INDIVIDUAL TRAINING IN AIRCRAFT ARMAMENT BY THE AAF 1939–1945

The original of this monograph and the documents from which it was written are in the USAF Historical Division, Archives Branch, Bldg. 911, Maxwell Air Force Base, Alabama.
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Air Historical Office
Headquarters, Army Air Forces

THIS PAGE Declassified IAW EO12958
This monograph is one of a series written on the training aspects of the air program. An earlier study, AAF historical Study No. 8, "Bombsight Maintenance Training," analyzes more in detail one of the subjects dealt with here but does not carry the history to the close of the war. Here we find the trends in aircraft armament training since World War I, described, with special emphasis on power-operated gun turret and remote-control turret courses, together with the instructional and administrative problems encountered.

Additional information and criticism will be welcomed by the Air Historical Office.
Individual Training in Aircraft Armament by the AAF, 1939-1945
INTRODUCTION

The modern warplane is virtually a flying ordnance shop. It bristles with machine guns and cannon to attack or defend itself against enemy aircraft; some types are loaded with tons of bombs to be dropped with such accuracy that the war fabric of the enemy will be seriously broken. For the sake of convenience, the machine guns, cannon, and bombs carried on a plane, and the elaborate equipment necessary to operate them—power operated and remotely controlled gun turrets, bombsights, automatic pilots, and the like—are known as aircraft armament. Closely allied to aircraft armament are the spray tanks and other chemical containers with which planes may be equipped for lethal or camouflage purposes.

In the Army Air Forces, responsibility for the routine maintenance of armament and chemical warfare equipment in first-class fighting condition is placed on a commissioned ground duty officer known as the armament and chemical warfare officer; he supervises the work performed on the flying line by a crew of enlisted aircraft armorerers, bombsight mechanics, power operated turret mechanics, and remote control turret mechanics. Repair work and maintenance of other than a routine nature, known as "third and fourth echelon maintenance" or "depot overhaul," is performed usually at depots and subdepots of the Air Materiel Command by enlisted men and
civilian employees. In the case of some of the heavy and very heavy bombers, enlisted aircrew members have been given training in armament as well as flexible munitions so that they could not only operate but if necessary maintain the armament equipment.
Chapter I  
EARLY ARMAMENT TRAINING  

Training for Enlisted Men  
The exact date when the technical schools of the Air Service began teaching aircraft armament to enlisted personnel is not known. The records of the "Air Service Mechanics Schools" at Kelly Field, Texas, and at St. Paul, Minnesota, which gave technical training during World War I, list 16 trades; but armament was not among them.

When the school at Kelly Field was reorganized in October 1919, under the direction of Maj. George E. Stratemeyer, armament was one of the 21 courses offered. In April 1921 the school was moved from Kelly Field to Chanute Field, Ill., and armament training was given as one of the courses in the Department of Mechanics there. Chanute remained the home of aircraft armorer training for the next 17 years.

Between 1919 and 1930 armament training was treated more or less as a stepchild of the Department of Mechanics. Students taking the course were mediocre at best—in many cases they were men with as many as 16 years of previous Army service spent as cooks or mess sergeants who felt that they could "handle" the course. This situation stemmed from the fact that at most airfields armament was considered an unimportant activity, and comparatively few graduates of the technical school course were ever actually assigned to armament work. From the fragmentary records which survive from this period, it appears...
that normally five classes were enrolled each year, with eight or less students in each class. The usual length of the course was five and a half months, although occasionally it lasted a month longer. There was considerable variation in the topics presented from class to class; but the following curriculum, given to a class graduating on 25 May 1928, is probably as representative as any:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics and Principles of Shop Work</td>
<td>147</td>
</tr>
<tr>
<td>Machine Guns</td>
<td>153</td>
</tr>
<tr>
<td>Small Arms</td>
<td>48</td>
</tr>
<tr>
<td>Bombs and Pyrotechnics</td>
<td>45</td>
</tr>
<tr>
<td>Ammunition and Explosives</td>
<td>15</td>
</tr>
<tr>
<td>Bomb Releases and Sights</td>
<td>117</td>
</tr>
<tr>
<td>Advanced Field and Shop Work</td>
<td>129</td>
</tr>
</tbody>
</table>

During the first half of the 1930's two events occurred which did a good deal to improve the caliber of armament training. In 1930 the armament course was withdrawn from the Department of Mechanics, and assigned to a new department of Armament. The step served to impress upon men in the Air Corps the importance with which armament work was coming to be regarded. Gradually better men were sent to Chanute to take the course and were later assigned to armament work in operational units.

The second development followed the appointment of Capt. Herbert Anderson as director of the Department of Armament in July 1935. Captain Anderson undertook a thorough reorganization that included renovation of the department's classrooms, replacement of its antiquated teaching equipment, and a revision of its curriculum.
Starting with the school year 1935-36, the course of instruction was divided into four principal divisions: (1) Elementary and Specialized Division; (2) Machine Gun Division; (3) Bomb Division; and (4) Chemical Warfare Division. Each of these divisions was supervised by a commissioned officer charged with the responsibility of revising the subject matter of the course as well as the texts and teaching methods through which it was presented. The instructor ranks were combed thoroughly, and only men of unusual ability were retained. Instructors were told that they must master all phases of the course so that they could teach any part of it and thus fill any vacancy that might occur. The course called for 582 instructional hours over a 24-week period; 5 weeks were devoted to basic mechanic subjects, the remaining 19 to practical armament instruction. The subjects taught and the time devoted to each were as follows:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>45</td>
</tr>
<tr>
<td>Mechanical Drawing</td>
<td>39</td>
</tr>
<tr>
<td>Elements of Metal Work</td>
<td>57</td>
</tr>
<tr>
<td>Electrical Controls</td>
<td>30</td>
</tr>
<tr>
<td>Small Arms</td>
<td>48</td>
</tr>
<tr>
<td>Gun Cameras</td>
<td>30</td>
</tr>
<tr>
<td>Aircraft Machine Guns</td>
<td>27</td>
</tr>
<tr>
<td>Heat Treating</td>
<td>15</td>
</tr>
<tr>
<td>Aircraft Machine Guns</td>
<td>108</td>
</tr>
<tr>
<td>Chemical Warfare Materials</td>
<td>50</td>
</tr>
<tr>
<td>Bombsights and Camouflage Obscura</td>
<td>45</td>
</tr>
<tr>
<td>Bomb Maps</td>
<td>30</td>
</tr>
<tr>
<td>Explosives and Ammunition</td>
<td>30</td>
</tr>
<tr>
<td>Towed Targets</td>
<td>15</td>
</tr>
</tbody>
</table>

