiation Laboratory (at MIT, radar research for NDRC)
ROTC	Reserve Officers Training Corps
RPF	Radio position finding (a term for radar before early 1942) or radio position finder
RPL	Rapid pole line (a type of pole line construction)
Rpt	Report
RR	Radio recognition (radar, similar to IFF)
RTC	Replacement Training Center
Rtty	Radioteletype
S&I	Storage and Issue
SADU	Sea Search Attack Development Unit
SAS	Signal Airways Service
SAW	Signal Aircraft Warning
SC	Signal Corps
SCASS	Signal Corps Aircraft Signal Service
SCEL	Signal Corps Engineering Laboratories
SCGDL	Signal Corps General Development Laboratory
SCGSS	Signal Corps Ground Signal Service
SCIA	Signal Corps Intelligence Agency
SCL	Signal Corps Laboratories
SCPC	Signal Corps Pictorial Center
SCPL	Signal Corps Photographic Laboratory

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SCR	Set complete radio
SCRL	Signal Corps Radar Laboratory
SCRTC	Signal Corps Replacement Training Center
SCS	Sector control system (radio and radar assemblage employed in aircraft interception)
Sec	Section
Sen	Senate
Sess	Session
SFSCPD	San Francisco Signal Corps Procurement District
SigC	Signal Corps
SigO	Signal Officer
SIS	Signal Intelligence Service
SLC	Search light control (radar)
SOI	Signal Operating Instructions
SOS	Services of Supply
SPA	South Pacific Area
SPBC	South Pacific Base Command
Spec	Special or specialist
SPOBS	Special Observer (U.S. Army group in London)
SSCS	Southern Signal Corps School
Stat	Statistics or statistical
Sv	Service
SWPA	Southwest Pacific Area
T/BA	Table of Basic Allowances
T/O	Tables of Organization
TAG	The Adjutant General
TBX and TBY	Types of short range Navy radios
TC	Transportation Corps
Tech	Technical
TF	Task Force
TFPL	Training Film Production Laboratory
Tng	Training
TRU	Transportable radio unit (a type of British radar)
TWX	Teletypewriter exchange
UHF	Ultrahigh frequency
USAFBI	United States Army Forces in the British Isles
USAFFE	United States Army Forces in the Far East
USAFIA	United States Army Forces in Africa
USAFIME	United States Army Forces in the Middle East
USFIP	United States Forces in the Philippines
USAFISPA	United States Army Forces in the South Pacific Area
USFOR	United States Forces
USN	United States Navy

USNR	United States Navy Reserve
USSR	Union of Soviet Socialist Republics
USW	Under Secretary of War
VHF	Very high frequency
VT	Vacuum tube
Waac	Member of the Women's Army Auxiliary Corps
WAC	Women's Army Corps
WD	War Department
WDGS	War Department General Staff
WO	Warrant Officer
WP&T	War Plans and Training
WPB	War Production Board
WPD	War Plans Division, WDGS
W/T	Wireless telegraph, i.e., radio

Glossary

Altimeter	An aircraft device for measuring altitude.
Antrac	A term often used for radio relay equipment. It is derived from the nomenclature AN/TRC—Army Navy Transportable Radio Communications—assigned to several types of radio relay and other radio sets.
Azimuth	Direction, in terms of horizontal angle, measured clockwise from north.
BLADE	An Allied armored task force formed for the drive to capture Tunis.
BLUIE	Greenland.
Boehme	High-speed radio transmission of Morse code signals by means of perforated tape which can mechanically key a transmitter at speeds up to 400 words a minute.
BOLERO	Build-up of American forces and supplies in United Kingdom for cross-Channel attack.
Breadboard model	A display of electronic equipment assembly in which the wiring and components are spread out over a horizontal surface for ease in making changes in the circuitry; employed both in development laboratories for experimental work and in school instruction.
Carrier	Carrier method, whether involving wire or radio, is a technique which permits many messages, many separate signals, to travel simultaneously without mutual interference over a single circuit.
Cathode ray tube	A vacuum tube with a picture screen, on which the electron beam emitted from the cathode produces a visual indication. *See* Oscilloscope.
Chain Home	British long-range aircraft detecting radar.
Chain Home Low	British radar able to detect aircraft flying at low elevations.
Cipher	A method of secret writing which retains the letters but transposes them, or replaces them with substituted letters, according to a plan or key.

