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BOMBSIGHT MAINTENANCE TRAINING IN THE AAF

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BOMB SIGHT MAINTENANCE TRAINING
IN THE AAF

Prepared by
Assistant Chief of Air Staff, Intelligence
Historical Division
June 1944
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FOREWORD

It is the desire of the President, the Secretary of War, and the Commanding General, Army Air Forces, that a solid record of the experiences of the AAF be compiled. This is one of a series of studies prepared as a "first narrative" in the projected overall history of the Army Air Forces.

The decision to make the information contained herein available for staff and operational use without delay has prevented recourse to some primary sources. Readers familiar with this subject matter are invited to contribute additional facts, interpretations, and constructive suggestions.

This study will be handled in strict compliance with AR 380-5,

THOMAS D. WHITE
Brigadier General, U. S. Army
Assistant Chief of Air Staff,
Intelligence

Readers are requested to forward comments and criticisms, and to this end perforated sheets, properly addressed, are appended at the back of this study.

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Bar-sight Maintenance Training in the AAF
Chapter I

BACKGROUND OF BOMBSIGHT MAINTENANCE TRAINING

The Purpose of Bombsights and Automatic Pilots

If it were possible to send into Germany two hundred gangs of super-saboteurs and these gangs could fire explosive charges at precisely the right spots, the entire war fabric of the Reich would collapse. That is the premise underlying the daylight precision bombing which the United States Army Air Forces was employing in Europe at the time this study was written (early in 1944). Instead of gangs, the AAF used hundreds of giant bombers to dump thousands of tons of high explosives on the vital spots in the enemy's territory. Naturally, if these targets were to be permanently destroyed, the bombs had to be aimed with almost perfect accuracy. It was not enough that they fell in the general vicinity of the target. Successful aiming effected an enormous economy both in the matter of bombs and in the crews and planes that transported them.\(^1\)

By the spring of 1944, all the AAF heavy bombers and an increasingly large percentage of its medium bombers were engaged in precision bombing. The alternative type of bombing—so-called "area saturation" bombing in which larger bomb loads are scattered over wider areas during night raids—was still being carried on by the Royal Air Force and a diminishing number of AAF medium bombers.

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1. This summary of the theory behind precision bombing is paraphrased from Francis V. Brink, Vertical Warfare, 102, 104.
Precision bombing would be impossible without two remarkable devices which are interrelated and work together—the precision bomb sight and the automatic pilot. To escape the antiaircraft fire of the enemy, a bomber must swerve and shift constantly. To drop a bomb squarely on a target, however, the plane must follow a straight, even course for a period of at least twenty to thirty seconds. The human pilot guides the plane through the evasive action as it approaches and leaves the target; but during the crucial twenty to thirty seconds of the "bombing run" over the target, the automatic pilot keeps the plane on its straight, even course. The bomb sight and the automatic pilot working in conjunction enable the bombardier to watch the target, direct the course of the plane toward it, and determine the instant when the bombs are dropped so that they will fall squarely on the target.

The non-precision type of bomb sight is a less intricate instrument because the function for which it is designed is a less difficult one. Inasmuch as it is unnecessary for the plane to follow a straight course during non-precision bombing, an automatic pilot need not be used.
Force of Bomblet and Automatic Pilots

Until the late 1943, only two types of precision bombing equipment were used as standard equipment by the AAF: the Norden B-series bomblet with its associated Minneapolis-Honeywell 0-1 automatic pilot, and the Sperry S-series bomblet with its associated A-5 automatic pilot. A conference of a board of officers meeting 15 September 1943 determined that production of the Sperry equipment for the AAF would be discontinued; but as use of this equipment tapered off very gradually, it continued to merit consideration for a considerable period afterward.

The first of the Norden sights, the so-called N-1, came into use by the Air Corps about 1928. The Navy had a contract with Earl L. Norden, Inc., of New York City, for its entire output; but through the Navy Bureau of Ordnance, the Army Air Corps arranged to obtain a small percentage of the firm's output. Various modifications of the Norden sight were adopted in the years that followed: the N-2 and the N-5, used in conjunction with the 0-1 automatic pilot, were standard about 1937 and 1938; the N-6 and N-7, models incorporating automatic arming features, were produced around 1940; and the N-8 and N-9, abandoning these features, became standard toward the end of 1942. To meet the increased need for these sights, the AAF obtained equipment of the latest Norden model from the Victor Adding.
The Norden Company, in addition to its quota from the Norden Company.
By December 1943, however, the total number of sights obtained
from Victor was only about 100.

About 1937 and 1938 the Norden Company began manufacturing
an automatic pilot for use in connection with its H-4 and H-6
sights. The Navy used this equipment only on bombing runs and
referred to it as S.B.A.E. (Stabilized Bombing Approach Equipment),
a term it classified as "secret." When the Air Corps adopted
this equipment, it employed it not only for bombing runs but
for general use as an automatic flight control. To avoid the
Navy's secrecy restrictions it was called A.F.C.E. (Automatic
Flight Control Equipment), and information about it was classified
"confidential" and later reclassified "restricted." The most
recent model automatic pilot used in connection with the Norden
sight is the 0-1, made for the AAF by the Minneapolis-Honeywell
Company of Minneapolis.

Different in most details, if not in basic principles of
operation, are the bombsights and automatic pilots made by
the Sperry Gyroscope Company of Brooklyn, New York. The 0-4
bombsight, made by this firm, was in general use in the Air
Corps from about 1933 to 1936. Later Sperry sights, of which
the Air Corps made small use, were the N-1, introduced about
1933, and the 0-1, introduced about 1939. The most recent Sperry
sight, the 8-1, was first produced in 1941.

Non-precision bombights are considerably less complicated than precision bombights and therefore require far less maintenance. In March 1944 only one type was used by the AAF, the "D" series sight originated about 1930. The most recent model, the "D-9," was developed about 1938; the principal producer was the National Cash Register Company of Dayton, Ohio. 3

Levels of Bombight Maintenance

To keep these ingenious devices in perfect operating condition requires the constant attention of numbers of well-trained non-
obardiers and armament officers, enlisted and civilian mechanics.

The role of the bombardier in the maintenance of sights and pilots differs from that of the other three groups. In the continental United States and at many air bases in foreign theaters the bombardier must be able to diagnose a malfunction well enough to give intelligent directions and counsel to the mechanic. At air fields in advanced stations there may be no mechanics, and he must be able to perform at least the simplest repairs and adjustments himself. To this end, cadets in training or bombardiers are taught to perform the "trouble-shooting" routine necessary at a fifty-hour inspection. 4 The individual

training of bombardiers has been treated extensively elsewhere.\(^5\)

The work of the three groups of men concerned primarily with maintenance of the bombardiers and pilots—armament officers, enlisted and civilian mechanics—is divided by the Air Forces into four levels:

First echelon maintenance of bombardiers and automatic pilots is a responsibility of all squadrons equipped with bombardment airplanes. It consists of preflight checks, cleaning, oiling, and replacement of parts.\(^6\) Normally for each bomber a bombardment squadron has one enlisted man and a bombardier concerned with this work. Closely supervising the work of the enlisted men is part of several duties in an armament officer.\(^7\) Second echelon maintenance is a responsibility of the air base group. It consists of calibration checks, replacement of unit assemblies and parts, and all other maintenance which can be performed by mechanics with equipment available at the air base. For this purpose the facilities of the armament maintenance base shop are used whenever possible; in the field, the facilities of the semi-trailer instrument shop are utilized.\(^8\) In each air base group there are customarily four enlisted men qualified to

\(5\) See Individual Training of Bombardiers, prepared in AFHED.

\(6\) AFCC LEO No. 65-5, 13 Oct. 1941.

\(7\) Unsigned letter to Chief of the Air Corps, 27 July 1940, in SAG 387.2-1A, Bombardier Training.

\(8\) AFCC LEO No. 65-5, 13 Oct. 1941.
perform second echelon maintenance on bombsights; and two enlisted men qualified to perform second echelon maintenance work are attached to each air base. The work of these men, too, is strictly supervised by an armament officer. 9 Enlisted men qualified by training and experience to perform first and second echelon maintenance are entitled to be rated as Military Occupational Specialists, number 633. 10

Third and fourth echelon maintenance is a responsibility of the depots and sub-depots operated by the Air Service Command. It involves the diagnosis and correction of all trouble, short of the manufacturing of the parts, by highly trained enlisted men and civilian employees working "under general supervision." A depot repairman "balances gyros and sub-assemblies; adjusts optics for parallax; selects and replaces bearings; and replaces, adjusts, and maintains all parts and components" of the equipment. At the end of 1943 the Air Service Command had 162 enlisted men and 239 civilians assigned to it who were capable of performing this type of work, although not all were actively engaged in it. 11 Enlisted men qualified by training and experience to perform third and fourth echelon maintenance are entitled to rating as Military Occupational Specialists, number 374. 12

9. Unidentified letter to Chief of the Air Corps, 27 July 1940, in AAG 333.9-1A, Bombsight Training.
11. CG, Air Service Command to CG, AAF, 8 Feb. 1944, in AFINED files.
Selection of Bombight Maintenance Men

The selection of men for bombight maintenance training has presented the AAF with a number of considerations which do not apply in other categories of technical training. Physical qualifications, however, follow the general technical training pattern. Army officers have simply to meet the physical standards of all technical officers; enlisted men, those of all ground crew personnel. A single exception exists in the case of color-blindness. Army regulations require that all prospective enlisted students "must be able to correctly interpret at least 75 per cent of the test charts in either the American Optical Company or the Ishihara color vision textbooks." This requirement was inserted by Headquarters, Army Air Forces in the latter part of 1943 at the request of the school authorities at Lowry Field who found that color-blind students were unable to complete their bombight maintenance course because they were unable to distinguish the different colors of wires in the instrument. Apparently no need has been felt for such a requirement in the case of armament officers.

Because of the delicate and intricate nature of bombights and automatic pilots, exacting mental, mechanical, and experience

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13. AAF Rec. No. 52-15, 10 Sept. 1943.
qualifications are required for training in their maintenance. The type of skill is that possessed by a good watchmaker, and indeed many men who were watchmakers or repairmen in civilian life have served creditably as bombsight mechanics.

Before the start of the expansion program, the only enlisted men who were eligible for maintenance work were those who had had three years of experience in the Army, presumably in that type of work, and who held the rating of qualified aircraft armorer.¹⁵ The latter part of this requirement was sharply criticized by a bombardment officer in June 1940. The maintenance of bombsights and automatic pilots, according to Captain Harold Q. Raglin of the School for Bombardment, Third Wing, General Headquarters Air Force, was entirely unlike any other work performed by the armament section. Most armament equipment was of rugged construction, while bombsights and pilots resembled electrical and similar instruments. Captain Raglin asserted that a bombsight maintenance man ought to have mechanical ability equal or superior to that required for an electrical or instrument specialist. Therefore, qualified airplane mechanics should be eligible for the training.¹⁶

¹⁵. C/AC to AG/S, 0-2, 29 Dec. 1939, in AG 382.9-1A, Bombsight Training.
¹⁶. Capt. Harold Q. Raglin to CG, 3rd Wing, GHQAF, 1 June 1940, in ibid.
The criticism found general favor when it was forwarded to the Office of the Chief of Air Corps and led to a general liberalization of requirements. The Training Section recommended that graduates of advanced electrical, instrument, or airplane courses, as well as active reserve, be considered eligible for the course. In the event no courses desired to send men to the course who did not have the above requirements, those provisions might be waived provided the applicant possessed "a satisfactory degree of mental alertness as determined by the Army Alpha and Mathematics tests," possessed mechanical aptitude, and was especially recommended by his commanding officer.17 With the adoption of the General Classification Test in the summer of 1940, a score of 100 was set as the minimum for acceptance for training in bombardment maintainance and 100 the lowest "satisfactory" score for the mechanical aptitude test. Both these scores were considered to be average.18

The requirement that only men with three years' Army experience be eligible for the course was modified as the Air Corps expanded. By the latter part of 1941, many commands and individual air forces could not spare the men to fill the quotas allotted them at the technical schools.19 The result was that

17. S.E.R., Training Section, CGAAC, to General Jacob J. Fitchel, 25 July 1940, in ibid.
18. AAF Hqrs. No. 65-12, 2 Feb. 1942.
19. CG, AGTG, to CGAAC, 17 Sept. 1941, in AAG 363.2-1A, Bombing Training.
men with less than three years' experience—even relatively recent inductees as yet unassigned to any unit—are admitted to bombsight maintenance courses if they have graduated from an armament course and met all other prerequisites. 20

The requirements for appointment as a commissioned bombsight or armament officer resembled those for other technical categories: a score of 110 or better on the General Classification Test and demonstrated qualities of leadership. Training in an engineering college or a minimum of two years' experience in industry were considered highly desirable. 21

The most notable prerequisite for bombsight maintenance training, and the one which gave AAF authorities the thorniest administrative problems, was that dealing with the prospective student's loyalty to the United States. Because bombsights and automatic pilots were long considered classified subjects, the AAF until June 1943 maintained special requirements for persons who used and serviced bombsights and pilots, whether they were officers, enlisted men, or civilian employees. The details of these requirements varied from time to time; and a discussion of them will be postponed until later in the paper, when the


21. AR 625-2, 29 Nov. 1942.
ways in which they affected the administration of the training program will be considered.22

Training before 1936

Before 1936 training in first and second echelon bombsight maintenance for air crew and ground crew personnel, officers and enlisted men alike, was conducted by the tactical units under the G5Q Air Force. Occasionally tactical units would send maintenance men to Wright Field, research center maintained by the Office of the Chief of the Air Corps, for informal instruction in third and fourth echelon maintenance. At Chanute Field, the Air Corps' only technical school, some instruction on bombsights was given to officers taking a ten-month maintenance engineering course.

In the spring of 1936 Chanute Field proposed that this type of training be placed upon a more systematic, formal basis through the establishment of a bombsight course in its Department of Ammunition. Inasmuch as bombsights controlled the dropping of bombs, it seemed logical that their maintenance should be charged to aircraft mechanics, the ground crewmen whose duties were the care of bombs and bomb racks. On 8 May, 1936 the Chief of the Air Corps authorized the Chanute authorities to initiate such a course.23 Accordingly, the Chanute Department

22. See Chap. IV.
23. G/AC to CO, Chanute Field, 8 May 1936, in AAG 353.8-1A, Bomb Sight Training.
of Armament began instruction in bombight maintenance the following October.

Owing to the non-existence of the available records dealing with the early days of Chispute Field, as well as the secrecy surrounding all information about bombights, the initial experiences are surrounded in haziness. Plans called for a course to last eight weeks, with four members in each class. Quotas for the classes were to be distributed among the various tactical units by the Office of the Chief of the Air Corps.24 Beginning with Class No. 4 there were six students to a class, and plans were drawn up to increase the number to eight in later classes.25

In February 1938, sixteen months after its establishment, the bombight maintenance course was moved, along with the Armament Department, from Chispute Field to recently opened Lowry Field, Colorado. The new site was regarded as a considerable improvement, for a near-by bombing range was available which possessed a high altitude bomb target, three bombproof observation cubicles, a set of pursuit targets, and a set of attack targets. The Armament Department felt that these features would facilitate testing the accuracy of the student's work as well as checking the methods of instruction.26 The following July.