In the opinion of Captain Anderson, the men graduated during that year were the first armorers truly qualified to work on modern air-
The following year, 1936-37, the course was extended to 32 weeks. The additional eight weeks enabled the school to give three more weeks to basic mechanic subjects and five additional weeks to more thorough training in electrical controls, the recognition and correction of malfunctions, and increased experience in handling live ammunition and high explosives. The last type of training was needed, it was felt, to overcome the students' native fear of explosives.

Even these modifications did not fully answer the need for "practical" instruction, school officials felt. One of the chief factors behind the move of the Department of Armament from Chanute to newly established Lowry Field, Colo., in February 1938 was the fact that close to Lowry were 64,000 unpolluted acres. Here students could learn to handle live bombs and high explosives and acquire some familiarity with gunnery and bombing practices, without endangering the lives of civilians—features not available at Chanute.

Within a few months of the move to Lowry, the armament course was again drastically reorganized. With the hope of shortening the course, greatly increasing the number of graduates, and stepping up the efficiency of the individual students, six highly specialized courses, each 24 weeks in length, were set up. Four were intended for inexperienced enlisted men: (1) primary attack aircraft armament; (2) primary pursuit aircraft armament; (3) primary bombardment aircraft armament; and (4) observation aircraft armament. A fifth course, the so-called "Advanced Armorer's Course," was designed for men who had had at least a year and a half of experience in aircraft armament work,
preferably had graduated from one of the primary armament courses,
but in any event had completed the basic mechanic phase in a tech-
nical school course. A sixth course, a Master Armorer's Course,
was initiated for men who, among other qualifications, had at
least five years of experience in the Air Corps, held a rank of
sergeant or higher, had previously graduated from the Gunner arm-
mament course, possessed "outstanding interest in the subject of
armament and exceptional mechanical ability," and were "considered
reliable in every respect." It was expected, when this plan went
into effect, that 255 men would be trained in the course of the year—
an increase of more than tenfold. Approximately two-thirds of the
students were to be in the four primary courses.

As might have been expected, the plan was so complicated that it
proved unworkable and was dropped before the end of the school year.
Another factor which hastened its abandonment was the inauguration of
a vast Air Corps expansion program at the beginning of the school year
1939-40. In each of the two years the six-course plan was in effect
14 separate classes were matriculated, but the annual attendance never
was higher than 156.

**Training for Officers**

An Air Corps engineering and supply conference held during 1927
at the Air Corps Material Division, Wright Field, reached the conclu-
sion that there was great need for the training of officers whose
duty it was to supervise armament work. Accordingly, during the school
year 1927-28, a course for Regular Army officers was established in the
Department of Mechanics at Chanute Field. It became the practice to give armament training to one class of officers each year, adhering rather closely to the curriculum of the enlisted men's course. When the separate Department of Armament was organized at Chanute in 1930, both officers' and enlisted men's courses were transferred to that department. 11

In 1934, the notion that officers ought to be equally familiar with aircraft maintenance and aircraft armament led the Chanute authorities to undertake an unhappy experiment. The two subjects were combined into one 10-month course, seven months being devoted to aircraft maintenance subjects and three months to armament topics. Two years of trial convinced the authorities that three months was far too short a period to cover armament—at least in peace time. At the start of the school year 1936-37 the armament course again became a separate entity, now seven months in length. 12

From the fragmentary records surviving from this period, it appears that in the 12 years between early 1928 and mid-1939, 15 classes with a total of 153 officers were graduated. Only in 1933, 1934, and 1936 was more than a single class graduated. The class records reveal that the topics presented varied greatly from year to year. 13

A notable experiment was conducted in connection with the classes graduated in 1935 and 1936. The officers taking the course at Chanute in these years were taken to Fort Knox, Ky., Fort Bragg, N. C., and an Air Corps tactical center near Valparaiso, Fla., for short periods.
of practice gunnery and bombing missions. These field trips not only provided the students with valuable experience, but furnished the Air Corps with evidence of the desirability of bombing and gunnery practice in connection with armament training.

In February 1939, Maj. Gen. Henry H. Arnold, Chief of the Air Corps, ordered all armament training of Regular Army officers discontinued so that the facilities and personnel of the Air Corps technical schools might be entirely devoted to the training of enlisted technicians to meet the demands of the Air Corps expansion program. Accordingly, the eight Regular Army officers who graduated 30 June 1939 were the last to receive armament training for some years.
Chapter II
TRENDS IN ARMAMENT TRAINING, 1939-1945

By early 1939 the designs of the Fascist powers had become so evident that Air Corps officials began to assess their resources to learn how they might meet any eventuality. Out of this stock-taking was developed a program designed to add 25,000 more enlisted men to the Air Corps by 30 June 1940. Of these, 1,581 were to be trained as aircraft armorers and 288 as bombsight mechanics between 7 August 1939 and 7 July 1941.¹

Once the program got under way, the practice was to send all Air Corps recruits to one of six fields possessing a basic training center. During their first month the men were given basic military training, inoculations, and tests to determine their capacity for technical training. Those found qualified for training as armorers were sent to Scott Field, Ill., for a one-month course in basic technical training—the instruction in shop mathematics, drafting, blueprint reading, elementary metalwork, and electricity—which had previously been given during the first weeks of the course at Lowry. Upon completion of this, the recruits were sent to Lowry to take the regular armament course.²

The procedure followed in billing the quotas for bombsight maintenance students, however, remained substantially unchanged from what it was before the expansion period. No recruits were admitted to the course; only men with three years' Army experience, a rating of qualified
aircraft armorer, and the specific recommendation of their commanding officer were admitted. Bombsight students came on quotas from airfields and depots, and normally returned to them upon completion of the course.