Code	A method of communication in which predetermined symbols or terms are substituted for the words of the message text.
Common battery switchboard	A switchboard which provides, from a central power supply located at the board, the current needed to operate the telephones connected to the board. Opposite to local battery switchboard, *which see.*
Continuous wave	A method of radio communications employing radio waves in which successive cycles are of constant amplitude. The method of transmission may be by hand key or by machine signals.
Crash construction	Rapid hand-construction of equipment by laboratory and engineer personnel.
CRIMSON	Project for airfields in central and northeastern Canada.
Cryptanalyst	One who recovers an original message text from an encoded or enciphered cryptogram, without knowing the key; also one who reconstructs such a key.
Cryptography	The process of putting message texts into meaningless letters or symbols by means of code and/or cipher systems.
CRYSTAL	Weather station.
Dah-dit	The dash-dot, or long and short, signals of Morse code, variously grouped to spell out letters of the alphabet.
Derax	An early name for radar.
Dielectric	An insulating material placed between the two plates of a capacitor.
Dipole	A T-shaped antenna, such as the familar television antenna, used with VHF radiations.
Direction finding	Determining, by means of a radio receiver and special antennas, the direction and location of a transmitter to whose radiations the receiver is tuned. *See also* Goniometry (radio).
Dynamotor	An electrical rotary device which is usually employed in the power supply of a vehicular radio set and which converts the low voltage of a vehicular storage battery to the higher voltages required by radio operation.
Electromagnetic wave	A radio or radar radiation traveling in space at 186,293 miles per second; also heat, light, X-, gamma, and cosmic rays, which are all alike except in frequency and wave length.

Frequency	The number of cycles per second which characterizes any electromagnetic wave or radiation.
Goniometry (radio)	Measuring or taking angles, by means of radio receivers and directional antennas, on radio or radar radiations so as to determine the location of the tranmitter. *See also* Direction finding.
Gun laying	The process of aiming a gun, often at a target which cannot be seen or which is moving, requiring complex calculations.
GYMNAST	Early plan for invasion of North Africa, referring to either the American idea of landing at Casablanca or the British plan for landing farther eastward on the Mediterranean coast.
Hams	Amateur radio operators and enthusiasts.
Handie-talkie	A hand-carried infantry radio transceiver, the SCR-536 during World War II.
Hand-key	In manual radiotelegraph sending, the key (operated by the hand or fingers) is a kind of switch capable of being opened or closed rapidly in order to form the dots and dashes of Morse code signals.
High frequency	3–30 megacycles.
High-speed radio	See Boehme.
Interrogator	A pulsed transmitter whose signals challenge and automatically elicit an identifying reply from a transponder in a distant craft; part of the IFF radar system.
Ionosphere	The outer layer of the earth's atmosphere which reflects the sky wave component of radio waves of the high frequency band, enabling long-distance signals.
Key	*See* Hand-key.
Kilocycle	One thousand cycles per second.
Kilowatt	One thousand watts.
Local battery switchboard	A switchboard which interconnects telephone sets, each having its own dry batteries to provide the talking current. Opposite to common battery switchboard, *which see.*
Loran	Long-range aid to navigation: a highly accurate system employing beacons and aircraft or ship receivers, the receivers determining the position of the beacons from their radiations.
Low frequency	30–300 kilocycles.