24. History, Armament Dept., Lowry Field, Vol. 2, p. 124; statements based chiefly on Annual Report of Armament Department, Lowry Field, 1936-37. All citations to this report refer to Chap. II.
25. Ibid.
When instruction on new equipment was incorporated into the curriculum, the course was lengthened from eight to twelve weeks. At the same time the size of each class was increased to twelve students. 27

During this early period the standard of instruction was restricted by a number of factors beyond control of the Armament Department. The expected advantages to be derived from the new bomb sight were cancelled by the inability of the school authorities to obtain a sufficient number of aircrews for the students' use. The effectiveness of the training was further reduced by the circumstance that all bombs had to be stored and loaded at the Denver Municipal Airport, in an area fairly densely populated by civilians, making it impossible to use anything but bombs during flights. The secrecy which shrouded bomb sight creation created a problem which was to vex, vex, vex, school authorities from that time forward. The Army had issued no textbooks on bomb sight maintenance and repair; for literature on the subject reliance had to be placed on whomever could be begged from the manufacturer and the Chief of the Bureau of Ordnance of the Navy Department. 28

From 1936 to 1939 instruction in bomb sight maintenance for officers followed roughly the same pattern as that for

27. Letter by the Department of Armament, Lowry Field, 15 July 1938, quoting paragraph 51 of the "Minutes of the Chief of Staff meeting held at Cheyenne Field, 6 June 1938," as cited in ibid., 156.
enlisted men. In June 1936, four months before the Chanute authorities had their enlisted men's course in operation, they began a course for airman officers distinct from the old maintenance engineers' course and lasting for seven months. This change and the transfer of the course to Lowry Field early in 1938 along with all maintenance activities made it possible to triple the amount of time devoted to bombing instruments.

Three classes, one starting in 1938 and two in 1939, spent an average of 158 hours on the subjects. The number of officers trained during these early years, however, was very small. Records for fifteen of the maintenance engineering and armament classes, from April 1938 to December 1938 inclusive, show that a total of 160 officers took the course. 29

The establishment of the enlisted men's and officers' however, courses at Chanute and Lowry, did not mark an end to the occasional, semi-informal courses. Tactical units continued to teach first and second echelon maintenance to their bombardiers and mechanics. Wright Field continued to teach third and fourth echelon maintenance from time to time. Toward the end of 1938, for example, the Chief of the Air Corps made arrange- ments with the Materiel Division and the CHC Air Force for a special fifteen-day course for thirty officers and thirty

enlisted men. Subsequently quotas were treated for three
officers and three enlisted men each from Hamilton, March,
Langley, and Mitchel fields, and one officer and one enlisted
bomb sight instructor from lady field. The course begun, after
a postponement or two, on 16 February 1939. 30

30. R.E. No. 3, G/AO to GO, AG Technical School, Cheyenne Field,
22 Oct., 1933; 1st Ind. (G/AO to Chief, Materiel Division, 
Wright Field, 22 Oct., 1933), Chief, Materiel Division to
G/AO, 5 Nov., 1933, in AAG 355.9-1A, Bombay Training,
Chapter II

THE EXPANSION PROGRAM BEFORE PEARL HARBOR

As the rumblings of war abroad grew louder and more menacing during 1938, the Air Corps began drawing up the first of a series of great expansion programs. The "Augmentation Program," as this was called, projected the production of a great many bombardment planes with a corresponding increase in the number of bomb sights and personnel to service them. On the basis of the proposed 16 heavy and 21 medium bombardment squadrons, a total of 163 qualified bombardment mechanics would be required under the tables of organization. An additional 16 mechanics would be required for air base squadrons, making a total requirement of 189.1

In drawing up its plans for the training of additional bombardment mechanics, the Office of the Chief of the Air Corps was handicapped by the fact that no information about the number and present location of men already qualified was extremely scarce. The available records of graduates from the Lowry course were contradictory; the estimate of men trained at Wright Field was little better than an intelligent guess; information about training in the various

1. SEE, Plans to Executive, 9 Feb. 1940, in AG 353.9-1A, Bombight Training.
tactical units was fragmentary and confused. At any rate, it seems clear that in 1939 there were not more than 75 qualified bombardment men in the Air Corps.

To meet the shortage, the "Augmentation Program" provided that between March 1939 and June 1940 bombardment mechanics were to be graduated from Air Corps technical schools at the rate of 144 per fiscal year, or an average of twelve a month. Responsibility for meeting this quota was placed upon the school at Lowry Field.

Less formal training, offered through informal classes and "on the job" in tactical units and at air depots continued as before, taking available additional trained personnel. As the program progressed, considerable use was made of the facilities of the schools of the Sperry and Porden companies.

During the spring and summer of 1940, before the Air Corps had a chance to complete its training under the "Augmentation Program," the "situation," which Germany, Great Britain, and France had been urging came to an abrupt end. Germany overrun all western Europe and threatened to invade the British Isles. In the wave of alarm

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that convulsed the United States, Air Corps officials set to work
drawing up a new expansion program that was to make the first one
look like a pygmy by comparison.

In the course of this planning, Lieutenant Colonel Ray A. Dunn
made a study of the status of bombardier maintenance men already
available to the Army. To date, he reported, Lowry Field had produ-
ced 148 enlisted bombardier mechanics, of whom all but four
remained in the service. Thirty-two more were undergoing instruction
at Lowry on that date—6 July 1940. There were records of seven
enlisted graduates of courses at Wright Field. He was able to list
only eleven Air Corps civilian employees highly trained in bomb-
sight maintenance. Not all of the enlisted men mentioned were
still available for maintenance work, as it was the practice of
Air Force/GHQ units to use them as bombardiers.

On the basis of this study, Colonel Dunn recommended a number
of policies to be pursued in conducting the second expansion pro-
gram. Some of these were: (1) In selecting enlisted men for train-
ing as bombardiers, only those who had never had maintenance train-
ing should be considered eligible. (2) Between August 1940 and
October 1941 the average Lowry class should be increased to forty-
eight, with the school on a two-shift basis. (3) Continued and
increased use should be made of the courses given at the Sperry and
Foran factories. Enlisted men should be sent to those schools.
"only when new equipment or maintenance methods warrant it."

Frequently, maintenance men and lower instructors would oppose the move sent to thosefactory courses. (4) Schools should be established at various depots for the training of civilian employees.\(^\text{4}\)

There is no record of any official action having been taken upon Colonel Dunn's recommendations, although the spirit of most of these appears to have been carried into effect. Perhaps it was the lack of exact information about the status of qualified bantamight maintenance men, which his study revealed, that led the Plans Division of the Office of the Chief of the Air Corps to recommend that the Personnel Section of the Personnel Division be directed to compile and keep up to date a record of all bantamight mechanics, showing the date of completion of their training, units to which they were assigned, discharges, reenlistments, and the like.

The Chief of the Air Corps approved the suggestion and ordered the Training and Operations Division as well as the Personnel Division to carry it out.\(^\text{5}\)

Out of these studies and discussions emerged a plan for increasing the enlisted strength of the Air Corps to 136,000 men—


\(^{5}\) RR, Plans to Executive, 28 July 1940; Executive to Personnel and TMO, 23 July 1940, in files of A9/48, Train.
the so-called 135,000-Men Program. That part dealing with bombsight maintenance training called for Lorry to produce 602 mechanics between the latter part of September 1940 and 1 April 1942. As before, other training was to be performed by factory schools and the schools of tactical units and air depots. A new source of bombsight training was the bombardier schools then being set up.

Training problems during this period were multiplied by changes in types of bombsight equipment used by the Air Corps. More and more tactical units were discontinuing the use of the Snerry O-1 sight in anticipation of a new model, necessitating several revisions of the course at Lorry and elsewhere.

Automatic flight control equipment, employed in connection with the Norden sight, was coming into ever increasing use, with even further reaching consequences. A report prepared by the Experimental Section of the Material Division in February 1941 declared that there was a widespread shortage of properly trained A.F.C.E. maintenance men in the Air Corps, and that too few armament officers had had this training. To remedy this situation, more visits should be paid to tactical units by factory representatives; and local schools should be established at as many stations as practicable.

7. See below, Training Enlisted Men at Lorry.
Training Enlisted Men at Lowry

While the details of the first expansion program were being drawn up, the Lowry authorities had an opportunity to offer suggestions as to how their course might be modified to meet the new conditions. They successfully opposed any move to admit recruits from civil life to the course. They did concede that it was possible greatly to increase their production rate. During the calendar year 1933 the Lowry school had produced 223 bomb-sight mechanics. Colonel Jacob H. Rudolph, Assistant Commandant, felt that it would be possible to increase this by nearly 500 per cent, or at the rate of 63 a year. This could be accomplished by putting the course on a two-shift basis, training 17 men every three months--9 on one shift, 8 on another. The increase, Colonel Rudolph declared, would require for additional uniforms other than expendable items for instruction purposes. He did not explore the question as to how many more instructors would be required under this plan.9

Such a rate would fall far short of the 223 bomb-sight mechanics desired by the Office of the Chief of Air Corps by 7 July 1941. Accordingly, the Lowry Field authorities were directed to expand their facilities gradually until they were entering twenty-four students a month—an increase of more than 1100 per cent over their

pre-expansion rate. By stretching material, personnel, and school housing facilities, the Loury school was able nearly to achieve the pace the higher authorities had set for it. By October 1940 the school was enrolling twelve students a month; beginning November 1940—although a new expansion program had since overscored the Augmentation Program—it matriculated well over twenty-four students a month.11

This record is the more impressive when one considers the various handicaps created by changes in curriculum, shortages of personnel and equipment, and other difficulties under which the Loury authorities labored during this period. In late 1939 and early 1940 they not only had to substitute instruction on the new Sperry C-1 right for that on the Sperry L-1 sight, but added instruction on the new automatic pilots used in connection with Sperry and Norden sights. Although these automatic pilots required considerable explanation, it was felt that the length of the entire course ought not to be extended beyond the twelve-week period already allotted to it. As a consequence, the other subject matter in the curriculum had to be condensed to make room for this new material, and the course as a whole became correspondingly more difficult.12

10. Memo by the School Secretary, Loury Field, to Director, Armament Dept., 25 April 1939, in Ibid., 262.
11. Ibid., 230, 231.
12. Ibid., 129.
In this form, however, the course pleased neither the Library officials nor the Air Corps officials in Washington. Both agreed that twelve weeks was too short a period for the amount of material covered at the attempt to cover. As the Director of the Library Armament Department pointed out, the Navy was devoting four months to instruction on the Norden sight and its associated pilot alone, whereas the Air Corps was giving only twelve weeks of training on the Norden sight and its pilot plus the Sperry sight and its pilot. By comparison with the Navy, the results in the Army Air Forces were admittedly poor.

One possible solution was to train students only on the particular type of sight and pilot they were to be assigned to maintain. The drawback to this, expressed by the Office of the Chief of the Air Corps, was that enlisted personnel were frequently moved from squadron to squadron, and that changes were often made in the equipment used by tactical units. Therefore, the service would be severely handicapped if its personnel were capable of maintaining only one type of equipment. Another solution, which was favored by the Library authorities, was to lengthen the course to four months, devoting three months to the Norden sight and pilot equipment, as well as to the mathematical and scientific principles necessary to its understanding, and one month to the Sperry sight and pilot. Admittedly this plan had one shortcoming: it would require one-third
more two, one-third more space, and three additional instructors.\

In forwarding these observations to the Chief of the Air Corps, the\
Office of the Commandant, Chanute Field, added:

It is believed that instruction on Scarry equipment should be as accurate and as thorough as that given for the Borden Bordight, even though new sets of Scarry equipment are available to the Service. It is the experience of the Armament Branch that the Scarry sight is the more difficult of the two types to teach and that instruction is simplified if the course in Scarry follows Borden.

Out of these discussions a new curriculum was developed which was put into effect 1 July 1940. The course was lengthened to sixteen weeks; instruction was given on both Borden and Scarry equipment, the latter first. This curriculum is interesting also because it is the earliest for which there is a record:

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<thead>
<tr>
<th>Hours</th>
<th>Description</th>
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<td>28</td>
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<td>8</td>
<td>A.F.K.B. classroom work, study of units and their functions</td>
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<td>A.F.K.B. maintenance and inspection of equipment in whine</td>
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<td>1-3 disassembly by students</td>
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<td>1-3 maintenance and cleaning</td>
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14. 1st Ind., Co-Mlt., Chanute Field to 0/AC, 30 Jan. 1940, in AG 346.9-1A, Bordight Training.
15. 2nd Ind., 0040 to Comit., AGIS, Chanute Field, 16 Feb. 1940, in ibid.
a dry of instruction here than they did during the entire time at Lowry Field. I have to prove to them that about half of what they were taught at Lowry Field is wrong... I don't know who there may be in the Air Corps that could change this condition overnight... Wright and Lowry Field can't tell them because they themselves do not know. 17

The criticism offered by Dixon shone an officer at Bockode into investigating the subject personally. Captain Hanlin, the
as command officer of the Fourth War, G3C, Air Force, was in charge
of the training of bombardiers and bombight maintenance men at
Bockode, rounded up his twenty-five Lowry graduates and questioned
them. What he learned did not impress him adversely. In the course
of his report to his commanding general, Captain Hanlin drew up a
bill of particulars against the Lowry school, objective to the type
of men chosen for the course, the material included in the curricula,
and the spirit in which the instruction was conducted.

A bombight maintenance man, Captain Hanlin maintained, should
be primarily a careful mechanic. He should possess intelligence,
native mechanical ability, and pride in his work. The existing
regulations, limiting admission to the course to competent graduates,
produced men who had no appreciation of the delicacy of the instru-
ments they were to maintain, and as a result they ceased their
work. Each of the Lowry course, he continued, was devoted to arithmetic.

17. Report, Carl L. orden, Inc., to Chica, 'Ordnance Division,
27 May 1940, in 1946.
16 hours 1-3 maintenance and cleaning
15 " 1-3 calibration by instructor, students observing, taking notes and practicing adjustments
8 " 1-3 calibration by students
6 " 1-3 calibration by students
8 " 1-series survey
6 " 0-1 general study of units and their functions
8 " 0-1 calibration by instructor, students observing and practicing adjustments
32 " 0-1 calibration by students
3 " 0-1 trainer exercise
1 " 0-1 installation in airframe
12 " Flying (dry runs)
16 " 0-1 survey
60 hours, total

The exact order in which these subjects were offered varied because the personnel and instruction available were limited.16

During the summer of 1940 considerable criticism of the Lorry course, as well as all Army Corps of Cadets maintenance training, was made by "anti-airmen" of the sighted by "untrained personnel in tactical units. The temper appears to have been set off by the visit of L. A. Dixon, a field representative of the Weather bureau, to Fort Worth Field, Louisiana, late in May. Dixon undertook to give instruction on his company's equipment to some ninety officers and enlisted men assigned to its operation and maintenance at the field. Some twenty of them were graduates of the Lorry course.

Dixon will not describe the conditions existing at this field [Dixon wrote in a frantic report to his superior]. They do not know a thing about the equipment... I have been told by the men that they learned more in half

and the theory of bombing, subject indispensable for bombardiers, but totally unnecessary for men the simply maintained aircraft. Almost no such time was devoted to Scarry instruments, a type not used by the Third Wing. He estimated that one-half of the time the men had spent at Lorry was wasted on day or their duties at Fort-Raft were concerned. Moreover, the spirit of the instruction was too theoretical. A mechanic, he felt, needed "plenty of practice on the equivalent he is expected to maintain." But Lorry graduates arriving at Fort-Raft were "at a loss when cut to work." They seemed to be entirely concerned with what happened to a bomb after it left a close and arguments on the relative merits of the Morden and Scarry of late. 18

A number of varying conclusions were drawn from Captain Eadlin's letters as they passed through channels. The headquarters of the GHQ Air Force declined to back the recommendation that instruction in astronomy and the theory of bombing be omitted from the course. It did assert, however, that the need for qualified mechanics were so great that the length of the course ought to be reduced as much as possible. It succeeded Captain Eadlin's proposal that students be taught either the Morden instruments or the Scarry instruments, but not both, because three weeks might thereby be

18. Capt. E. Q. Eadlin to CJ, 3rd Wing, GHQAF, 1 June 1940, in GHQAF.
sliced off the course. The setting of separate courses in the
two types of instruments would entail "additional administrative
work", but the gains would make it worthwhile. 19 The Material
Division of the Office of the Chief of the Air Corps, on the other
hand, concluded that Dixon's findings indicated that far from re-
ducing the length of the course, it should be increased "to at
least six months." 20

In one respect Captain Hulda's recommendations bore fruit
promptly. The Headquarters of the Third Wing, COM Air Force, at
Dixmude, and the Headquarters of the Office of the Chief of the
Air Corps agreed that the course should be opened to electrical
and instrument specialists as well as radio operators. Final
approval was granted on 9 August 1948. 21

The Army officials concurred in the liberalization of entrance
requirements, but resisted the other criticisms made by Captain
Hulda and Dixon they offered stout defense. It was vital that
the portion of the course devoted to mathematics be retained.