To make room for the additional numbers of students in both courses, school buildings and barracks of the temporary type were constructed as rapidly as possible. To obtain the necessary new complements of instructors, students graduating from the course were impressed into teaching service. Lowry had little difficulty in meeting the goal set up for it; by the end of 1939 the school was regularly entering students at close to the desired rate—66 armors and 12 bombsight mechanics a month.

The alarming successes of the German Army in overrunning Western Europe and the threatened German invasion of Great Britain during the spring and summer of 1940 caused the Air Corps to supplant the first expansion program long before training under it had been completed. This second program, the so-called 136,000-man program, went into effect late in September 1940, and called for the training of 5,775 armors and 602 bombsight mechanics by 1 April 1942.

The Lowry officials encountered considerable difficulty in achieving the pace that was now set for them. The housing, messing, and classroom facilities could accommodate only 264 students at one time. For a little more than a month, from late September until the middle of November 1940, the school operated on a two-shift basis,
which relieved the strain on the available classroom—if not mess and barracks—facilities.

Not until the end of January 1941 did the War Department grant the funds necessary to construct eight temporary school buildings. As a result, it was not until the middle of 1941 that students were entering Lowry at a rate great enough to achieve the goal.

As soon as the 136,000-man program was put into effect, the basic mechanic course given at Scott was discontinued and the subject matter previously included in it added to the armament course at Lowry without, however, any increase in the over-all length of the course. Although great numbers of men became available to the Air Corps through the operation of Selective Service about this time, none of the men so inducted were assigned to armament training. It was the view of the Air Corps that as Selective Service inductees would remain in the Army only a year, it was not worth while giving these men an extended period of technical training only to have them return to civilian life soon afterward.

Owing to rapid and prodigious growth of the Air Corps, a need for additional officers to supervise the work of enlisted aircraft armorer and bombsight mechanics began to be felt during this period. Late in 1940 it was decided that a course of training for aviation cadets should be established. Upon graduation these men were to be commissioned second lieutenants and assigned to ground duty as armament and bombsight officers. At first it was expected that this course would be filled with eliminines from the flying cadet course;
but when this source rapidly became depleted, quotas were filled
with promising enlisted men and men from civilian life with some
technical training and experience. After debate as to whether all
the cadets should be given training in bombsight maintenance as well
as armament, it was determined that approximately 25 per cent of them
should be given a cadet bombsight course after completing a cadet
armament course. This quota was based on the number of officers needed
at that time for bombardment squadrons. The first class of 32 arma-
ment cadets entered Lowry on 3 March 1941; additional classes of the
same size entered every four weeks thereafter.

The remarkable demonstration in Europe of the effect of air
power during 1940-41 convinced the Air Corps that it must again raise
its goals for the production of planes, aircrews, and ground crews.
On 19 August 1941 it put into effect a program designed to produce
100,000 technicians a year—or twice as many as were then being grad-
uated. Inasmuch as at the time the plans for the program were being
drawn up, armorer cadets were being trained at the rate of 5,005 a year and
bombsight mechanics at approximately 500 a year, new goals were set at
10,000 and 1,000, respectively. These were to be accomplished through
the use of two shifts—an "A" shift which attended classes from 0400
to 1245, and a "B" shift in session from 1300 to 2200 daily except
Saturday and Sunday. No increase in classroom and teaching equipment
was necessary, although additional instructor personnel had to be chosen
and trained and more economical use made of housing facilities.
The work of the Lowry Armament Department in meeting the demands of the 100,000-technician program, however, was made more difficult by the inauguration on 15 September 1941 of a new course in power operated turrets. Phases for such a course had been under discussion for a whole year, but it was not until actual installation of four types of power operated turrets in Air Corps bombers began to take place in the late summer of 1941 that the school officials were given word to go ahead. The policy was to take the most outstanding 10 percent of each armament class and give these men 12 weeks of training in turret maintenance. Actually, the shortage of qualified instructors, the complete lack of teaching equipment, and indecision as to which types of turrets were actually going to be used in combat caused the turret department to follow a somewhat spasmodic course during its first months.

The Japanese attack on Pearl Harbor on 7 December 1941 and the resulting declaration of war against the fascist powers led to an immediate scrapping of the 100,000-man program and the replacement of it by a far more ambitious program. The so-called Victory Program, which was put into effect during the following month, called for the training at the rate of 36,090 aircraft armormers, 3,000 power operated turret mechanics, 3,460 bombsight mechanics, and 675 armament officers a month by 31 December 1942.

These goals had all been met by the end of 1942. In accomplishing them, some drastic wartime measures were resorted to. Immediately after
Pearl Harbor the length of the courses was reduced by approximately one-fifth, through the introduction of a six-school-day week in all courses and three shifts in all courses except the cadet course; and through the elimination or shortening of phases not considered absolutely essential in the case of the enlisted armorer course. The size of the classes, which were now begun at more frequent intervals, was increased. Beginning in October 1942 all courses except the cadet courses were given on a seven-day week schedule, with one-seventh of the students and instructors off each day of the week.