Magnetron	An electronic tube in which the electron flow is controlled by an externally applied magnet and which is capable of producing powerful oscillations at microwave frequencies.
Manual radio	Transmitting Morse code dah-dits by hand key.
Megacycle	One million cycles per second.
Microwave	Radio waves which radiate at frequencies above 300 megacycles with a wave length of 50 centimeters (20 inches) or less.
Morse	Morse code: communications according to the code, employing combinations of dashes and dots (dah-dits) to spell out the letters, as in radio or wire telegraphy.
Open wire line	A pole line carrying bare wires, usually galvanized iron or bare copper, for telephone and/or telegraph communications.
Oscilloscope	A cathode ray tube (*which see*) used, like a television picture tube, in a radar receiver to display visually target echoes.
Phantom circuit	An additional channel of communications which can be superimposed upon two physical pairs, that is two pairs of telephone wires already carrying two channels of communications.
Piezoelectric effect	The effect of producing an electrical voltage in a crystal by compressing or twisting it.
Pipsqueak	An airborne radio transmitter employed in the British system of aircraft control by DF, used to identify and track friendly craft.
Point-to-point	A term used of radio operation between two stations (generally fixed, with directional antenna arrays) signaling between each other only. Compare with radio broadcast operation, when a transmitting station signals to all receivers in its net, which are tuned to the frequency employed by the transmitting station.
Radio compass	A receiver which determines the direction of received radio waves and registers the direction visually on a meter or compass scale.
Radio range beacon	A radio transmitter radiating a narrow directional guide beam on which craft may "home."
Range	The distance from a gun or an observer to the target.

Rectifier	An item of equipment which converts, or rectifies, alternating current (AC) to produce a desired direct current (DC).
Responsor	The receiver of an IFF radar system, used with an interrogator, *which see.*
Rhombic antenna	A large transmitting antenna utilized by fixed long-range radio stations. The antenna wires, extended between four poles or towers, form a diamond-shaped or rhombic pattern, capable of directing powerful electromagnetic waves in a definite direction.
ROUNDUP	The name by which plans for cross-Channel invasion were known until the summer of 1943.
Shoran	A short-range navigation system employing electronic methods similar to Loran, *which see.*
Sky wave	That portion of a radio wave transmitted from an antenna which travels upward and is reflected down to earth by the ionosphere, *which see.* Used in the high frequency band by long-range military radios, the sky wave under favorable conditions enables communication over very long distances.
Spiral-four	A rubber-covered field cable of four conductors especially constructed for the transmission of multiple telephone and/or telegraph signals by means of wire carrier techniques.
Steatite	A form of talc used in the manufacture of high-grade insulators and dielectric parts.
Theodolite	A telescope, similar to the tripod-mounted transit of a surveyor, by which an observer can follow moving objects, such as a weather balloon, reading its elevation and azimuth from moment to moment.
TORCH	The Allied invasion operation in North Africa, November 1942.
Traffic	Passing of messages over wire circuits or radio channels.
Transceiver	A radio transmitter and receiver combined in one unit, portions of its circuits being used for both functions.
Transponder	A combined receiver-transmitter employed in the IFF radar system. The receiver on being challenged by a distant interrogator, stimulates the transmitter to send back coded identification signals. *See also* Interrogator and Responsor.
TRIGGER	Plan to set up a model air defense sector in the United States with RAF aid.

Ultrahigh frequency	300–3,000 megacycles.
V-mail	A method by which personal mail was microphotographed on 16-mm. film for ease and economy of transportation. At the destination the filmed messages were enlarged and reproduced for delivery.
Very high frequency	30–300 megacycles.
Walkie-talkie	A portable radio set adapted for carrying on a soldier's back, having a longer range than the smaller handie-talkie. The standard walkie-talkie during World War II was the infantry's SCR-300, replacing the original walkie-talkies, the SCR's-194 and 195.

United States Army in World War II

The multivolume series, UNITED STATES ARMY IN WORLD WAR II, consists of a number of subseries which are tentatively planned as follows: The War Department, the Army Air Forces, The Army Ground Forces, The Army Service Forces, the Defense of the Western Hemisphere, The War in the Pacific, The European Theater of Operations, The War in the Mediterranean, The Middle East Theater, The China-Burma-India Theater, Civil Affairs, The Technical Services, Special Studies, and Pictorial Record.

The following volumes have been published or are in press:*

The War Department
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