Lieutenant Clifford M. Foss, Assistant Director of the Air-
man Department, assured the Army School Executive. Although
Air Corps

19. 2nd Ind., No., GCAF to O/AO, 15 June 1949, in
   AEA.
20. P.W., Material Division to CMC, 5 June 1949, in idd.
21. 1st Ind., No., 3rd Wing, GCAF to CO, GCAF, Kenley Field,
    5 June 1949; 2nd Ind., No., GCAF, Kenley Field to O/AO,
    11 June 1949; 3rd Ind., CO2 to CO1, 2nd Ind., 17 June 1949;
    4th Ind., CO2, 2nd Ind., CO2, 17 July 1949; P.W., Executive
    to Inspector, 3 Aug. 1949, in idd.
Circular 25-7 stated that ability to handle simple problems in arithmetic and proficiency in fractions, decimals, square root, and ratio and proportion were requisite for admission to the course, and many of the airmen arriving at Iorry had been found to be deficient in these.

Lieutenant Rees was equally opposed to the suggestion that separate honor and S&R courses be established. He pointed out that the existing dual curriculum had been adopted at the instance of the Chief of the Air Corps "after mature consideration." Some of the factors behind this decision had been: the frequent movement of enlisted men between units in the Air Corps, the instability of assignment of flying equipment, the essence of sending men from tactical units to Iorry, and the comparatively short time required for training on both types of instruments.

Another Iorry officer, Lieutenant William J. Travis, who was in charge of the ground maintenance course, offered further rebuttal to the criticism leveled at the school. It was the practice at Iorry to state on the qualification card of each graduate whether his instructors felt that he was competent to work alone or only under supervision. If an instructor could give close attention to these comments when assigning men to duty, he declared,

37. Director, Armament Dept. to School Executive, Iorry Field,
1 July 1940, in History of Armament Dept., Iorry Field, Vol. 7, p. 137.
much of the instruction of equipment Dixon mentioned would be
stopped. Lieutenant Travis had a practical suggestion to offer as
to how calibration and instruction therein might be standardized
throughout the Air Corps. This called for each bombardment manu-
facturer to issue a step-by-step calibration chart and an operation
chart for his product. These would be roughly comparable to the
takeoff, landing, and other charts used in airplanes. Such cards
would not endanger the security status of the bombardment and related
equipment if they were classified as confidential material. Liet-
tenant Travis felt that a number of the shortcoming which Dixon had
found in Lowry instruction could be traced to the secrecy of all this.
The most recent model Fokken night, the M-4, was in general use at
Dunkirk, but as yet only one of these had reached Lowry where it
had to be used in an airplane most of the time. The consequence
was that, in the main, Lowry students got only operating—no
opposed to maintenance—training on this new model.

Steps were immediately taken by the Office of the Chief of the
Air Corps to correct any of the conditions at Lowry pointed out
in their exchange of letters. Through the Material Division and the
Navy, it arranged that a representative of the Gordon Air visit
Lowry to demonstrate the latest Gordon models to all enlisted

83. 222, Lt. W. L. Travis, Lowry Field, to Chief, Material Division,
3 June 1943, in files of AG/3, Training.
instructors and officers concerned with the target sight course. It recommended that thereafter every be given a high priority for visits by factory representatives, and that new models of equipment be furnished the school as promptly as possible so that one would be available for every six students.

In line with this policy, Lord B. Morello of the Gordon company spent three days at Italy in the middle of June 1940. He was distressed to learn that none of the recent Gordon models with automatic ejection features were available—or indeed any information about them. When his complaint was brought to the attention of the Material Division, Wright Field replied that "ejects of the type desired are not yet available." In a stop-gap it forwarded six F-5 sight, which possessed the automatic ejection feature. In correspondence, the Material Division reported that, inasmuch as these sights were later to be put into practical use, they should not be reconditioned and disassembled more than was absolutely necessary for instruction purposes. They added that no data on the installation, operation, or maintenance of this model had been furnished by the manufacturer. They had compiled some data on the subject themselves and were forwarding it to the manufacturer for review. Once this was reviewed, they could publish

W. OSAC to OAC, 2/9, 4 June 1940, in file.
it as a confidential letter of instruction.  

The letter originally sent off by Dixon to Captain Euclin led to one other result—the dispatching of Lorry Field personnel to schools operated by the eight manufacturers. On hearing Dixon's comments, the Material Division proposed that "all Lorry Field instructors should be sent to both the [Scorpee and Scorp] factories for intensive training" in classes which could be attended also by its own Depot personnel. In line with this suggestion, a short time later an officer and an enlisted man were sent to the Fordon factory for a four-week course.

And Lorry school had barely in an operating under the 135,000-man program, which went into effect in September 1940, before the consequences of the discontinuance of use of the Scorpee 0-1 night

16. Instruction was given on that two or instrument after 16 November. With only the London model to teach, the course was reduced to twelve weeks and again placed on a single-shift basis. The rate of production of students remained as before.

25. Asst. Grad., Lorry Field to 0/10, 29 June 1940, in AAA

26. Grad., Material Division to 0/10, 4 June 1940, in AAA.

27. Asst. Grad., Lorry Field to 0/10, 15 June 1940, with in

receiving additional equipment, but no additional personnel.?

Only two weeks were devoted to training in A.F.C.E. maintenance. (See Appendix I for the course of instruction.) But about this time reports began to reach the office officials complaining that their graduates were inadequately prepared to do work on these instruments. This criticism was readily admitted by the school authorities. Only superior students, they agreed, could master the material in the time permitted; it would take the average student four weeks to become proficient. To correct this situation, barely 6 weeks after the reduction of the course to 16 weeks, it was increased to 18, the 7 week extension being devoted to further instruction on A.F.C.E.

Under this program the sixth to ninth weeks inclusive were devoted to A.F.C.E. (See Appendix II for breakdown of this phase of the course.) During the eighth and ninth weeks twenty-four hours were credited as "flying time." Although the bombardier maintenance men were not expected to fly in the normal course of his work, this feature was incorporated because it was felt that he should have a better appreciation of the importance of his work if he had such experience. The school officials desired to see the final flight a sort of examination in which the student would have to show his

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ability to adjust instruments in the air as well as on the ground. It was impossible to achieve such a goal because of the shortage of airplanes and flying personnel available at Lorry. In actual practice, only one-half of an eight-man class could fly at one time, with the result that only twelve hours were actually spent on the aerial instruction of a student. Efforts by Lorry officials to obtain seven additional airplanes to remedy this situation were unavailing.

It was likewise in the belief that maintenance men would profit from course material of the operation of back-seat instruments that a training film intended primarily for bombardiers, TF 1-377, "The Theory of Bombing," was introduced as part of the course on 8 December 1941.

A number of problems arising out of the rapid increase in the size of the Air Corps began to bother the Lorry officials in the summer of 1941. It was observed that the majority of men entering the course were recent graduates of the current course. In earlier years there would have been no objection to this; indeed it could have been desired. But with the demand for trained technicians becoming increasingly acute, such a practice seemed a waste of manpower, since few men were not assigned to duty or

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39. Ibid.
both air-ore and bombard (continued). The school recommended
action to end the practice, but there is no record of any having
been taken. 22

Yet another manifestation of the Air Corps' errors came in the
increasing number of men being sent to heavy without previous
experience in stock at work in tactical units. Recognizing that
their course was too short and limited in scope to turn a novice
into an expert, Major O. G. Perry, the Director of the Armament
Department, gave an order that thereafter the fact that the man was
not fully qualified was to be entered on the qualification card of
all rangers. 23

As the pace of expansion quickened, more and more tactical
units were sent on maneuvers, making it impossible for them to
spend their own for training. Soon they began to alter their
quotas to go unknown, and the result was a serious shortage of
students at Kelly looked as a likely possibility. Captain O. A.
Grossenb, Supervisor of Instruction at the school, proposed that
students be drawn directly from the basic training centers, but
this change was resisted by the higher authorities. 24 For the time
being, the school managed to continue close to capacity by allowing:

21 Ibid., 1/7.
22 Ibid., 1/4.
23 Ibid., 1/6.
24 Ibid., 1/5, 1/7.
recent graduates of a variety of technical courses—e.g., elec.
tronics, mechanics, instrument men—to enter on the same
basis as current graduates.35

Training Officers at Loury

The technical school at Loury for a number of years had been
training officers in bombardment maintenance, part of its course
for current officers.36 On 23 February 1939, while the Air Corps
was setting up its Reconversion Project, the Chief of the Air
Corps issued an order cancelling all future classes for officers
to that the personnel and facilities of the technical schools
might be devoted to training such greater numbers of enlisted
personnel.37 Loury Field records indicate that eight officers
were graduated from a bombardment maintenance course in September
1939 and three the following December.38

Training Aviators—Loury

After the issuance of orders to discontinue training of current
officers, a new problem became increasingly pressing: where
are the Air Corps to obtain the great number of current officers
required by its expansion project? The view that such body-somewhat

35. 0/A to C/A, 17 S. Cot., 1941, with 1st Ind., CCAC to C7,
36. Sec above, Opn. I.
37. 0/A to C/A, 28 Feb. 1939, in Loury, Aviamat Rep., Loury
38. Ibid., p. 71.
squadron should have an armament officer assigned to it was gaining general acceptance. It was undesirable to reverse the order of the Chief of the Air Corps because the demand for officers was now so great that none could be spared for further training. There were considerable numbers of men, however, who had been eliminated from flying schools who, it was believed, could be profitably trained to become armament officers and commissioned second lieutenants. The Chief of Training and Operations of the Office of the Chief of the Air Corps directed the Lowry school authorities to submit an outline for a course of training for such cadets.

In complying with this order in November 1940, Major Lawrence L. Lawson was faced with the question whether to include instruction in bombsight maintenance. It seemed clear that cadets destined for service with bombardment groups ought to receive such instruction, but whether all armament officers should be so trained was debatable. Major Lawson suggested two possible programs. One called for a basic 16-week course, containing no work on bombsights; 25 per cent of the graduates of this course—the men expected to be assigned to bombardment squadrons—would then be given an additional 16 to 19 weeks' training in bombsight maintenance. The second plan proposed that

39. ENG, TSO to Inspector, 18 June 1941, in ibid.
25 per cent of the enlisted cadets arriving at Loury be given a
3.6-week course devoted entirely to boiler maintenance; no instruction
in aural or manual work could be given then.49

The first of the program was launched on 3 March 1941 and every 7 weeks thereafter, 39 (to on mid-
summer 53 June) aviation cadets began a 14-week course in boiler;
upon completion of it, 3 of the cadets entered an aural boiler main-
tenance course lasting 13 weeks. In the absence of a syllabus, it
is reasonable to assume that the Loury officials carried out their
original intention of using a curriculum for the course that was
almost identical with the enlisted men's course, with course added
features for the discontinued officers' course.41

Training by the Jordan oil Security Command

Soon after the initiation of the Boilertaining Program, the
Office of the Chief of the Air Corps, to enable the work of its
technical school at Loury, began to make use of the training services
of the Jordan oil Security Command. The matter of men so trained
was not large, but this type of instruction was of great significance
because it was offered in every echelon of boiler maintenance.

49. A. G. Comdt., Enry Field to Lt. Col. Froy, 70 Nov. 1940, in
AAG BG 9A, Bureau, Miscellaneous Training History, Armament
51. Sd. Hist., Chemist Field to 142, 1 Dec. 1941, 712 FB 32,
Froy, Miscellaneous Training.
The two manufacturing companies had long made it a practice
to give instruction in the maintenance and repair of their products
to the employees of firms buying them. Occasionally, they sent
field representatives to their customers' factories; more often
they invited the customers to send their employees to courses
held in their own factories. Normally, at least, there was no
charge for such services.

Then the armed services contracted for large quantities of
Horden and Scotty products, the two firms began extending these
services to the Army and Navy. This development could scarcely
have occurred after the inauguration of the conversion program. When the
Scotty company introduced its O-1 boiler in 1926, it sent a
representative to Horden Field to give instruction in its design,
construction, operation, and maintenance to the personnel of the
school there. In the spring of 1929 a Horden representative paid
visits to Wright, Langley, and Pictou-Beaconsfields. During his five-
day stay at Pictou-Beaconsfield, the Horden representative held classes as
follows:

Monday—8 hours on A.F.C.C. for maintenance men and
controllers
Tuesday—8 hours on A.F.C.C. for maintenance men and
controllers
Wednesday—8 hours on A.F.C.C. and A.F.C.C. for officers
Thursday—8 hours 'how to' on boilers for mechanics
Friday—8 hours 'how to' on boilers for mechanics

10. 3rd Ind., Chief, Material Division, Wright Field, to 0/90,
11 Aug. 1929, in A.O. 233.6-1A, Air-Outlet Training.
11. Carl L. Horden, Inc., to Chief, Material Division, 27 Aug. 1929,
in H.A.D. It was his visit to Pictou-Beaconsfield. It will be recalled,
that evoked the storm of discussion about the 'cause of the low-
to-bit' at courses.
12. Ibid.
More extensive and regular use was made of the factory courses offered by the bombsight firms. Late in 1939 the Materiel Division asked the Sperry Company to offer a course for Air Corps personnel at its Brooklyn plant. It suggested four weeks as a desirable length. On 8 January 1940 the Sperry people not only indicated their willingness, but proposed a number of details. The course should be opened to three types of personnel: (a) civil foremen of depot repair units; (b) military personnel from an air base or shop; and (c) instructors from Air Corps technical schools who were teaching or would be willing to teach bombsight maintenance. This instruction ought to be conducted on two levels: (1) for depot men and air base personnel, the practical aspects of construction, assembly, and overhaul—roughly third and fourth echelon maintenance—should be covered; (2) for instructors, the operation and inspection of the bombsight, field maintenance, and trouble-shooting—roughly first and second echelon maintenance—should be stressed. The Sperry officials were prepared to begin the course the following 15 April. They insisted that four weeks was much too short for such a course; six weeks was an absolute minimum.45

The firm's proposals met the approval of the Office of the Chief of the Air Corps. On 19 January it informed the GHQ Air Force, Langley Field, and the Commanding Officer, Lowry Field,

45. Sperry Gyroscope Co. to Materiel Division, 8 Jan, 1940, in ibid.
that they should recommend students to attend a six-week course 
at the Sperry factory beginning 15 April. Insert your to provide 
military personnel from air bases and ships, and Navy to assign 
the instructors from the bombard maintenance course. 

3. At the time of the plan, the Material Division was authorized to send civilian 
personnel from depot repair units.

About the same time, the Air Corps was negotiating with the 
Norden company for a third and fourth echelon maintenance course 
at its factory. Here the problem was complicated by the fact that, 
like the Norden bombsight itself, arrangements for instruction in 
its maintenance had to be handled through the Civilian Bureau of Ordnance. 

Then approached by the Material Division through this devious channel, 
the Norden people showed themselves as eager to cooperate as the 
Sperry company. Carl L. Jordan, head of the firm, "personally 
stressed" the "urgent necessity" of training both civilian and 
military personnel in the maintenance of the bombsight manufactured 
by his company. His recommendations corresponded closely with those 
offered by the Sperry officials: a course for civilian depot mechanics, 
enlisted air base personnel, and technical school instructors.