As soon as the nation entered the war, Lowry abandoned its policy of refusing to give technical training to Selective Service inductees. Even in the case of the bombsight mechanic course, where previous Army experience had been considered indispensable, the shortage of old-time enlisted men made the school willing to accept even relatively recent recruits as long as they had graduated from the enlisted armorer course and met other physical, educational, and security prerequisites. For the cadet armament course, the ACCT (Army General Classification Test) score of 110 demanded of all officers was another requirement. In general, any man eligible for Army service was considered physically qualified for training in armament subjects, although from time to time limits were placed on the number of "limited service" men acceptable. An ACCT score of 100 and a mechanical aptitude score of 100—approximate average—were set as the minimum for training in the enlisted courses.
But the large quotas of the Victory Program could not have been met if the housing and classroom facilities available for armament training had not been considerably expanded. During July 1942 the enlisted armament course at Lowry was moved to a newly constructed school area known as Lowry Field No. 2.

A few days later a large new school, devoted exclusively to armament training, was opened at Buckley Field, a few miles east of Lowry Field in Colorado. Additional facilities were made available for armament training in January 1943 when the cadet armament course was moved to an AAF technical school at Yale University, where all ground duty cadet training was being centered.

Within two and a half months after the move of the enlisted armament course to Lowry No. 2 and Buckley, a policy of specialization in training was introduced which made it possible further to reduce the length of the course by one-quarter. Starting late in September 1942 the course curriculum at Buckley was revised to train armors for service in pursuit squadrons, that at Lowry to train armors for service in bombardment squadrons.

The entry of the United States into the war produced an immediate need for numbers of enlisted men capable of performing third and fourth echelon maintenance of armament equipment in the depots and subdepots of the Air Service Command. To meet this need the ASC in June 1942 set up the Armament Training School at the Indiana State Fairgrounds, Indianapolis, Indiana. Courses in bombsight repair and power operated gun turret repair on the depot overhaul level were started shortly
thereafter. Recognition that the newest types of planes were to employ a complicated system of remotely controlled guns led to the establishment of a Central Fire Control Equipment Course at Indianapolis the following November. The enlisted students for the bombsight and power operated gun turret (FCT) courses came from the graduating classes of Lowry's first and second echelon courses; those for the CFCE course from Indianapolis FOGT course. In February 1943 administrative responsibility for the Armament Training School was assumed by the Technical Training Command, which thus was enabled to coordinate its work more closely with that done at Lowry. 25

In January 1943 an important new course on the first and second echelon level was established at Lowry. At first called the Central Fire Control Equipment Course, later the Remote Control Turret Course, this was designed to teach the maintenance of the new fire-control systems being installed in B-29 and B-32 aircraft. As the course included some very difficult subject matter, only men with unusual backgrounds—an FCT score of 120 or over and experience in radio and electronics—were admitted. 26

During the first half of 1943 the AAF approached the 2,500,000-man strength which had been calculated as necessary to win the war in the air. The number of recruits made available to the AAF by Selective Service each month was sharply reduced. Losses of ground-crew men, including armormen, were light, and resulted in moderate demands for replacements. In the two-year period between the middle of 1943 and V-J
Ray in September 1945, armament training was characterized by three factors: a sharp diminishment in the number of men under training; a reduction in the number of schools offering armament training until finally Lowry was again the only armament school; and the lengthening of the curricula of courses to permit more comprehensive and thorough instruction and the addition of newly adopted types of equipment. There is no reason to believe, however, that AAF training officials fully recognized that these factors were at work, at least not until late in 1944; up to that time the student flow, course length and content, and choice of schools followed a chaotic path for every one of the courses, indicating that improvisation was the rule at the higher headquarters.

The reduction in the number of students was most precipitous in the case of the basic armament and power operated turret courses. The enrollment of the armament course dropped from 12,547 in April 1943 to 2,292 in December 1944 to 1,11 on V-J Day. In the case of power operated turrets, the decline was from 248 in April 1943 to 120 in December 1944 to 2 on V-J Day. The drop would have set in earlier and would have been even sharper if it had not happened that in the last days of 1942 the Directorate of Individual Training issued a directive that henceforth all flexible gunners must be trained in some technical specialty either before or immediately after attending gunnery school. This meant that beginning in early 1943 large numbers of flexible gunnery graduates or men earmarked for service as gunners were assigned to the basic armament course, the power operated gun turret.
mechanic course, and the remote control turret course. After this trend reached full force, approximately three-quarters of the basic armament students were gunners. But by early 1945 Headquarters, AAF concluded that to conserve equipment and personnel no additional armorer-gunners ought to be trained. There now appeared to be a surplus of this type, at any rate. Precitous, although not to the same degree, was the decline in enrollment in the bombsight course. In April 1943, 1,255 bombsight mechanics were in training at bomy, while in December 1944 there were only 186. But by V-J Day there was actually a slight increase, to 198. This was the result of the AAF policy, inaugurated during the interval, of releasing enlisted men according to a point system in which length of service was an important factor. Inasmuch as most bombsight mechanics then in the AAF had long records of service, and as the AAF expected to need the services of this type of technician indefinitely, it was planned to continue such training steadily on this modest level.

Still another factor served to slow down the volume of officer training in armament. By the spring of 1944, it became apparent that the AAF had commissioned more ground duty armament officers than it could possibly use. But it did not seem advisable to curtail armament training on the officer level entirely: armament officers would be needed in the postwar AAF. So the nature of the course was changed drastically; rated officers who planned to make a career of the AAF were to be given the training. Thus the drop in the enrollment of
the officer course was relatively slow: from 305 in April 1943 to 215 in December 1944 to 64 on V-J Day.

In the case of one armament course—that in remote-control turrets—the enrollment actually increased from three students in June 1943 to 1,226 in December 1944 to 2,672 on V-J Day. The reason for this gain was, of course, that remote control turrets were a type of equipment found only in the new very heavy bombers which the IAF was putting into operation in the war against Japan.

While the volume of armament training was declining in general, the IAF made a comparable reduction and concentration of training facilities. The Armament Training School at Indianapolis was closed in January 1944; and the three-capot overhaul courses—bombsight, power operated turrets, and remote-control turrets—were resumed at Lowry during the following spring. The fulfillment of training requirements for armorers for pursuit squadrons and the diminution of needs for bombardment squadrons left the IAF with a surplus of facilities for the basic armament course. In the spring of 1944 the armament school at Buckley was closed, and Lowry No. 2 once again became the only school giving this course. During the summer of 1944 the IAF abandoned the facilities it had leased at Yale University, at the same time discontinuing the cadet armament course. The successor course, an Armament and Chemical Warfare Officers Course for rated personnel, was opened at Buckley in July, only to be moved to Lowry in January 1945. Thus the end of the war found the IAF giving all of its aircraft armament training at the same single station it had used at the start.
of the expansion period, Lowry Field.

With the demand for more numbers satisfied, after the spring of 1943 AAF officials could give more attention to the quality of the training. One of the first steps taken was to drop the third, or night, shift, which was generally conceded to present barriers to good teaching which were difficult to surmount. During 1945, as most of the courses shifted to a "token" basis, a single shift became sufficient.

The school authorities undertook to extend the length of all the courses so as to make instruction more thorough and to permit proper presentation of new equipment which the AAF was adopting as it waged the war in the air. These requests were resisted for a time by Headquarters, AAF, which held that the necessity for economizing personnel and equipment, as well as "the present policy of this Headquarters" made it impossible to grant them. During the latter half of 1944 and in 1945, however, requests to extend the courses from one to three weeks were granted in most instances.

In the case of the basic armament course, where perhaps the sacrifices of quantity to quality had been greatest, the shift back to peacetime training standards was slower in coming than the school authorities would have liked. At the time of the discontinuance of the pursuit armament course in the spring of 1943, they proposed that here-after basic armament training cover comprehensively and thoroughly all phases of armament work—even if that should require a doubling of the length of the course. The need for armament training for flexible
gunners provisioned Headquarters, AAF with an excuse to postpone the granting of this request. Thus it was not until the summer of 1945, when the AAF had a surplus of both gunners and ground duty armorers, that the course was reestablished on a standard compatible with that prevailing before the expansion period, but incorporating all the technical and pedagogical lessons learned during three and three-quarters years of war.
Chapter III

ARMAMENT COURSES FOR ENLISTED MEN

As soon as Air Corps officials realized that under the so-called Augmentation Program they would have to increase their training rate more than 300%, they decided to scrap the complicated three-level armament training they had been giving at Lowry Field and concentrate on a single three-month basic armament course.

This new course started with a four-week phase called Basic Mechanics, given to all Air Corps recruits selected for technical training. The principal features of this phase, conducted at Scott Field, Illinois, were as follows:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Shop Mathematics</td>
<td>27</td>
</tr>
<tr>
<td>II. Mechanical Drafting and Blueprint Reading</td>
<td>26</td>
</tr>
<tr>
<td>III. Air Corps Fundamentals</td>
<td>27</td>
</tr>
<tr>
<td>IV. Elements of Metalwork</td>
<td>40</td>
</tr>
<tr>
<td>V. Elements of Electricity</td>
<td>40</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>160</td>
</tr>
</tbody>
</table>

Upon completing this phase, armament students were transferred to Lowry Field, Colorado, where they started on the following 12-week course of study:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Chemical Warfare Materials</td>
<td>24</td>
</tr>
<tr>
<td>&quot;agents; weapons; supply; technique and meteorological factors affecting their use; chemical tanks; operation loading; safety precautions.</td>
<td></td>
</tr>
</tbody>
</table>
Subject

II. Explosives and Ammunition
   Military explosives, pyrotechnics, and ammunition use in the Air Corps; their composition, uses, properties, handling, storage, safety precautions, inspection, and packing.

III. Small Arms and Gun Cameras
   Description, nomenclature, operation, care, and maintenance of service-type shotguns, pistols, rifles, and gun cameras; film interpretation; details of range procedure and principles involved in the firing of a pistol and a shotgun.

IV. Electrical Armament Controls
   Operation, maintenance, and inspection of all electrical armament controls.

V. Aircraft Machine Guns
   Description, nomenclature, theory of operation, adjustment, maintenance, inspection, handling during operation and correction of malfunctions during firing of caliber-.30 and caliber-.50 machine guns.

VI. Synchronizers and Gun Installations
   Description, nomenclature, operation, installation, maintenance, and inspection of standard aircraft machine gun synchronizers, controls, and mounts.

VII. Bomb Racks and Tow Target Equipment
   Description, nomenclature, operation, installation, and maintenance of service type internal and external bomb and flare racks, shackles, and tow target reels; chemical carrying and release mechanisms, their operation, installation, and maintenance.

VIII. Aircraft Machine Gun Sights
   Description, theory, installation, harmonization, maintenance, and inspection of service-type aircraft machine gun sights.

IX. Field Exercises
   Practical work in inspection, installation, and maintenance of machine gun synchronizers; installation and harmonization of machine gun sights.

TOTAL 480
...hen the 136,000-man program, put into effect in September 1940, increased training goals of basic armorers 400%, the Air Corps discontinued the basic mechanic phase at Scott Field. Thereafter armament students reported directly to Lowry for both the basic mechanic and armament phases. The material in the former phase was compressed into two weeks so that the entire course could be given in 14 weeks:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Shop Mathematics</td>
<td>16</td>
</tr>
<tr>
<td>II. Metal Work</td>
<td>40</td>
</tr>
<tr>
<td>III. Soldering</td>
<td>8</td>
</tr>
<tr>
<td>IV. Electrical Armament Controls</td>
<td>40</td>
</tr>
<tr>
<td>V. Explosives and Ammunition</td>
<td>32</td>
</tr>
<tr>
<td>VI. Chemical Warfare Materials</td>
<td>24</td>
</tr>
<tr>
<td>VII. Small Arms and Gun Cameras</td>
<td>40</td>
</tr>
<tr>
<td>VIII. Aircraft Machine Guns</td>
<td>120</td>
</tr>
<tr>
<td>IX. Aircraft Machine Gun Sights</td>
<td>40</td>
</tr>
<tr>
<td>X. Synchronizers and Installations</td>
<td>80</td>
</tr>
<tr>
<td>XI. Bomb Racks, Flare Racks, and Tow Targets</td>
<td>80</td>
</tr>
<tr>
<td>XII. Field Exercises</td>
<td>40</td>
</tr>
</tbody>
</table>

TOTAL 560

A year later the course was lengthened to 15 weeks to permit the addition of a second week of field exercises.