Accordingly, the Office of the Chief of Air Corps arranged with the 
Army for thirteen officers and enlisted men to attend a Norden factory
course beginning early in June. This time we selected so that the course
that be attended by many of the men who were to attend the
April course at Sorey, since it was felt that Air Corps personnel
should be equally familiar with both types of equipment. 49

The course at the Sorey Factory began, as scheduled, on 16 April.
Attendance were twenty students—the reasons under the Sorey
people felt they could accommodate in the class. These included six
civilians (four from Air Corps units, one from Wright Field, one
from Lowell); ten enlisted men from Bolling Air Base; one enlisted
instructor from the school at Bolling. 50 On the whole, this class
made a creditable record—an average grade of 66. As a group, the
fourteen enlisted men did somewhat better than the six civilians, hold-
ing an average grade of 69.17. 51 At the conclusion of the course
five of the enlisted men were ordered to report to the course start-
ing at the Horden Factory a few days later. 52

More difficulty was encountered in the administration of the
Horden course. The trouble grew out of the failure of the Air Corps,
the Navy, and the company officials, in making arrangements for it,
to reach an understanding about its length. When the Field Service

49. MS, Field Service Section to Chief, Engineering Section, 29 Feb.
1940, in ibid.
50. Administrative Director, CMA to Sorey Gyroscope Co., 6 and 8
March 1940; Sorey Gyroscope Co. to Material Division, 23 March
1940, in ibid.
52. Secretary of War to CO, Bolling Air Base, 7 May 1940, in ibid.
Section of the Material Division had crooked the idea of course to the London people, they had envisioned six weeks as the desirable duration. The London officials protested that this was not long enough, that a course so short would only prepare trainees to destroy the sight they were supposed to maintain. Four or five months, they insisted, was an absolute minimum, with nine months the desirable length. The London course consisted of three months at the London factory, followed by a month of work at the Naval Proving Ground, Dray ton, Virginia. They reported that the Air Corps followed a like procedure, with a fourth month spent at an Army school.\(^2\)

To emphasize the necessity existing in the Air Corps for thorough training, the London company forwarded a report made by one of its field representatives who had recently returned from a visit to London Field. "The equipment of the Second Equipment Group," he reported, "was in very good condition, and the Group had been well trained, efficient men. The Equipment Group which was recently transferred to Florida for station had their equipment in a deplorable condition." The condition of the equipment of the other Equipment Group at London was "miserable.\(^3\) It was just a few days before this

\(^2\) Chief, Navy Bureau of Ordnance, to 0/48, 23 April 1940; Cdr. B. Serrella of Carl T. Morris, Inc., to Lt. D. H. Kilpatrick, Naval Ordnance Center, 17 May 1940, in file.

\(^3\) Op. cit. for Chief, Material Division by Chief, Experimental Section, Material Division, 31 May 1940, in file.
that the same Norden representative reported that "words would not describe the conditions" he found at Barksdale Field. 54

In spite of this appeal, the Air Corps made no move to lengthen the Norden factory course. The result was that soon after the course began on 5 June a crisis developed. The situation was well described by Technical Sergeant Jack H. Hobbs, on detached service from Barksdale Field, in a report to his superior officer. When the Norden officials learned that the Air Corps was planning to insist on the six-week length, he wrote, "they gave up, and now refuse to give us any sort of rating on the grounds that it will be impossible to make bombsight mechanics in that length of time."

Sergeant Hobbs himself had become convinced of the correctness of the Norden people's position.

I don't believe I can learn all I'd like to know about bombsights in six weeks [he went on]. Everyone ... think[ed] the same. In fact, the general superintendent told us that about all he knew to get over in that time was to "leave them alone." Incidentally, they seem to think that our overhaul docks and the school at Fort [a word illegible] are pretty bad, and after seeing the setup here, I'm inclined to agree with them. 55

This letter apparently stirred the Office of the Chief of the Air Corps to action. A conference was held with representatives of the Navy Department, at

which - decision was reached to lengthen the course to four months. After that, instruction at the Jordan Factory followed a more even tenor.60

From this time forward, training at the Jordan Factory, like training at the Currae plant, went through a regular pattern of the Air Corps, technical training program. However, difficulties continued to be encountered in setting up the course. Even while the idea of the Air Corps sending air crews to the Jordan Factory was first discussed, the Navy had indicated that it was willing that the Navy establish a continuing program with alternate classes for the two services.61 But it was not until the first Jordan course was three-quarters finished that the Air Corps gave serious consideration to the question of whether there should be substitute ones. On 19 September 1940 the Chief of the Air Corps wrote to the Chief of the Navy Bureau of Ordnance that the Air Corps be permitted to send its students to the next ordnance class to be given at the plant, and one from the school at Bassy, and expressed the hope that the class would start "as early as possible."62 The Navy, however, was willing to allow the Air Corps an allotment of only ten.63 Two officers from tactical units

60. 3rd Ind., 0/20 to 02, NCO, Infantry Field, 9 July 1917, in ibid.
62. 0/AC to Chief, Navy Bureau of Ordnance, 19 Sept. 1940, in AAF 42-39-12, School at Bassy.
63. Chief, Navy Bureau of Ordnance to C/AC, 15 Sept. 1940, in ibid.
and right from the start were noted to the class that began on 1 Novemr 1949, 69.

The Sperry school had been in use by the Air Corps only a few months when it became the subject of several complaints and investigations. The first of these came in July 1949 as the result of the visit of Major Edgar T. Salzer, air base training officer at Schriever Field, to a class in instruments involved at the Sperry factory.

I found about twenty men undergoing instruction [as reported]. I was more or less struck with the presence of a lack of interest on the part of the students. I inquired from various students as to what they were out of the course. Their answers brought out that the instruction was poor, no assistance or advice was given them, and as far as they were concerned, they were just wasting time... I told certain that there instruction was sufficient to express an opinion on the course that they were taking.... This was the fifth week of the school, or the men... were not getting very far with repair and adjustment procedure due to lack of instruction. The men themselves had a desire to learn, but they seemed to be lost from the start, and naturally they were discouraged. In a whole, the school did not impress me at all. The scope of instruction was not in accordance with the Air Corps plans for the school. I felt that the Sperry company could do better. It sort of gave the idea that they were just wasting time and that it was really too bad. I could not help but get the impression that the school was not operating as it should. 61

We enlisted men were housed at the Brooklyn Air Base, and according to Major Salzer the conditions there were far from satisfactory.

to them. "The Brooklyn Zone, as we know, is very busy place,"
In that on; "since not enough attention can be given there.
Nevertheless this does not mean there can never be more
or mind."?

The electric which Major Selzer observed, it should be er-
chained, dealt with aircraft instructors, there are no course in
berd night maintenance in session at the Sperry plant at the time.
Nevertheless, it is responsible to ensure that approximately the
same conditions prevailed during both the instructors and berd-
night maintenance courses. At any rate, such a view appears to have
been shared by the Office of the Chief of the Air Corps, to the
the letter was referred through channels. The Chief, on 9 August
1929, directed the Commandant of the Air Corps Technical School
at Quantico Field to assume responsibility "for the coordination of
instructional matters relating to technical training, in cooperation
with the Air Corps Section" source at time at the Sperry factory.
He was also to be responsible "for the coordination of instructional
matters relating to technical training, in cooperation with the
Factory Inspector, Board of Ordnance, Army Department, at the
O. L. Ordnance Factory, and the coordination of Air Corps personnel

30. Ibid.
Get-able to pursue course of instruction at the "操纵nable at
school."  The Commandant was ordered to "write a report on con-
dition" at each of the schools.  By this act, the Office of the
Chief of the Air Corps placed responsibility for the training
schools in the hands of the rear officer who administered the
troubled course at Perry—the Commandant of Carnegie Field.

That the criticism Major Silver's role of the Supply School was
to get him to work in the report the Carnegie Field Command
order to the Chief of the Air Corps on 9 November 1949. Some of
the condition prevalent at the time of Major's visit, it de-
clared, counted to have been corrected. Classrooms and laborato-
ries were "sounder." But no schedule of progress on instruction similar
to those used in the Air Corps technical schools were followed. The
teaching method employed was criticized with particular severity
for it

Places the responsibility of success more on the student
than on the instructor. . . . [After a general lecture,]
the student was given a test on a price to work and
told to proceed. . . . Occasional lecture was given
to determine the progress of the student. This type
of instruction . . . [placed] the responsibility of
initiative and thinking on the student. . . . In the
opinion of the Air Corps Technical Schools.

Moreover, the teaching aboard included, only one instructor
tried on full-time duty. The report revealed Major Silver's claim
that the arrangements for curriculum and care were "unsatisfactory."

The Gurney monument recommendations were as follows: (1) there ought to be two full-time instructors at Gurney. (2) Gurney instructors ought to visit Ohsawa Field to learn the teaching methods practiced by Air Corps Technical School. (3) Air Corps technical school methods should be adopted at the Gurney school. (4) After completion of the present project, instruction in the subject ought to be given by the Air Corps technical schools.

The report on the Gurney school, which the Gurney Committee submitted at the same time, was enthusiastically favorable. "The class is divided into groups and receives instruction in the factory where work is being done and various units are installed," said the report. "A good instructor is placed with each group during its progress through each phase of instruction. ... Instruction proceeds to or of the highest type and invaluable to the Air Corps." The report continued: the course had a "high record" for the instruction and the students were receiving. There was a high morale, too, in this statement: "The authorities of the C. L. Power, Inc., and the Factory Inspector, Bureau of Ordinance,avy Department at ... cooperate with the students to the fullest extent possible, and relations are most ideal."

S. C. D., Ohsawa Field to G/Al, 15 Sept. 1943, in file.
As far as the housing and welfare of cadets attending the Jordan school were concerned, the report was equally approving. All cadets were on a rotation of rests and quarters status, which had proved "very satisfactory." Assignment might be even better if the men were placed on detached service from their organization while attending the course, and paid by check mailed directly to them in care of the Detachment Inspector of the New York Bureau of Ordnance stationed at the school.

A number of the recommendations that the Correnti made underscored his approval of the Jordan school: (1) Lieutenant William L. Travis of the Armament Department at Long Island should be detached to attend the next course at Jordan. (2) Armament instructors in the bomb and anti-aircraft course at Long Island should be given priority for attendance at the Jordan school. (3) "The effort [should] be made to continue this school until such time as the Air Corps was less dependent on front line anti-aircraft personnel."

Further confirmation of the Jordan course came from Captain Travis a few months later when, in accordance with the Correnti's recommendation, he was detached to the next class of the school. In writing to the Chief of the Training and Operations Division he declared that, because of the small student capacity of the school and its advanced level of instruction—third and fourth sections.

CS. Ibid.
In 1941, more care should be exercised in the selection of students to increase the school's usefulness to Air Corps. Only the following types of men, Captain Travis thought, ought to be detailed to ordnance: (1) rated mechanics concerned with aircraft service; (2) students who had had previous experience with ordnance instruments and A.M.E.; (3) experienced officers in charge of the aircraft ordnance of ordnance instruments and related ordnance; and (4) officers in charge of ordnance ordnance ordnance in an Air Corps technical maintenance school. There was, of course, nothing radical in this proposal. Most of its provisions were intended to be an effect already. Captain Travis' statement of the necessity for it, however, may have hindered its enforcement.

The Army and Air Force schools: we not much help in meeting the needs of the 125,000 men I was. During part of the war, it was in effect, the Army conducted the production of its own J-3A bomber and A-5 aircraft. A number of conversations were held between army officials and Air Corps authorities leading toward the inauguration of a new course starting about 1 May 1941, but as aircraft pilots were not available, plans were revised. During the early period, other cost of Air Corps on technical training at the training. Our clas-
Even then on 7 July 1941, a record the following took place.

Training center officials collected they would be willing to
transmit classes for on underground collected in a time.

Training and Operations, however, there is no authority for the
idea, holding that the instruction offered at least one alternate
for routine Air Force needs. Therefore, the Air Corps conducted
the 17th in accordance with the "for half of the route of each
class," or the war, during 1941. The order of the classes were again
directed by civilian leadership from the Secretary of the "interview
Corps" had collected personnel from the Air Force Cadet College,
the successor to the OCS, Air Force; to instructors from Air Corps
technical schools attended.39

39. See, Chief, Instruction Division to G/O, through S/O, 7 July
1941; S/O, C/O, 2 July 1942, in OHD file.
39. Army Enlisted Ordnance to G/O, 10 April 1941; S/O, C/O to
1941, in OHD file, dated 14 January.
Chapter III
THE TRAINING PROGRAM DURING THE WAR

When it was set up in September 1940, the 126,000-Man Program was expected to operate until April 1942. But in the early months of 1941 the course of the war in Europe and the continued aggressiveness of Japan in Asia made it increasingly clear that the United States could not escape even participation in the war. To meet the anticipated needs, new training programs for air crews and ground crews were adopted to go into effect on 3 November 1941. The ground crew program called for the training of technicians at the rate of 100,000 men a year, or twice as many as under the preceding program. The Acceleration of Training Program, as this was called, provided that one percent of the technicians, or 1,000 a year, should be bomb sight mechanics. 1

The schools had barely reconstituted their facilities to these requirements when war was forced on the United States on 7 December 1941. Almost overnight the training programs had to be sharply increased again. During 1942, it was planned, 200,000 technicians were to be produced, of whom 1.15 per cent, or 3,480, were to be bomb sight mechanics. 2 This meant nearly 300 graduates

2. C/AC to CG, AFIT/TO, 20 Dec. 1941, in ibid.
a month—a tremendous goal which the technical schools were not able to meet until November 1942. Even before this goal was attained, supplemental directives raised the production rate to 1,150 a year, or an average of almost 380 a month.3 Throughout 1943 the record was one of steady increases until July when an all-time high of 820 men were produced.4

The personnel trained in boondoggle maintenance following American entry into the war was of every type—enlisted men, aviation cadets, training to be combat officers, armament officers, Navy officers, and civilian employees, women as well as men. More schools were used and a greater variety of training was offered than ever before. At Lowry Field great numbers were trained in first and second echelon maintenance of sights and pilots. A course in the first and second echelon maintenance of the Honeywell C-1 pilot was taught at a school in Minneapolis conducted by the Minneapolis-Honeywell Regulator Co., subsequently in Indianapolis at the Ammunition Training Center, and later in Denver at Lowry Field. Aviation cadets were taught to supervise first and second echelon maintenance of sights and automatic pilots at Lowry and later at Yale University. Third and fourth

3. CG, ALF to CG, AUTFC, 8 Aug. 1942, in AG 355.9 D2, Training General; Report to Inspector General by Technical Training Liaison Section, ARMIT, 1 Oct. 1942, in ARMIT files.
echelon maintenance of flight and pilots was taught at the
Armament Training Center, at the factories of the Sperry and
Norden companies, and at Fort. And as in earlier periods,
considerable "on-the-job" training was conducted in tactical
units by military personnel and by representatives of the
manufacturing companies.

In this period, training was probably conducted more
efficiently than before. Now that the country was at war,
school officials were able to evaluate more accurately the
efficiency of their teaching through the practical test of how
well their graduates performed in theaters of combat. Un-
fortunately the reports reaching the schools were not always
consistent. In March 1943, Colonel John H. McCormick, just
back from an inspection trip to Northwest Africa, reported that
he found the men there needed "further instruction in field
maintenance" of bombsights. 5 Early a month later a study based
on interviews with officers returning from a number of combat
theaters indicated that the maintenance of bombsights was not
proving to be as much of a problem in war zones as it was in
the training schools, and this in spite of the row-her headline
the instruments received overseas. 6 Late in August, Colonel

5. C9, AFT to C6, AAE-92, 30 March 1943, in AAG 253, 8, Miscellaneous Training.
6. C9, AFT to C6, AABT3, 8 May 1943, in AAG 452, 73, Bomb Sights.
Travis, returning from an inspection trip to the Southwest Pacific theater, reported conditions which fell between the two extremes. Maintenance of equipment he found "fairly satisfactory," although the omission of preflight inspection often seriously affected the accuracy of bombing.\(^7\)

**First and Second echelon Maintenance Training for Enlisted Men at Lowry**

In less than a week after Pearl Harbor the Lowry school authorities had revised their first and second echelon course for enlisted men to meet the greatly increased demands imposed by the war. This was accomplished by putting the school on a six-day week, two-shift basis, with a new course starting every three weeks. The normal class was increased to 110 members. The length of the course remained twelve weeks.\(^8\) During 1942 the course was modified further in order to meet the desire of Headquarters, AAF that an average of at least 300 mechanics be trained each month. In August 1942, 463 men entered the school; and every month thereafter with few exceptions, well over 300 men were graduated.\(^9\)

No important changes were made in the curriculum until the summer of 1943. At that time production on the new Sterry S-1 and the A-5 automatic pilot was well under way; plans were

\(^7\) Data for AG/AS, Training by Col. W. L. Travis, 2 Aug. 1943, in file of AG/AS, Training.