The demand for armorers rocketed when the United States entered World War II late in 1941; between that time and March 1943, when the peak was reached, the training rate had increased about 900%. To meet these prodigious increments the course was progressively shortened; and the content of the instruction was made ever narrower—or more "specialized," as the term was. The day after the attack on Pearl
Harbor, the length of the course was decreased from 15 weeks to 12. This was accomplished by making Saturday a regular eight-hour school day, and by eliminating certain "not absolutely essential" parts of the electrical armament controls, explosives and ammunition, metalwork, chemical warfare, machine gun, and small arms phases.

The course length was again reduced in September 1942, in compliance with a directive of the Technical Training Command (TTC) that as far as possible all technical courses were to be specialized. Two types of armament were to be taught—pursuit armament at recently opened Lackley Field, and bombardment armament at the new Larry Field No. 2. Both courses were to be nine weeks in length. The phases and distribution of time of the two courses are as follows:

<table>
<thead>
<tr>
<th>Bombardment Armament</th>
<th>Pursuit Armament</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase</strong></td>
<td><strong>Hours</strong></td>
</tr>
<tr>
<td>Aircraft Machine Guns</td>
<td>126</td>
</tr>
<tr>
<td>.30- and .50-cal. machine guns, fixed</td>
<td></td>
</tr>
<tr>
<td>20- and 37-mm. aircraft cannon.</td>
<td></td>
</tr>
<tr>
<td>Electrical Armament Controls</td>
<td>31</td>
</tr>
<tr>
<td>Explosives and Ammunition</td>
<td>10</td>
</tr>
<tr>
<td>Bomb Work</td>
<td>42</td>
</tr>
<tr>
<td>Field Exercises</td>
<td>42</td>
</tr>
<tr>
<td>Power Turrets</td>
<td>126</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>378</strong></td>
</tr>
</tbody>
</table>

The principal differences between the two courses lay in the bomb rack and power turret phases, which treated equipment found only in
bombardment squadrons; and the synchronizing and aircraft gunsight phases, which covered material which would be of particular value to men who would be assigned to pursuit squadrons. During the field exercise phases, conducted in hangars, embryonic bombardment armormers were assigned work on bombers and bomber equipment, while prospective pursuit armormers practiced on fighter aircraft and equipment. Specialization was not carried to such a degree that no information on bombardment armament was given to pursuit armormers, or vice versa. During the 21 hours of instruction on explosives and ammunition given to pursuit armormers, there was some familiarization instruction on bombs and bomb shackles.

When the AAF reached the limits of its expansion in the spring of 1943, certain new factors appeared which considerably affected the curricula of the basic armament course. A few armormers were needed as replacements in pursuit and bombardment squadrons. Now, however, most of the students would be men earmarked for training as flexible gunners; they would need bombardment armament training. The Technical Training Command directed that beginning early in May almost three times as many men would enter the bombardment course as would enter the pursuit course (717 bombardment armormers per week as compared with 265 pursuit armormers).

Inasmuch as the facilities at Lowry No. 2 and at Buckley had been set up on the assumption that the number of bombardment armormers and pursuit armormers to be trained would be approximately equal, considerable re-adjustment was necessary to meet the new conditions. All equipment and
personnel of the aircraft machine gun phase was concentrated at Buck-
ley, beginning in May. Thus all basic armor students now began
their training at Buckley; upon completion of the machine gun phase,
73 per cent went to nearby Lowry for the later phases designed for
bombardment armors, while the remaining 27 per cent remained at
Buckley to take pursuit armament.

The Technical Training Command officials recognized that this
arrangement was at best a makeshift. They invited the authorities
at the two schools to propose plans for the improvement of the
course. Two plans were forthcoming, both based on the assumption
that inasmuch as the demand for large numbers of armors had now
ceased, the course ought to be more comprehensive, more thorough,
and considerably less hurried.

The first plan called for a 16-week course—eight weeks to be
spent at Buckley studying machine guns, cannon, explosives and am-
munition, electrical armament controls, and such specialized pursuit-
armament subjects as synchronizing and machine-gun sights; and a
second, eight-week period to be spent at Lowry covering bomb racks
and power-operated turrets. The phase on turrets would be so com-
prehensive that it would obviate the need for the eight-week advanced
course on power turrets then being offered at Lowry. It was suggested
that a more thoroughly trained, all-around armor would result from
this course.

The second proposal contemplated a course on the same general
principles, but the pace was to be even less hurried—22 weeks in length. The first 10 weeks, devoted to general and pursuit armament phases, were to be given at Backley. Of the 12 weeks to follow at Lowry, nine were to be devoted to bomb racks and thorough training in power operated gun turrets, and three weeks to exercises in maintenance of bombardment and pursuit aircraft.\textsuperscript{11}

No action was taken on either of these proposals for more than two months. Finally, on 17 July 1943, the Assistant Chief of Air Staff (AC/AS), Training of Headquarters, AAF gave orders that the pursuit and bombardment courses were immediately to be combined into a single 12-week course. The switch in curriculum was to be conducted in such a way, the directive specified, that there would be no interruption in the regular flow of armorer graduates to the flexible runnery schools.\textsuperscript{12}

When this directive reached Lowry Field, where it was generally supposed the combined course would be located, the school authorities protested vigorously that 12 weeks was not long enough a period to train an armorer comprehensively. In August they submitted as an alternative a 16-week curriculum that was in its essentials similar to the one they had proposed three months earlier.\textsuperscript{13}

The suggestion was rejected by the Training Command (the command which was created by the merging in July 1943 of the AAF Technical Training and the AAF Flying Training Commands), which now adopted the stand taken by Headquarters, AAF that a 12-week period was long enough.
The 16-week curriculum, Headquarters, AAF told the Lowry officials, contemplated too thorough a presentation of turret maintenance. Familiarization instruction on this equipment would be adequate.

None too enthusiastically, the Lowry and Lackey officials complied with the directive. By 13 October 1943 they had shifted around enough personnel and equipment to put the following 12-week curriculum into effect:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Explosives and Ammunition</td>
<td>18</td>
</tr>
<tr>
<td>II. Chemical Warfare</td>
<td>18</td>
</tr>
<tr>
<td>III. Electrical Armament Controls</td>
<td>36</td>
</tr>
<tr>
<td>IV. Bomb racks</td>
<td>36</td>
</tr>
<tr>
<td>V. Cal. .50 Aircraft Machine Guns</td>
<td>36</td>
</tr>
<tr>
<td>VI. Cal. .30 Aircraft Machine Guns</td>
<td>12</td>
</tr>
<tr>
<td>VII. 20-mm. Aircraft Cannon</td>
<td>24</td>
</tr>
<tr>
<td>VIII. 37-mm. Aircraft Cannon</td>
<td>24</td>
</tr>
<tr>
<td>IX. 75-mm. Aircraft Cannon</td>
<td>12</td>
</tr>
<tr>
<td>X. Synchronizing</td>
<td>36</td>
</tr>
<tr>
<td>XI. Aircraft Machine Gun Sights</td>
<td>24</td>
</tr>
<tr>
<td>XII. Gunsight Aiming Point Camera</td>
<td>12</td>
</tr>
<tr>
<td>XIII. Power Operated Gun Turrets &amp; Tow Targets</td>
<td>108</td>
</tr>
<tr>
<td>Martin upper turret; Consolidated tail turret; Emerson nose turret; Sperry upper locally controlled turret; Sperry lower ball turret; Bell 1-6 and 1-7 twin gun mount; Bendix upper gun turret; Bendix lower gun turret; Bendix chin turret type 1-16; tow targets, windlasses, and related equipment.</td>
<td></td>
</tr>
<tr>
<td>XIV. Field Exercises</td>
<td>36</td>
</tr>
<tr>
<td>Pursuit and boararmament armament.</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>432</td>
</tr>
</tbody>
</table>

This curriculum is interesting because it was a reversion to almost the same order of presentation of subject matter which had been used before the course had been made "specialized." Such
subjects as explosives and ammunition, chemical warfare, electrical armament controls, etc., were relatively easier than machine guns and cannon for a beginning student to grasp, the school authorities felt, so it was better to present them at the start of the course. The phase on chemical warfare was restored in response to a protest from the Air Chemical Officer that such training ought to be given armors because "virtually all tactical aircraft was a potential carrier of spray tanks."

The new curriculum was noteworthy for another reason—it included subject matter which the school authorities had long believed ought to be included in the basic armament course, but for which they had never been able to secure approval from higher headquarters. In this category was instruction on the new 75-mm. cannon, used on B-25 airplanes, the Emerson nose turret, and the Sanix upper, lower, and chin 20 mm turrets, which were being widely installed on heavy bombers. The 42 hours specified in the new 12-week basic armament curriculum permitted familiarization training for all armors.

Lowry and Buckley had barely begun using the 12-week curriculum when their equanimity was upset by the receipt of AAF Training Standard No. 80-51, for aircraft armors, dated 2 October 1943. At this time Headquarters, AAF, in an effort to standardize AAF training, was preparing a series of directives listing, in some detail, proficiencies which individuals must attain to be considered adequately trained in technical specialties. The Lowry and Buckley officials had understood
that the preliminary draft of the training standard for aircraft armorers would be drawn up in Headquarters, Western Technical Training Command (WTC), inasmuch as the greater part of armament training was conducted under the supervision of that command. The Lowry officials in particular had several objections to AAF Training Standard No. 20-51. The wording of a statement of the general objectives of armament training and of another dealing with equipment maintenance seemed to them inaccurate in details and open to misinterpretation. They suggested substitute statements to avoid these objections.

More serious so far as the school was concerned were certain specifications. Paragraph 2a, for example, provided that an armorer be able to demonstrate his proficiency in the "blindfold disassembly and assembly of the caliber .50 and caliber .30 machine gun ...." As they then were giving the course, the school authorities had time for a blindfold test only on the caliber-.50 machine gun. They did not consider it advisable to readjust the training schedule, "since the caliber .30 gun has a very limited use." Nor was the Lowry school meeting four other specifications:

2c. Care, adjustment, and operation of all small arms and weapons used by the Army Air Force units.

i. Adjustment and use of shut traps.

1. Safety regulations, range rules, and procedure.

m. The use and purpose of all supply, maintenance and other forms, plus replenishment of supplies and survey procedure.
The Lowry officials and the Western Technical Training Command authorities agreed that one of these things should be done: (1) the training standard must be revised, omitting the parts in question; or (2) the length of the course must be extended to 15 weeks to allow time for the addition of necessary instruction; or (3) the familiarization training given on power turrets must be considerably reduced in scope to provide time for the addition of the required material.

The Lowry officials inclined toward the second alternative.

When the Training Command presented to Headquarters, AAF these suggestions, together with its own recommendation that the course be extended to 15 weeks, Headquarters, AAF replied that "in view of the existing need of armorers for new units," the request could not be granted, but that it should be resubmitted in about four months.