\(^8\) CNO, ADMN to CG, Entry Field, 10 Dec. 1941, in AG 333.11, Lowry.

ultimately to install them on 50 per cent of all new bombardment
planes. To be forewarned for the expected second, a new twelve-
week course covering the Sperry instruments was inaugurated on
20 July.\(^\text{10}\) Men reporting to Lowry were divided between the two
courses so that in September the ratio of Norden graduates to
Sperry was 2 to 3, in December, 7 to 3, in February 1943, 6 to
4, and in March and thereafter, 5 to 5.\(^\text{11}\)

The prospect of wide use of the Sperry sight and the belief
that bombardment schools were not geared at such a
high production rate that there might be a surplus by the end
of the year caused Headquarters, AAF to make a drastic reversal
of policy in the spring of 1943.\(^\text{12}\) To avoid "over-specialization,"
it directed the Technical Air Training Command to train every
maintenance men to service both types of sights. This could
be accomplished if the practical work to be done by the students
were greatly increased.\(^\text{13}\)

In putting this directive into practice, however, the
and
Training Command's Lowry officials realized it so that they
could provide training for both first and second echelon main-
tenance men and depot overhaul men. Under this plan, half of

\(^{10}\) CG, AATTC to GG, AAF, 25 July 1943, in AAF 333, 11, Lowry Field.
\(^{11}\) CG, AAF (by Col. L. S. Smith, AFR) to GG, AAFTR, 3 Sept.
1943, and 1st Ind., No., AATTC to GG, AAF, 19 Sept. 1943,
in files of AG/AS, Training.
1943, 27 Feb. 1943, 4 March 1943, in AAF 321, Mecherier,
Miscellaneous.
\(^{13}\) CG, AAF to GG, AATTC, 11 May 1943, in AAF 333, Mechanics.
every group entering the bordright school took a Norden first and second echelon course, the other half a Sperry first and second echelon course. At the end of ten weeks the students in both groups were screened. The half of the Norden group which demonstrated particular aptitude was then given eight additional weeks of Norden third and fourth echelon training, becoming qualified Norden E-4 combat service men. The half of the Sperry group with unusual aptitude was given eight weeks of advanced Sperry training to qualify them as Sperry E-4 combat service men. The remaining half of the Norden group was then given ten weeks of Sperry first and second echelon maintenance training; the remaining half of the Sperry group was given Norden first and second echelon maintenance training, thus producing men qualified in the maintenance of both rights.  

A scarcely less important modification in the education given Sperry first and second echelon maintenance men was the inauguration of an "on-the-job" training program following their graduation from the course. The need for practical experience before assignment to tactical units had become apparent as early as May 1943, when recruits were first admitted to the bordright maintenance course.  

For a time, however, the situation did not become serious, as sufficient numbers of experienced personnel

15. See above, p. 10.
were available to act in supervisory capacities in tactical organizations. But with the shakedown of many organizations overseas and the activation of many additional ones, the shortages grew steadily worse.

"Only in June 1942 the Directorate of Bombardment in Headquarters, AAF submitted two plans designed to correct the situation. One proposed that the Loyd course be extended four weeks to allow students to work in the bombardment sections of bombardier schools. Not until the men had thus proved their ability to perform all the duties normally performed by bombardment maintenance personnel would they be assigned to tactical units. Although the bombardier schools were under the jurisdiction of the Flying Training Command, the men would remain under the supervision of the Technical Training Command until their assignment. The alternate plan looked to the same objectives, but with a different arrangement for supervision of the students during the period of "on-the-job" training. Upon graduation from the course at Loyd, according to this proposal, the men were to be assigned to tactical units. But before resuming duties at their permanent posts, they were to be sent on four weeks' detached service at bombardier schools, during which period they were to be supervised by the Flying Training Command."16

16. WP, ARDB to ATRIT, 8 June 1942, in AAF 53.9-1A, Bombardment Training.
The difficulty of deciding who should operate the plans during the "as-the-job" training period led to the belief that the shortage of mechanics was not yet acute enough to warrant an acceleration of the course, temporarily deterred Headquarters, AAF from taking any step at the time.\textsuperscript{17} 

But as time went on, the need for "as-the-job" training grew ever greater. This was essential not only during the next year by responsible AAF authorities. In August 1942, for example, a board of officers was asked to review and recommend the technical training program. The board of such an innovation on the model that the period of training of one year at such schools will furnish... products with more practical experience in situations of combat than they could ordinarily obtain in six months at the average over-technical training unit.\textsuperscript{18} 

Air in June 1942 the Assistant Chief of Staff, Training issued a plan to the Technical Training Command calling for a period of eight week "as-the-job" training in bomber school. This called for adoption of the plan successfully, over an eighteen-week period, to lessen the problem of administration for the Flying Training Command. The Flying Training Command was to supervise the training of men while...

\textsuperscript{17} Air, ARM to ARM, 19 June 1942: ARM to AAF, 29 June 1942, in this.

\textsuperscript{18} Air, ARM to AAF, 31 Aug to ARM, 21 Sept, 1942, in files of AAF/AS, Training.
they were at the border school. 10

Realization of the long-discussed change was undoubtedly accelerated by the consolidation of the Flying Training Command and the Technical Training Command into the Training Command in July 1943. Beginning early in September 1943 five-hundred technicians, won their graduation from the course, were assigned to one of three border school for eight weeks' practical experience. From the statistics cumulation of this period, they were ordered to an air force or returned to a tactical unit. 19

First and Second School Maintenance Training for Aviation Cadets and Officers at Lawry and Yale

Under the stress of war the border maintenance course for aviation cadets at Lawry was greatly accelerated. The work previously done in sixteen weeks was given in twelve after 5 January 1943. A new class was entered every four weeks, or previously, cut the size was raised from eight to sixteen. As before, all students were drawn from recent graduates of the aviation course for aviation cadets. 21 Early in January 1943, then all technical courses for aviation cadets were moved to Y-19 University, cadet and instructor personnel were moved from

10. See a draft of letter, 10/18, "border" to 03, ADM 73, 7 June 1943, in file.
19. 09, AD (transferred in 09/43, Infantry) to 03, ADM 96, 09 Aug., 1943, in file.
21. 09, ADM 73 to Cor dt., Lawry Field, 10 Dec., 1943, in ADM 355.11, Lawry; 1st Ind., No. Lawry Field to 09, AD, 7 June 1943, in file of 10/13, Trained.
Error to New Haven, Connecticut. No important changes in the course of instruction were made at that time.

During the spring of 1943, however, headquarters, AAF concluded that to facilitate assignment of officers and to conform to recent tables of organization, the category of maintenance officer should be eliminated. Therefore, current officers, in addition to their present duties, should be made responsible for 2nd Line Maintenance as well as maintenance on cover turret. As of May 1, 1943, AAF ordered the Technical Training Command to shorten the current course for officers to include three weeks on local line maintenance, making the transition as rapid as possible, but gradually enough to produce a even flow of graduates. In late May, it reverted to the policy it had followed before the start of the conversion program of giving its current officers training in all phases of current.

Under the new consolidated program the number of weeks devoted to local line maintenance was reduced from six to five. In 150 hours—six hours a day, six days a week—the course covered Principles of operation and use of the cover turret in conjunction with the automatic pilot and its relationship to flight and operation of the airplane. Maintenance and serial adjustment of the automatic pilot.

Cf. Sec 2 for AO, Enlisted Men, 16th and 31st, 1 May 1943, in 1942.
Cf. AO, AAF to AO, ASC, 133, 1 May 1943, in AAF 702, Armament Training.
Performance of the 90-hour, 90-hour, 90-hour, and 90-hour inspection and
maintenance on Bendix, Honeywell and Sparling equipment. Security, handling and storage of torpedoes.²⁴

Broke down into groups, the first week covered the theory
of torpedoes; the second week to torpedoes at 90; the third
week to sparling 6-1 torpedoes; the fourth week to Honeywell
0-1 automatic pilot; and the fifth week to sparling 6-1 automatic
pilot.²⁵

And there was considerable delay in getting out the details
for the revised course as indicated by Colonel Travis, then of
Headquarters, AAF, who visited Fort Meade in October 1943. He
found that project sheets for students and instructors were still
in the formative stage. His five-day inspection convinced him,
however, that the effectiveness of the teaching in the course was
very good; that the training was "superb," that the students were "superbly excellent,"
and the instructors enthusiastic; and "quite different." He noted the
need for more air cadets.²⁶

A new method and techniques in teaching were developed, the
AF found it necessary to depart more and more frequently from
the dicta laid down by the Office of the Chief of the Air Corps
in November 1942 that officers no longer be trained in torpedoes.

²⁵ For AG/18, Training by Col. W. L. Irwin, 3 Oct. 1943,
in ibid.
²⁶ Ibid.
maintenance at technical schools. As facilities were devoted exclusively to the training of officers and enlisted airmen, it was possible to establish short special courses for officers there on the occasion. In the summer of 1943, for example, a series of four-week courses was conducted to teach maintenance methods to officers unfamiliar with ordnance equipment. The officers attending were drawn primarily from the Flying Training Co., and the Second Air Force.27

First and Second echelon training on H-31 in the Republic-Herringwell school and training center

Instruction on first and second echelon maintenance of the C-47 transport pilot, can only referred to as A.A.F.L., had its feature of the course in London instruments of Jowett-Weld, but during the period of rapid expansion following Pearl Harbor, the course of corrective training--enlisted control and antis--civilians--who could maintain flight control and equipment although not necessarily the instrument control of Jowett. To meet this need, the AW later overrode with the General Electric Company, manufacturers of C-47 engines, to give a course in their maintenance at first and second echelon levels.

The course at Republic-Herringwell was established through a letter contract on 24 May 1942, with the Army Air Forces Training Center.

Detachment No. one organized the following 57 June. Under this one
subcontract the company sold to track approximately
one hundred aircraft to 25 June 1945 for 618,000.

Costs included personnel, materials, tools, etc., fictitious,
and supplies were to be furnished by the company. Students were
housed in a dormitory of the University of Minnesota, and instruction
to be given at the University and the Still-Harderlin Airport,
Minnopolis. 23

The course lasted thirty-eight days and, at least, consisted of lectures, laboratory work, and observation of equip- 
during flight. (See Appendix 3 for syllabus followed.) Although
the enrollment at Minnopolis-Honeywell was never large—it
averaged somewhere less than 100—the student body was considerably
more varied in character than that at most technical schools.

Army officers and enlisted men, Navy officers, and civilians
studied side by side. Considerable numbers of officer instruc-
tors and enlisted men from the bomber and fighter tactical units of the Second and Fourth
Air Forces attended under control allotted by Headquarters, AAF. 24
The course at Minneapolis-Kenosha had been in operation but a few weeks when a number of criticisms on the way it was being conducted were submitted by Lieutenant Clark A. Frantor and Technical Sergeant Bradley J. Bennett, civilians in the course. The course, these men complained, was too theoretical; the instructors were too few and inadequate; there was a lamentable lack of cooperation between the teaching staff and the factory supervisors. The instruction suffered from insufficient teaching aides; only one section and one class were available to the school.

From the evidence now available, it is clear that these criticisms were just in part merited, although the fault was not always the college's. An official study of the course indicates that a considerable amount of time was spent on theoretical material. The first part of the course was taught by the lecture method, with one instructor in charge of as many as 50 or 60 men; during the laboratory part of the course the ratio of instructors to students varied between 1 to 5 1/2 and 1 to 7.

It was the responsibility of the AI to furnish aircraft to the
school, but no more than three were available at any time, and
the condition of those was so poor that they could not always be
used.31

Instruction between the Hinsdale-Honeywell people and the
AA was increased by the order of the Technical Training Command,
issued in October 1919, directing the elimination of all lecture-
and "theoretical" material, the extension of the use of laboratory
work, and raising the ratio of one instructor to eight
students.32 The company officials protested the application of
this directive to their school, and to no avail. Methods of in-
struction were modified to conform. In most cases it was

Another source of friction between the school authorities
and management was the manner in which students were
assigned to the course. After conversations with the company
officials, Captain Joseph C. Moore, commanding officer of the
detachment at Hinsdale, submitted a list of striking cases of
"obstinate". "In 50 of the cases," he explained, "the men had
no electrical experience in civil life. In some cases, too, the
men received extensive technical training in fields not rela-

31. History of A-10, Hinsdale-Honeywell Detachment C, 19,
32, 33.
32. For fuller discussion of this order and its effects on
training, see chapter 16, p. 92.
to A.I.C.O.S. were assigned to the course, "C.4." Headquarters, Technical Training Command, in a letter to Headquarters, A.I.C.O.S., reiterated that this constituted "inadequate technical training." 55

In view of the difficulties with the course, Army school officials on Headquarters of the Technical Training Command, Headquarters, A.I.C.O.S., were given the A.I.C.O.S. course to carry out and conduct it in conjunction with its ordnance training course. 56

Army officials stated that it has been severely handicapped in its instruction on A.I.C.O.S. by the lack of adequate equipment. 57

During that period of time, A.I.C.O.S. were transferred from "rescue," Honey-ill to Army, the situation could be remedied. 58

Once the Army officials were aware of the projected transfer, they instigated a vigorous attempt to insist that they continue an improved wedding between A.I.C.O.S. equipment and the ordnance training. According to Dr. Ronald Barton, Director of the ordnance division, the 0-1 automatic pilot "has direct connection with the high training center, but it is no more wrong to teach it to the ordnance officer than it would to teach the Sorry 3-1." A.I.C.O.S. involved electronics, while the taught at ill in another category. "Our experience has also shown that"

56. 1st Ind., 02, A.T.T.S. to 02, A.7, 10 Sept. 1947, in ind.
the realization that most senior personnel are often poor students in electronics. Some of the men trained in Vietnam equipment who attended our school have failed to retain anything in the school work. 27 Apparently Dr. Burton's current advice was invalid for training in air-to-air action.

The creation of transferring the school located near a city in December 1965, the officers of the flying training command submitted a report criticizing the Inveraray-Venitall Center for flying insufficient attention to technical maintenance and were at all to bombard and stabilizers. As informed of the charges, George B. Bacon, Director of the school, replied that the course had been recognized so that at least 70 percent of it dealt with technical maintenance. Furthermore, it had been impossible for the school to teach the technical maintenance of stabilizers because until recently those instruments had been classified as "confidential," and consequently, Inveraray-Venitall officials were not expected to know anything about them. In such a situation, one instrument had been labeled as "restricted." It could not be possible to offer some instruction on that. The school had no stabilizers, but felt that various other training material would serve for

27. For example, "Inveraray-Venitall Soldier Co., to Col. H. J. Smith, ATCS, 18 Oct. 1965, in file.

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Fair's Enterprise Institute, Benton said that on a recent visit to Luke Field he had learned that the instruction on the C-1 pilot training plane almost paralleled that which Faircolli- mont gave, although Fair lacked certain instructional materials that the corps possessed. In spite of the protests of the company officials, headquarters, AF decided to the advice of the Technical Training Board to order the course transferred from Faircolli-mont to the Air Training Center, Luke-ville, on 6 March 1943.

During the winter of 1942 the AF realized itself of the Faircolli-mont Company's offer to give a one-week "refresher" course on the C-1 pilots to instructors from all schools. The purpose of this was to prevent the instruction on recent scheduled improvements developed at the plant. Formally, ten men were selected to a class.

The Air Training Center had been conducting A.F.C.O.C. training on the third and fourth section maintenance level for one month under the guidance of the Air Service Command. Then

26. MACO-26 to 28, AAF, 6 March 1943, in I.A.S.
27. 02, MACO-22 to 23, AAF, 7 Jul. 1943, in AAF 252-2, Factory Training; C Technical Training Group Daily Diary, 7 July 1943, in AAF 252-9.
the course was held to Iraan, Texas on 3 March, the Technical Training Center moved control and the course was lowered to the first and second echelon level. The course was inactive in length, no new class starting in two months. Each class had 25 to 30 enlisted men, graduates of a Technical Training Center sinehale technical course, and 3 civilian Air Service Corp and employees. Occasionally, as at Hurricane-hurricane, 40 personnel were added. (See Air Service for course of instruction.)

Third and Fourth echelon "Maintenance at Advanced Training Center and Base"

A hybrid school, teaching all levels of maintenance to civilian personnel and enlisted men, and operated at various times by the Air Service Corps and the Technical Training Center, ran the Advanced Training Center at Iraan, Texas. The school was established in June 1945 by the Air Service Corps to meet the emergency need for trained civilian and military personnel to work in its centers. A corner on a warehouse, located in the State Fairgrounds in Iraan, was converted into classrooms, the latest type of order at installation, for the existence.

of representatives of the Sperry, Norden, and other companies obtained in drawing up courses.  

44. Key men from Air Service Command’s depot in all sections of the country were brought in on temporary duty to get the school started and to teach civilians and enlisted men earmarked to be instructors.  

45. When the Training Center was established, it was understood that the Technical Training Command would eventually assume responsibility for its operation. The Air Service Command kept putting off the transfer on the grounds that it desired to put the school in a "smooth-running" condition first.  

46. One factor in its reluctance to give up control undoubtedly was its desire to continue to send its civilian air depot personnel to the school, according to established policy the Technical Training Command trained only military personnel. The unfavorable comments on the quality of the training at the Center, made by representatives of the Sperry and Norden companies late in 1942, reinforced the claims of the Technical Training Command.  

47. Finally, representatives of the two commands reached agreement that the Technical Training Command’s policy would be modified to permit Air Service Command civilian employees to attend courses at the school.
er correspondence were made for the transfer to take effect 1 February 1953. Ultimately, it was desired, the trainees eligible of the Center were to be sent to another station of the Technical Training Command so that the Air Service Command might have additional space for storage and maintenance of equipment.

Three courses in subjects relating to equipment were offered at the Airman Training Center: a course in A.T.C.M. management, for both civilian personnel and enlisted men; a course in Jorn 8-1 overhaul maintenance for enlisted men; and a course in Unit IV aerial bomb sight maintenance for enlisted men. All were on third and fourth schelon level, although the course in A.T.C.M. was subsequently reduced to first and second schelon level.

The A.T.C.M. course was begun first in August 1953. At the outset, there was a great deal of variation in the size of the class and the length of the course of instruction. Some classes lasted 6 weeks, others 9; some classes had as many as 50 entrants, others as few as 30; some classes were made up of both civilian and military personnel, others civilians alone. After

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the Technical Training Command assumed responsibility for the school, the course was reduced to first and second echelon maintenance level.\textsuperscript{48}

The four-week Battery J-18 course was terminated on 3 March 1945 and a new course was begun every two weeks thereafter. The twelve students in each class were furnished by the Technical Training Command from the remnants of the first or second echelon course at LORRY. (See Appendix B for the course of instruction.)

A four-week course in Battery J-18 began on 10 March and every two weeks thereafter. Each class was composed of twelve enlisted men, remnant of the first and second echelon course at LORRY, who were furnished by the Technical Training Command. (See Appendix B for the course of instruction.)

The quality of the instruction offered at the Armament Training Center, as instructor of the office of the Assistant Chief of Air Staff, Irvinia reported, was "excellent." Instructors at the school stressed the importance of their brothers at other technical schools that the students being sent there were not sufficiently well prepared in "fundamentals" to take full advantage of the informal training offered there.\textsuperscript{49}

\textsuperscript{48} See clause, Para. III, First and Second Echelon "Instructor on A.T.T.C. at First and Second Echelon Armament Training Center.

\textsuperscript{49} Para 40 for 3/23, training by Col. L. O. Brum, 19 May 1945, in file of 30/23, training.
The Training Center had been under control of the Technical Training Command for twelve air weeks. The idea to discontinue it was arrived at. This was the result of the dissatisfaction of both the Air Service Command and the Technical Training Command with the current hybrid nature of the school. The Air Service Command felt that Aviation cadets were inferior to its own at the time in the instruction. The Technical Training Command found it difficult to cope with the confusion over such matters as customs, schedules, and transportation arising from the interest of two commanders in the school. To the satisfaction of both the Technical Training Command and the Air Service Command training at the Training Center was discontinued on 1 February 1923, precisely a year later, responsibility for the school was assumed by the Technical Training Command. The last group of students went to Indio, Calif., at the end of October 1922; thereafter students receiving instruction in 3rd and 4th scholastic semesters in weights and pilots were sent to Loyce to attend a newly established course.

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61. 08, AMB to 08, AEF, 18 Jan 1918, in AEF.
62. 08, AMB to 08, AEF, 1 Dec 1918, in AEF. AEF, Ammunition Train. Schools; Hill, W. R., Technical Training Division, 10 Oct 1922, in AMF File. For information about the new course at Loyce, see above, Para. III, First and Second Scholastic Maintenance Training for 2nd and 4th at Loyce.
Third and Fourth Aircraft Maintenance at Smyrna and London

After Pearl Harbor the factory schools of the Smyrna and London commanders taught third and fourth echelon technical maintenance to larger numbers often than ever before, but responsibility for their administration became divided and correspondingly confused. In May 1942 the Technical Training
Command was given jurisdiction over both the following
Aircraft training personnel attending the two schools were
the charge of the AAF Technical Training Command located
at the Smyrna Factory. As of June, 1942, the AAF allotted
the capacity for both schools.

Then the United States formally entered the war, the Smyrna
S-1 plant and the A-5 plant were put coming into general use.
The Air Service Command arranged that the civilian workers
at its depots receive training in the overhaul of the new instru-
cements. To meet its demand, Underwriters, AAF arranged with the
Smyrna Factory to start two courses at its factory, one in S-1
overhaul, the other in A-5 overhaul. The length of the courses
and the type of the classes varied. Some ran for only 12

13. 03, AAF to 03, ARDD, 9 July 1942, in AAF OIC-2, Factory
Schools.
14. 03, AAF to 03, ARDD, 10 Sept. 1942, in AAF OIC-201,
"irellence."
In October 1944 the Sequoyah County CCOB had a new course exclusively for military personnel. This was a twelve-week course covering both the 311-night and A-14 pilot training intended to prepare officers to serve as instructors in bomber pilot schools. About six men were included in each class. Strictly speaking, this was not on third or fourth selection entrance level, although it was considered that the course was at least in the mid, indeed, the only one to instruct of that course.  

Endowment, AIP had some difficulty in administering the courses at the Fordon Factory. When the United States entered the war the 'Fordon course' was then conducted in cooperation with

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57. Ross Kelley, Sequoyah Ordnance Co., to AFR, 19 May 1944, in AAF 388.9, Factory Training: 13, AFR to AFRCC, 13 May 1944, in AAF 388.9, Factory Training: 12, AFRCC to CG, 16 May 1944, in AAF 388.9, Factory Training: 6, AFRCC to CG, 1st A, 1 Oct. 1944, in AAF 388.9, Factory Training.
the Navy, ordinarily only half of the places in a class of ten could be filled with officers and enlisted men of the AAF. Soon after Pearl Harbor, Navy officials approached Navy and Marine officials with proposals that they shorten their course, offer a wider variety of instruction, and allow larger numbers of both military and civilian personnel to attend. The Air Service Command was particularly anxious that additional trained mechanics become available, as a severe shortage of maintenance men was being felt in its depots.67 The Navy officials frowned on the notion of starting any additional courses, but agreed that beginning with the next class—the one starting 6 March 1941—the course should be reduced to three months and the allotment created in the AAF should be doubled to twenty men per class.68

Although in theory the Technical Training Command became responsible for the administration of the course, courses on this type,69 headquarters, NAVY, supervised the allotment of the twenty places in each class. For the class beginning 1 September 1940, for example, allotments were made as follows: 3 instructors

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67. G/AG to C/O, NAVY Bureau of Ordnance, 6 Feb. 1940, in AG 771.3 M1, Training General.
68. Letter for G/AG by C/O, NAVY Bureau of Ordnance, 18 Feb. 1940, in AG 771.3 M1, Training General.
69. G/AG, NAVY to G/AG, AAF, 7 Sep. 1940, in AG 771.3 M1, Training General.
To: Timer Field; & collect data from the first Order Group.

1. Collect data, and civilians from the Air Service Command.

The flight training program was also rated dislike for the instructors in the London area for prospective instructors.

Throughout 1926. Approximately, difficulties occasionally experienced by the various commands in filling the quotas allotted them, for there are no quota restrictions on personnel and the requirement that only personnel of the London and second echelon courses were available was noted to in almost all instances.

Late in 1926, the AAF made a concerted effort to remove the law to increase the training facilities at the London area. This was due to actual necessities that a four- to eight-week advanced course for instruction on old instructors to established, with twenty to thirty men in each course. All students would be transfer of the elementary course at London, and most of them would be used to satisfy the growing needs of the London personnel for instructors.

But the Bureau of Personnel of the Secretary of War had to meet each present. The instructor at the London plant was, in mind, that at a time with the

61. AFR to AFRF, 14 April 1926, in AFR CR 32, 2nd Army Training;
62. AFR to AFRF, 9 May 1926, in AFR CR 3, 2nd Army.
Army and navy were crying for more instructors, but use of skilled personnel and factory space for instructional purposes was unapproved. The difference in the type of training required by the Army and the Navy, the inspector noted, imposed a further penalty. The Navy urged the MF that it shortly intended to close down the ordnance school completely.

The MF protested that such a move would have a "deliberious effect" upon its personnel, especially the civilians of the Air Service Corps, who were just used to training. The situation was even more alarming, he reported, as recently been told for the MF to receive the major part of its ordnance instruction. Then it became clear that the Navy was not likely to alter its position, the MF proposed that it be permitted to administer a course of its own at the ordnance factories, "subject to the general supervision of the Joint Representative of the ordnance factory." It was necessary for the republication on the usual lines to adopt such a procedure would continue the interference with French operations, and insisted that training at the factory must come about.

22. C6, AEF to Chief, New Bureau of Ordnance, 1 Dec. 1917, in AEF.
23. C6, AEF to Chief, New Bureau of Ordnance, 15 Jan. 1918, in AEF.

THIS PAGE Declassified IAW EO12958
1 March 1943. 66 Before arranging for a course to replace that at the Norden Factory, Headquarters, NAF, convinced the commanders and air forces to learn the need for this type of training. The Air Service Command declared that sixty of its civilian employees needed such training. 67 The Flying Training Command indicated that it did not feel that third and fourth echelon maintenance training was necessary for its maintenance men, although it hoped it would continue to be available for civilian personnel working at sub-depots. 68 Ultimately, the problem was solved by the establishment, early in the spring of 1943, of a Norden third and fourth echelon phase in the course at Lowry. 69

**Footnote:**

During the calendar year 1943 production of bombsight maintenance mechanics declined sharply. An all-time high was reached during the month of July, when 822 men were graduated in all categories of bombsight maintenance training; during December only 297 were produced. The reason for this was that the NAF had about attained

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the limits of its expansion. By 1972, only replacements were required. The casualty rate of ground crew personnel such as weapons maintainers was declining.

Nonetheless, the training of weapons maintainers was continued to be a problem for the AF. For one thing, plans drawn up in early 1969 called for the installation of weapons control units on all light aircraft as well as heavy bombers. Aircraft were to be equipped with weapons control units in the same manner as if they were nuclear. For another, as the war progressed, new weapons equipment was installed for use in supporting and developing, requiring major modifications in the weapons and equipment. Two of these had occurred considerable importance by the beginning of 1970. They were the adoption of the "Slide East" and the abandonment of the "Factory Right" and pilot-controlled equipment.

The "Slide East" was an ingenious device used in connection with the "Factory Right" to control the flight of the bomb after it left the plane. Following its adoption late in the summer of 1968, Headquarters, USAF, directed the Training Command to incorporate instruction in this equipment in courses for both officers and enlisted personnel in November.71 This equipment.

72. Staff Diary, Inland Training Division, 10/13, Training, 12 Nov. 1969, in ADC Files.

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the extension of the first and second echelon course at forty-
year one-year, the third and fourth echelon course by the very.75
The present course for section officers at Yale was lengthened by
one week.76

In the fall of the development of 1967-68 at the train-
ning, an additional train-
ning. This was devoted to the recons-
ideration of the board of officers
that we of the Sppernight and pilot be discontinued by the
AIR.76 It required a few months after this for the recons-
ideration to be approved by AIR authorities, and even longer for the
delivery of the decision to be felt in the training program. In
the letter sent out of 1967, 50 per cent of the enlisted men receiving
instruction in basic and maintenance were being taught the Sppernight.
76 Orders were issued on 15 January 1967 that the entire
class continue in the following day were to receive " Odin
training. The course in first and second echelon -inter-
tions, to last sixteen weeks, one-third of the graduates were to
continue in a third and fourth echelon maintenance course of

75. Daily Diary, AIR, 21 Nov. 1967, in AIR files.
76. Daily Diary, AIR, 21 Nov. 1967, in AIR files.
77. Report of an Officer, board of officers indicated by OD,
AIR to consider one had been authorized their associated
section, OD, dated 21 Nov. 1967, in file of Amount
section, OD, 1967.
78. 61, AIR, to OD, Training, 15 Dec. 1967, in AIR files,
Odin-Odin training (draft only).
of this paragaph. The course for or-ganized officers at Yale
was to be altered more radically: the cadets were to be
"industrialized" with some rights and billets because these in-
struments would continue to be used by core AAP units for a
while. The time saved by reducing the thermal stress of Sorry
training was to be added to the period for formal instruction.\footnote{1st Ind., 03, 200 to 05, ALTRO, 18 Jan. 19\textsuperscript{th}, in ibid.}
Chapter IV

ADMINISTRATIVE PROBLEMS

Quantitatively, the strides the AAF made in the three and three-quarters years following the inauguration of the expansion programs were tremendous. It was estimated at the start of the expansion period that there were no more than seventy-five qualified bombsight mechanics in the Air Corps. By 31 December 1943 between 7,000 and 7,500 men—enlisted men, officers, and civilian employees of the Air Service Command—had received training and were presumably qualified to maintain bombsights.

Types of Schools and Their Problems

Most of these men were trained in courses run by the Technical Training Command, later the Training Command. The officers, either as aviation cadets or commissioned officers, underwent instruction at the school at Lowry Field and after January 1943, at Yale University; a very few took the courses conducted at the factories of the Sweety and Norden companies. The enlisted men attended courses at Lowry, and in a few cases the manufacturers' factory schools, the Armament Training Center, Indianapolis, and the school of the Minneapolis-Honeywell Regulator Company, Minneapolis. Most of the civilians were trained by their employer, the Air Service Command, at the Armament Training Center. In addition, considerable numbers of enlisted men were given

1. See above, Chap. II.
training in less formal ways, with the result that records of
their training are largely fugitive. In this group are men who
were given "on-the-job" training at the bombsight vaults of the
Air Service Command, at the bombardier schools of the old Flying
Training Command, and in the tactical units of the various air
forces.

Except during the period of greatest expansion, from 1940
through 1942, the general policy of the AAF was to concentrate
all bombsight and pilot maintenance training at Lowry Field, under
the direction of the Technical Training Command and its successor,
the Training Command. Courses were started at other centers during the three-
year period principally because the facilities at Lowry were so
overtaxed that they could not accommodate instruction on third
and fourth echelon maintenance, for which great demand had appeared.
As the production pace slackened, the advanced courses at other
centers were moved to Lowry.

The record of the experience of AAF training suggests that
this policy of concentration was probably well taken. Instruction
at Lowry has always been maintained at a fairly high and uniform
standard, while that at other schools varied from excellent to
very poor. The brief course of the Armament Training Center was
a chronic one because responsibility for its operation was divided
between the Technical Training Command and the Air Service Command.
The school conducted by the Minneapolis-Honeywell Regulator Company
was admitted to be less than a success by both company and AAF
officials; responsibility for this failure appears to lie princi-
pally with the AAF, which established the
school as a temporary expedient and never gave the company all
the cooperation it owed it. The schools at the Sperry and
Forden factories were more successful, especially the latter,
which achieved a notably fine record. Undoubtedly the AAF could
have exploited these schools even more profitably if it had
adopted a continuing program for their use rather than arranged
for only one class at a time. The circumstance that arrangements
for classes at the Forden School had to be made through the Navy
was a serious handicap. The AAF did miss an opportunity to
avoid much of this when it rejected overtures from the Forden
company to arrange a continuous schedule of classes for the
Army's exclusive use in 1941. The fact that neither the Sperry
nor Forden companies accepted payment for the training they gave
in reduced to some degree the control which the AAF could exert
over the subject matter and the way in which it was presented,
although officials of both companies apparently went out of their
way to cooperate completely. The schools at the factories
presented peculiar problems of military administration in respect
to rationing, housing, and giving military training to enlisted
personnel. The training detachment at the Minneapolis-Honeywell
school appears to have operated with better than average efficiency;
detach-
ments took care of the needs of the students at both
Sperry and Norden were at best makeshift affairs, with the inevitable indifferent results.

**Procurement and Employment of Instructors**

In conducting training in bomb sight maintenance, as in all technical training, the AAF had to cope with a perennial problem in procuring competent instructors and making the most advantageous use of them. The problem was most pressing in the AAF's own technical schools. The experience of the Lowry school was characteristic. Soon after the inauguration of the expansion program, a shortage in qualified instructors resulted. Instructors were required to teach long hours, and were denied such privileges as leaves and furloughs. By May 1940 their morale had slumped so low that Lieutenant Travis, in charge of the course, recommended that they all be given the rating of staff sergeant. Apparently no action was taken on his request. The morale situation was gradually improved as the most proficient men passing through the school were retained to augment the instructor corps.

After America's entrance into the war, the instructor problem became increasingly acute. Ever greater numbers of instructors were called into tactical units and sent to combat areas. Between 1 July 1942 and 17 January 1943, for example, eighty-three Lowry instructors left for assignments overseas to attend

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officer candidates and technical officer schools. During this period the student body increased almost 300 per cent, the ratio of instructors to students was raised to one to five, and material on the new Sperry gun was added to the course.

To meet the instructor shortage, Navy authorities had to depend on the most veteran limited-service men and men over forty—recent recruits from civilian life. Although these men were intelligent and eager, virtually none had any practical experience in the maintenance of bombsights. Moreover, in spite of a liberal use of these only partially satisfactory men, the growing student body created a shortage of fifty instructors by the middle of January 1943. It was estimated that the school could use an additional twenty-five every month to the end of 1943. The authorities were especially eager to obtain as replacements men who through service overseas had been rendered unfit for any but limited service. Headquarters, NAVY declined to grant blanket authority for the retention of large groups of students as instructors, but granted the school's request for specific numbers each month. The idea of using limited-service personnel returning from overseas harmonized with established Headquarters policy, but in practice very few men of this type were made available to the school.  

Like other schools of the Technical Training Command, Lowry was an effort to use civilian instructors during late 1942 and early 1943. A few of the sixty-six courses run by the Lowry Armament Department were assigned to teach basic armament. The school authorities did not consider these efforts successful, pointing out to the higher authorities that the comparatively low costs offered and the transportation difficulties involved in reaching the school discouraged the most suitable type of civilians from applying for teaching positions.  

As time went on, the tendency to replace the more experienced enlisted instructors with graduates of the school produced a serious problem at a school like Lowry. Men were teaching first to fourth echelon maintenance, who had never had any practical experience in tactical units; there was no longer a single instructor who was a qualified bombardier. In August 1943 the school authorities asked the Headquarters of the Training Command whether some sort of "on-the-job" training, similar to that being given to their graduates at the bombardier schools, might not be made available to their teaching staff. Accordingly approval was never granted by Headquarters, AAF.  

Training Methods

Like all other types of training conducted by the Technical Training Command, that in bomb sight maintenance was seriously affected by the instructional methods prescribed by Major General Walter R. Sever, Commanding General of the Technical Training Command, in the autumn of 1942. A series of inspections of the technical schools convinced General Sever that too much time was being spent on theory, lectures, and written examinations. Late in October he issued a directive ordering that lectures and written examinations be abolished; that the practice of having students sketch parts of the equipment being studied be discontinued; and that emphasis be placed on laboratory work, with the students becoming familiar with the equipment through handling it. 7

Evidence of the effect of this directive on bomb sight training is neither complete nor convincing. The most elaborate protest came from the Honeywell Regulator Company which was giving instruction on A.F.C.T. at the time. George H. Benton, director of the school, argued that certain fundamental theoretical material—which had to be given to the ill-prepared students being sent to the school—could be just as effectively presented to groups of 25 or 30 men as to the groups of 6 to 8 ordered by the October directive. 8 "Resistance among the civilian

instructors" at the Indianapolis Armament Training Center against the new teaching principles was reported by Colonel L. O. Ryan of Headquarters, AAF after an inspection trip in May 1943. Colonel Travis of Headquarters, AAF found that the "proficiency of the training was very low" on a visit to Lowry the following September. There is reason to believe that the new teaching methods met similar opposition at Lowry, Yele, and other AAF bombardment maintenance schools. At any rate, when the Technical Training Command was absorbed into the new Training Command in July 1943, all pretense of enforcing them was abandoned. But as Colonel Travis' comment indicates, the effects of the October order lingered on for some time afterwards.

**Teaching Equipment**

Bombardment maintenance training was handicapped by the inadequate number of instruments available to the schools. The records are scarce, but the pattern they suggest is a familiar one. In the autumn of 1939 the commanding officer of Lowry was complaining that although the Sperry 0-1 sight was the standard, his school was having to give instruction on the older N-1 for want of any of the latest type sights. Early in 1941 the course had to be "modified" for six weeks because of

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11. 3rd Trapper Ind., CO, Lowry Field to CO, Chanute Field, 5 Sept. 1939, in AG 363.9.-1A, Bombardment Training.
the lack of bombights and other instructional equipment.\textsuperscript{12} Again, late in 1942, conflict arose between the authorities at the factory school and the Lowry over a supply of Minneapolis-Honeywell automatic pilots.\textsuperscript{13} Apparently the shortage of bombights handicapped the bombardier schools even more than it did the technical schools, for a number of the former complained during 1943 that they were having to curtail the "on-the-job" training they were accustomed to give their maintenance men.\textsuperscript{14}

The scarcity of other teaching tools was a scarcely less troublesome handicap. This was the result of the circumstances that bombight instruments and all information about them were classified, and that the AAF had to obtain its Forden sights through the Navy. For a number of years the Army issued brief guides to the operation of the Sperry sight, but published none on the Forden, contenting itself with a cautious distribution of the Navy's Ordnance pamphlets Numbers 311 and 630. Ordinarily students were given access to these pamphlets only while in the classroom. Check lists and charts were issued in small quantities and were scarce around technical schools.\textsuperscript{15}

\textsuperscript{12} Lt Ind., School Eq., Lowry Field to Materiel Division, Wright Field, 16 Jan. 1941, in AG 353.9 A, Denver, Miscellaneous Training.

\textsuperscript{13} CG, AAFTRG to CG, AAF, 17 Nov. 1942, in AG 452.19, Auto Pilots, 1st CO, AAF Bombardier School, Midland, Texas, to CG, AD/SC, 7 May 1943, in AG 452.26, Bomb Sights; E&F, AC/AS, 1210 to AC/AS Training, 9 July 1943, in ibid; Report on Inspection of AAFTRG Schools by Col. T. S. Power, Air Inspector, 12 July 1943, in ATRG files.

\textsuperscript{14} History of Armament Dept., Lowry Field, Vol. 2, p. 125; R&E, Materiel Division to SG, 1 April 1941, in ATRG files.
Complaints against this situation were raised by the Inspector General of the AAF on a visit to Lowry during March 1941. He felt that the "confidential" label put on A.F.B.E. had been used by the school as an excuse to avoid instruction on client and adjustment. The only manual being used on the subject was the Program Enrichment, 380, nearly four years old, which was "outdated and inadequate." The Lowry officials acknowledged the justice of some of these criticisms, but protested they were doing their best to correct them. To correct some of the shortcomings, they suggested that a student of the course be permitted to take the notebook he kept on a student book with him to his home organization. If a student knew during the course that he would be permitted to retain his notebook, they argued, he would give more attention to its completion, thus increasing the amount of benefit he derived from the instruction. Under existing conditions, it was bright that maintenance products had nothing to which he could refer for figures or to derived tolerances, curvatures, and other necessary adjustments. Unwilling to rely on his memory, he hesitated to take the necessary chance in the notebook. Such

conduct led officers of tactical units to claim that the schools were giving their students inadequate training. The proposal was vetoed by the Office of the Chief of the Air Corps on the ground that literature on the subject was in preparation and would eventually be given adequate distribution. The situation did improve somewhat toward the end of 1941 and throughout 1942 as the literature was gradually made available. The training film, "Theory of Bombing," was added to the Lowry course just before Pearl Harbor, and subsequently became available to the other schools. Only inferentially was there any consideration of the work of bomb disposal; in its nineteen minutes' running time it described the theory of falling bodies and its application to practical bombing. The velocity of closing on moving targets, the effects of head, cross, and tail winds, and the establishment of collision courses were analyzed and explained.

It was not until December 1943 that any training films on the bomb disposal themselves were issued. At this time a series of ten well-produced films—five on the operation of the Loden sight, five on the Lowry sight—were made available by the Army Air Forces Training Films Laboratory at Wright Field. These were designed primarily for the training of bombardiers, with emphasis

18. E.E., Materiel Division to M.0, 1 April 1941, in ATCRED files.
19. Air Service Command, Army Air Forces Training Films and Film
Storage Catalog, Feb. 1943, p. 15.
placed upon the operation, rather than the maintenance of the sight. Nevertheless, as was true in flying experience, the information presented gave the bombsight maintenance man a better understanding of the nature and significance of his work. Beginning early in 1943 the technical schools made extensive and effective use of such pedagogical devices as "mock-ups" and "breadboards." The introduction of these into the classroom increased the laboratory nature of the teaching.

Training in Automatic Pilots

Training in the maintenance of automatic pilots became a peculiar administrative problem around 1940 and 1941. It grew out of two facts: (1) The Sperry A-1, A-2, A-3, and A-4 pilots, which were not connected with a bombsight, had been regarded by the Air Corps as aircraft instruments and their maintenance attended to by instrument mechanics. The Sperry A-5 pilot and the Minneapolis-Honeywell C-1 pilot, on the other hand, were

20. The films are as follows: TF 1-871, Norden Bombsight Principles; TF 1-872, Norden Operation; TF 1-873, Norden Preflight Inspection; TF 1-874, Norden Conduct of a Mission; TF 1-875, Norden Levelling System; TF 1-832, Theory of S-1 Bombsight; TF 1-833, S-1 Azimuth; TF 1-834, S-1 Operation; TF 1-835, S-1 Preflight Inspection; TF 1-836, S-1 Conduct of a Mission.
cater-rily—although not necessarily—used in connection with
a bombight. (2) The construction of the pilot was extremely
delicate. These facts worried two questions for the Air Corps:
Should the pilots be maintained by instrument or bombight
maintenance men? Should training in these subjects be given in
instrument schools or in a bombight maintenance course?

At the outset, a compromise arrangement was effected. In
circumstances which used the A-5 pilot without bombights, responsibility
for the maintenance of the pilot was to rest upon instrument
mechanics. In circumstances where the pilots were used with bomb-
ights, they were to be tended by crossers, or more ideally,
bombight maintenance men. Therefore, training in pilots was to
be offered both as part of the instrument course at Chanute
Field and as part of the bombight—maintenance course at Lowry
Field.21

As the C-1 pilot came into general use throughout the Air
Corps, instruction on it was offered at Lowry, Yale, and the
Armament Training Center and for a time at the Minneapolis—
Honeywell School. A suggestion made by the Technical Training
Command in April 1943 that Chanute set up a four-week course in
this pilot for graduates of its instrument course was vetoed by
Headquarters, AAF on the grounds that the C-1 was too intimately

connected with the bombardment to be a concern of instrument mechanics. A minority opinion of a sort was offered by the Office of the Material Division of Assistant Chief of Air Staff, Materiel, Maintenance, and Distribution, which insisted a few months later that the mechanics of the pilots and bombardiers were considerably different and 'experience has indicated that a good pilot mechanic does not necessarily do a good job on a bombardment mechanic.' The situation was muddied further by a directive that the Assistant Chief of Air Staff, Training, sent to the Training Command in October 1943 authorizing organizations using C-41 and A-5 pilots without bombardiers to send instrument mechanics to 'the bombardment mechanic course covering the automatic pilot.'

The diversity of opinion prevailing at Headquarters, AAF produced confusion in the air forces and commands. In the Flying Training Command and the Second Air Force, graduates of C-25's 'airplane and engine mechanic' course and the

22. CP, AUP-70 to AC/AS, Training, 29 April 1943, with endorsements in AC 52.19, Auto Pilots.
Amurin Training Center's G-1 pilot course were classified as bombright maintenance men during the summer of 1943 until the situation was brought to the attention of Headquarters, AAF and directives to correct it were issued.25

Bombrights as a Classified Subject

The fact that bombrights were long a classified subject provided Air Corps officials with an extremely difficult administrative problem. In order to check on the loyalty of every prospective student in bombright maintenance, a rule in effect in 1939 provided that he must "be a citizen of the United States of unquestioned loyalty, trustworthiness and reliability" who had served in the Army for at least three years. The statement of the commanding officer of the post at which he was stationed that he fulfilled this requirement was deemed sufficient proof.26

The revelation in July 1941 that a cadet bombright instructor had a felonious record so disturbed the Air Corps' Legal Division that it demanded immediate stiffening of the requirements.27 The Chief of the Air Corps responded with a new AAF Regulation No. 35-13 specifying that no person could be trained as a bombright or bombright maintence man until his application, together with a set of his fingerprints, had been submitted to

25. CG, AAF to CG, AAFEO, 29 July 1943, in AAG 532, Mechanics; CG, AAF to CG, 2nd AF, 10 Aug. 1943, in AAG 521, Mechanics, Miscellaneous.  
27. Ibid, Legal Division to CG, 15 Jul. 1941.
his office and approved. It was understood that the Chief of the Air Corps would have Military Intelligence check the candidate's record and fingerprints with the Federal Bureau of Investigation before granting this approval. Civilian personnel sent to schools had to be cleared by the Federal Bureau of Investigation.

In practice, this investigation of loyalty qualifications took a long time—so long that it became customary to wait at the letter of the regulation and allow students to start the course while their records were still under investigation. It was a common occurrence at the Lowry school for men to be permitted to reach the last two weeks of the course before being cleared. In one instance a student was removed when an unfavorable report was received the day before his graduation.

Various officers of Headquarters, AAF had suggestions as to how this situation might be remedied. The Assistant Chief of Air Staff, A-1 suggested in February 1943 that AAF Regulation No. 35-13 be rewritten to provide an "adequate period" for investigation of the prospective student's loyalty qualifications, while "experienced soldiers" should be excluded from the investigation.

The latter part of this proposal evolved.

28. Memo for AG by Chief of Air Staff (written at the direction of the Secretary of War), 21 July 1943; Acting AG/3, G-3 to Chief, AAF, 1 Aug. 1943, in ibid. (telegram).
29. Arnold to Chief, Field Service Section, AAF/AG, 14 May 1943, in ATFD files.
expressions of hearty dissent from the Assistant Chief of Air
Staff, A-3 and from the Director of Bombardment.

Colonel L. S. Smith, Director of Individual Training, had an
even more radical suggestion. Because of our losses of heavy
bombardment aircraft, he believed it was reasonable to assume that
some bombers had fallen into enemy hands. Thus, he thought, there was no longer any more need for investigating the loyalty
of men who maintained and operated bombers than there was for
investigating the loyalty of men who maintained and operated the
planes. He believed that the regulations should be rewritten so
that "no delay whatever will ensue due to investigation of
loyalty, that investigation proceed and that individuals suspected
of disloyalty as the result of investigation be relieved of all
duties concerned with maintenance of equipment wherever sabotage
could affect the war effort."32

AAF authorities were not yet ready to accept a suggestion
so novel as Colonel Smith's. The revision of AAF Regulation
No. 75-13 issued in April 1942 continued to require that an inve-
sigation be made into a prospective student's loyalty, but
prescribed a procedure designed to eliminate some of the delay
carried by the existing manner of investigations. A request for

32. WR, L.S.S. [Col. L. S. Smith, AFTET] to AFDDB, 17 March 1942,
in files of AG/AS, Training.
fingerprint investigation of an individual . . . will be submitted by his organization commander direct to the Federal Bureau of Investigation at least four weeks prior to the opening of the course of training to be pursued," this regulation stated. "A request for investigation will be accompanied by a completely executed copy of the candidate's fingerprint impressions on a standard United States Army Personal Identification fingerprint card together with the organization commander's certificate that the candidate possessed other loyalty and eligibility qualifications.

The Federal Bureau of Investigation will notify the organization commander direct concerning the candidate's fingerprint investigation. Notification thereof will be entered on the candidate's service record under 'Remarks Administrative,' and the notification will be filed with the service record. An individual suspected of disloyalty as a result of investigation will immediately be relieved of all duties wherein subversive activity could offset the war effort."

A few more months of struggle to administer this regulation convinced the War Department of the validity of the point of view expressed by Colonel Smith. Increasing numbers of bomb sights were falling into the hands of the enemy, it was realized; meanwhile the attempt to enforce the loyalty requirements was interfering more and more with the administration of the training program. Finally, on 13 November 1942 the Secretary of War directed that the commanding generals of the various air forces and commands would immediately cease to forward the prospective students' fingerprints to the Commanding General, AAF. Early in 1943 the classification of

33. AAF Reg. No. 35-13, April 1942.
34. Secretary of War to CG's, Defense Commands, Depots, and Service Commands, in files of AG/AS, Training.
bombights and literature relating to them was lowered to "restricted."\(^{35}\)

In June all references to a fingerprint investigation were removed from AAF Regulation No. 35-13.\(^ {35}\)

**Navy Control over the Norden Sight**

The circumstance that the Navy had had the foresight years before to obtain exclusive control over the production of the Norden bombight created a number of administrative problems. Some of these have already been mentioned. The sights used in AAF schools were obtained only after long negotiation with the Bureau of Ordnance of the Navy. Almost all literature about these instruments originated with the Navy. The valuable training offered at the Norden factory school was granted the AAF by the Navy on a quota basis.

Yet in an even more serious way the Navy's control of the Norden sight affected the conduct of training. To avoid dependence upon the Navy, the AAF persisted in using the Sperry S-1 sight long after its mechanical inferiority had become apparent. This in turn led the AAF, between 1939 and the start of 1944, to waste approximately one-half of its training in teaching personnel the maintenance of a type of sight which had virtually no combat use during World War II.

---

35. CG, AAF to CG, AAFSc, 3 June 1943, in AAF 45°26, Bomb Sights.
36. AAF Reg. No. 35-13, 3 June 1943.
In administering the training of bombsight maintenance men during World War II, the Army Air Forces encountered a host of problems made none the less difficult because the instrument it dealt with was a novel one in the history of warfare. The problems common to all technical training were handled in pretty much the same fashion with pretty much the same degree of success that prevailed in other fields of technical training. The problems peculiar to the bombsight itself were met as they arose rather than through the employment of planning and foresight. Judged by the numbers of men trained and their performance in combat, however, the program was successful even beyond the hopes of most IAF optimists.
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AR 61f-28, 15 September 1942
AR 625-6, 26 November 1942

Headquarters, Army Air Forces:

AAF Regulation No. 35-13, 24 June 1943
AAF Regulation No. 35-46, 11 December 1943
AAF Regulation No. 50-13, 2 February 1942; 10 September 1943

Headquarters, Air Force Combat Command:

Air Force Combat Command Memorandum No. 65-5, 13 October 1941

Headquarters, Air Service Command:

Army Air Forces Training Film and Film Strip Catalog, February 1943

Air Adjutant General Central Files

000-200 Miscellaneous

220.63 Technical Schools, Miscellaneous
220.66 B Factories
220.66 C Factories
221 Mechanics, Miscellaneous

352.11 Lowry Field
353 Armament Training
355 Bombardier Training; (Bombardment)
353 Mechanics
353.01 R Training Programs
353.0 C Miscellaneous Training
353.9 Factory Schools
353.9 Factory Training
353.9-1A Bombardier Training
353.9-1B Training General
353.9 A Denver, Miscellaneous Training
353.9 C2 Training, General
353.9 D Factory Training

THIS PAGE Declassified IAW EO12958
These Army Air Forces Central Files books were the most valuable materials for this study. The 353 files—particularly those dealing with Bomb-Sight Training and Factory Schools—were especially rich.

Command and Office Files

Office of the Assistant Chief of Air Staff, Material, Maintenance, and Distribution:
Armament Section, Material Division Files

Office of the Assistant Chief of Air Staff, Intelligence:
Historical Division Files

Office of the Assistant Chief of Air Staff, Training:
Armament and Photo-Recy Training Section, Individual Training Branch Files. These files are not very extensive, but contain recent material, much of it of primary importance.

Bureau of the Budget:
Administrative Management Files

Office of Management Control:
Statistical Control Division, monthly reports on "Training Status of Army Air Forces Personnel"

Miscellaneous

Books:

Special Studies:
Individual Training of Bombardiers. In Archives of AG/AS Intelligence, Historical Division.

"History of Armament Department, Lowry Field." In Archives of AG/AS Intelligence, Historical Division. As the bulk of bomb-sight maintenance training was conducted at Lowry, the record given here, while lacking definitiveness and being uncritical in many respects, is very valuable.
"History of Army Air Forces Training Detachment, Minneapolis-Honeywell Regulator Co." In Archives of AO/AS, Intelligence, Historical Division. A good, although incomplete, account of experience at this important factory school.

Training Films:

TF 1-832 Theory of S-1 Bombeight
TF 1-833 S-1 Azimuth
TF 1-834 S-1 Operation
TF 1-835 Preflight Operation
TF 1-836 Conduct of a Mission
TF 1-871 Norden Bombeight Principles
TF 1-872 Norden Operation
TF 1-873 Norden Preflight Inspection
TF 1-874 Norden Conduct of a Mission
TF 1-875 Norden Levelling System

These films were intended primarily for the instruction of bombardiers. However, they are shown to students in bombeight maintenance to give them an appreciation of the problems involved in the work for which they are being trained.

Interviews and conversations with:

Colonel V. L. Travis, formerly of the Ammunition and Photography Training Branch, Technical Training Division, AO/AS, Training.

Major W. S. Blalock, Bombardment Branch, Requirements Division, AO/AS, Operations, Commitments, and Requirements.

I. G. Boehm, Ammunition Section, Materiel Division, Assistant Chief of Air Staff, Materiel, Maintenance, and Distribution.

Major R. O. McDonald, Aircrew Training Division, Assistant Chief of Air Staff, Training.
Course of instruction at Lowry Field after 30 November 1949

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<td>Locomotive troubleshooting</td>
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Source: I.T. Ind., O. & T., Group Field in Charge of the Air
Appendix 2

AR 161-1. INSTRUCTION AT LODG.: LINDO,
JANUARY 1971


t-30 hour—Obtain general picture of serious and operation of "A.I.C. . Oliveira." (See summary in this.

3 hour—Operation of the flight gear and the creation of the flight.

2 hour—Operation of the operation and version of the Servo unit.

1 hour—Detailed study of the operation and version of the Servo unit.

2 hour—Detailed study of the operation and version of the Servo unit, connection with the Servo unit, and the version and operation of the precision meter.

-30 hour—Detailed study of the Servo unit, its purpose and operation.

3 hour—Operation of the relationship between the various units and the role each plays in controlling the control of the flight. (See summary in this.

3 hour—Detailed study of the various elements and maintenance of the Servo unit.

3 hour—Detailed study of the role of the Servo unit in the control of the control.

1 hour—Detailed study of the role and operation of the Servo unit.

1 hour—Training, adjustment and operation of the Servo unit in flight.

10 hour—Detailed study of the role of units, training, reconditioning and maintenance (10 hour instruction), reinstallation and adjustment.

1 hour—Training, adjustment and operation of the Servo unit in flight.

1 hour—Operation of the flight gear and the creation of the flight.

3 hour—Trouble-shooting, operation of the flight gear and the creation of the flight.

3 hour—Trouble-shooting (without tools).

3 hour—Trouble-shooting.

-30 hour—Trouble-shooting.

1 hour—Trouble-shooting: emphasis throughout the entire course, but 10 hours are devoted to this subject at the end of the course because of its importance.

Source: School No., Merry Hill to Cordt., Ocrucite Field,
Aircraft Maintenance Course
AFSC 44-A301-37

Chapter 6

1st. Day (conducted in the classroom and shop areas of the University of Mincinco, 20 hours)

Orientation test, instruction: a.c. and d.c. theory of lighting, fuses, relays, electrical circuits, voltage, current, resistance, ohms, power, etc. Study of a.c. and d.c. circuits, transformers, motors, alternators, generators, etc. Introduction to the shop areas of the University of Mincinco.

2nd. Day (conducted in the classroom and shop areas of the University of Mincinco, 20 hours)

Construction of circuit boards, experimentation, study of lighting, fuses, relays, electrical circuits, voltage, current, resistance, ohms, power, etc. Practical work with a.c. and d.c. circuits, transformers, motors, alternators, generators, etc. Introduction to the shop areas of the University of Mincinco.

3rd. Day (conducted at Wild-Oxenordheim Airport, 20 hours)

Ground instruction on electrical theory, principles of a.c. and d.c. circuits, voltage, current, resistance, ohms, power, etc. Practical work with a.c. and d.c. circuits, transformers, motors, alternators, generators, etc. Introduction to the shop areas of the University of Mincinco.

4th. Day (conducted at Wild-Oxenordheim Airport, 20 hours)

Work on vacuums, checking instruments, circuits, ohmmeters, voltmeters, ammeters, fuses, relays, transformers, etc. Practical work with a.c. and d.c. circuits, transformers, motors, alternators, generators, etc. Introduction to the shop areas of the University of Mincinco.

Final examination.

This Page Declassified IAW EO12958
A. Basic Fundamentals (1 hour)

1. Gears of flight
2. Flight instruments
3. Gage and indicator calibration
4. Electrical wiring (basic)
5. Electrical devices and instrument
6. Wire circuits
   a. rubber-and-screw terminals
7. Control of elevator
   a. turn box
   b. control box
8. Aileron
9. Actuators—throttle
10. Electric motors

B. Flight manual check on equipment (1 hour)

C. Maintenance of equipment (4 hours)

1. Disassembly of equipment
   a. stabilizer, directional
   b. undercarriage
   c. servo motor
   d. control box
   e. turn box
   f. control box

2. Maintenance and servicing—electrical
3. Maintenance—calibration

D. Trouble shooting on armament control board (1 hour)
1. Electrical
2. Mechanical

Source: Plotting freedom at A&t Training Center, Illinoi State, Ill., attached to letter of 09, AL to 83, ARS, 17 March 1954, in ARS 115-01 Z, Training Program.
Appendix C

I. Introduction.
1. Grounding of unit—three men to a town.
2. Arrival of tools, benches, and units.
3. Line work procedure.
   a. Location of work to be done on equipment and machinery.
   b. Tools and techniques.
   c. How to clean and touch·t-com work to be done.
4. Salary and expenses.
5. Salary or 10 call expenses.

II. Disassemble complete unit into sub-assemblies.
1. Detailed list of sub-assemblies from unit following given procedure.

III. Disassemble, clean, oiling, adjustments and reassembly of each sub-assembly.
1. This must be done on each sub-assembly by each man in the town.
2. Life is to be a complete overhaul of all sub-assemblies doing all work necessary for correct operation, including replacing of broken or worn parts, cleaning of dirty or rusted parts, covering of exposed parts with rust-inhibiting oil, and reassembly of unit, making all adjustments.
   a. Disassemble followed giving procedure.
   b. Disassemble work giving procedure.
   c. Static balance following given procedure.
   d. Dynamic balance following given procedure.
   e. Bendix balance following given procedure.

4. Assemble pro unit.
   a. Disassemble, inspection, re-assembling of unit following given procedure.

5. Vehicle pro unit.
   a. Disassemble of unit.
   b. Cleaning of rollers and discs.
   c. Oilin' of rollers and discs.
   d. Reassembly of unit using necessary substitution on rollers and bearing rollers.
g. Unit tests.
   1. Disassembly, inspection and reassembly of unit following given procedure.
   2. Reassembly of unit following given procedure.
   3. Cleaning and inspection of parts.
   4. Reassembly of unit and review all tolerances for correct operation of release control and shifting mechanism.

h. Unit tests.
   1. Disassembly, inspection and reassembly of unit.
   2. Reassembly of unit into unit following given procedure.

V. Troubleshooting
   1. Unit into a check for operation of the 5-1 prior to calibration.
      a. Check: tension of brake cable.
      b. Check: tension of parking brake.
      c. Check: tension of control cables and trail cam.
      d. Check: cross trail mechanism.
      e. Check: D-C circuit.

VI. Calibration
   1. Unit in a procedure to calibrate the unit to perform according to the given criteria.
      a. Adjustment of brake angle.
      b. Check: pre or drift, actuation, vibration and freedom.
      c. Check: mill 
      d. Check: recovery of engaging angle.
      e. Check: wear of cross-heads.
   2. Run-in of calibration and procedure to check overall error of unit.
      a. Preliminary check.

VII. Troubleshooting
   1. Field check:
      a. Inspect unit for check to be used on the unit in the field.
      b. Correct source of trouble with the 5-1 end their resolution.
Appendix 6

HARDEN ELECTRIC MAINTENANCE COURSE OF INSTRUCTION
AT ARTILLERY TRAINING CENTER, MARCH 1943

1. General lectures.
   1. Purpose of the course.
   2. Rules and regulations.
   3. Discussion of pertinent matter pertaining to this equipment.

B. Laboratory work.

1. Norden Stabilizer.
   a. Complete disassembly.
      (1) Stabilizer.
      (2) Servo motor.
      (3) Precession motor.
   b. Gyro balancing and building.
   c. Cleaning and maintenance.
   d. Reassembly.
   e. Calibration.

   a. Complete disassembly.
      (1) Gyro.
      (2) Rate end.
      (3) Synchronous end.
      (4) Trail and cross trail mechanism.
   b. Cleaning and maintenance.
      (1) Motor balance.
      (2) Shaping springs.
      (3) Sight balancing.
      (4) Automatic erective system.

3. Pedestal clock.
   a. Wiring.
   b. Precession runs.
   c. Ecn and tape.
**GLOSSARY OF ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
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<tr>
<td>AAF</td>
<td>Army Air Forces</td>
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<tr>
<td>AAFCTC</td>
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<td>Flying Training Command</td>
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<td>AAFASC</td>
<td>Air Service Command</td>
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<td>AAFETTC</td>
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<td>AAG</td>
<td>Air Adjutant General</td>
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<tr>
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<td>Air Corps</td>
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<tr>
<td>AC/AS</td>
<td>Assistant Chief of Air Staff</td>
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<td>Air Force Combat Command</td>
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<tr>
<td>AFESC</td>
<td>Automatic Flight Control Equipment</td>
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<td>AFDEP</td>
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<td>Historical Division, AC/AS, Intelligence</td>
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<td>Chief of the Air Corps</td>
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