Meanwhile, however, the Lowry authorities had attempted to improve the general standard of the course through their own efforts. With the authorization of the WTC, in January 1944 they issued a detailed statement of proficiency standards which students were expected to attain in each phase of the basic course. Before being adopted they were reviewed by officers and enlisted men recently returned from combat duty who had had experience in the type of work included.

By the start of 1944 the AAF had trained all the armorers it would need as replacements. Accordingly, on 16 February, the Training Command announced that henceforth the only men to be given basic
armament training would be men earmarked for service as armorer
26 flexible gunners. This, so the ATC concluded, made it possible
to eliminate from the armament curriculum much of the material which
was also curriculum of the flexible gunnery course. It had been
impracticable to avoid the duplication of such material earlier,
when embryonic armorer-gunners and round only armorers were taking
the armament course side by side. Through the elimination of such phases
as synchronization—useful only to pursuit armors—and the introduc-
tion of a new type of specialization, it was possible to reduce the
length of the armament course from 12 to seven weeks. As the quotas
of armorer-gunners would be small enough to be accommodated at Lowry
27 No. 2, it was decided to discontinue giving the course at Buckley.

Training under the seven-week specialized curriculum began at
Lowry on 24 April 1944. The syllabus, originally drawn up by the
28 Lowry officials, was as follows:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Basic armament—Taken by all students</td>
<td></td>
</tr>
<tr>
<td>Technical orders and supply</td>
<td>1</td>
</tr>
<tr>
<td>Bombs and fuses</td>
<td>2</td>
</tr>
<tr>
<td>Caliber .45 pistol</td>
<td>1</td>
</tr>
<tr>
<td>Caliber .50 aircraft machine gun</td>
<td>9</td>
</tr>
<tr>
<td>20-mm. automatic aircraft gun</td>
<td>5</td>
</tr>
<tr>
<td>TOTAL</td>
<td>18</td>
</tr>
<tr>
<td>II. Heavy bombardment armament—Only for B-24 crews</td>
<td></td>
</tr>
<tr>
<td>Electrical armament controls and bomb racks</td>
<td>9</td>
</tr>
<tr>
<td>Power operated gun turrets</td>
<td></td>
</tr>
<tr>
<td>Gun sights and cameras</td>
<td>2</td>
</tr>
<tr>
<td>Martin upper turret</td>
<td>3</td>
</tr>
<tr>
<td>Sperry lower ball and untractable turret</td>
<td>3</td>
</tr>
<tr>
<td>Consolidated tail turret</td>
<td>3</td>
</tr>
<tr>
<td>Flexible gun</td>
<td>1</td>
</tr>
<tr>
<td>Field test on B-24 airplane</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>22</td>
</tr>
</tbody>
</table>
### III. Heavy Bombardment Armament—Only for B-17 Aircrews

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical armament controls and bomb racks</td>
<td>9</td>
</tr>
<tr>
<td>Power operated gun turrets</td>
<td></td>
</tr>
<tr>
<td>Gun sight and camera</td>
<td>2</td>
</tr>
<tr>
<td>Sperry upper turret</td>
<td>3</td>
</tr>
<tr>
<td>Sperry lower ball and retractable turret</td>
<td>3</td>
</tr>
<tr>
<td>Benaix chin turret</td>
<td>2</td>
</tr>
<tr>
<td>Bell gun mount (12.7, 12.7)</td>
<td>1</td>
</tr>
<tr>
<td>Flexible guns</td>
<td>1</td>
</tr>
<tr>
<td>Field test on B-17 airplane</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total** 22

### IV. Medium Bombardment Armament—Only for B-25 or B-26 Aircrews

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical armament controls</td>
<td>9</td>
</tr>
<tr>
<td>Power operated gun turrets</td>
<td></td>
</tr>
<tr>
<td>Gun sight and camera</td>
<td>2</td>
</tr>
<tr>
<td>Harmonization</td>
<td>1</td>
</tr>
<tr>
<td>Martin upper turret</td>
<td>3</td>
</tr>
<tr>
<td>Bendaix upper turret</td>
<td>2</td>
</tr>
<tr>
<td>Bell gun mounts</td>
<td>1</td>
</tr>
<tr>
<td>75-mm, aircraft gun</td>
<td>2</td>
</tr>
<tr>
<td>Flexible guns</td>
<td>1</td>
</tr>
<tr>
<td>Field test on B-25 and B-26 airplanes</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total** 22

### V. Miscellaneous Armament Equipment—For all students

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Towed targets, windlasses, shut traps</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total** 2

Quotes for the second, third, and fourth phases were set by the flexible gunnery schools, which in turn were determined by commitments for operational training and assignment of combat groups overseas. The first classes were taught according to the following percentages:

- 26% B-17 crew members
- 36% B-24 crew members
- 28% medium bombardment crew members
In the assignment of students to the three courses, an unusual
screening process had to be followed, necessitated by the physical
dimensions of the Sperry ball turret, installed on the B-24 airplane.
It had been found that men taller than 5 feet 5 inches and heavier
than 150 pounds could not operate this type of turret satisfactorily.
Therefore, 36 per cent of the students whose weight and height were
closest to this limit were assigned to the B-24 course, the next 36
per cent to the B-17 course, and all the others to the medium bombard-
ment course.

Then it was determined, in the autumn of 1944, that the aircrew
of the new very heavy bomber, the B-29, would include an armorer-gunner,
the Training Command directed that the scope of armament training at
Lowry be expanded to offer instruction for these men before they entered
the flexible gunnery schools. On the basis of this, a B-29 course
was begun in January 1945 which called for 42 days of training. Dur-
ing the first 20 days the instruction covered the same material given
in the B-17, B-24, and medium bombardment armament courses. The latter
22 days covered material from the remote control turret course.

The AAF expected that its other type of very heavy bomber, the
B-32, would also require the services of an armorer-gunner. During the
latter months of 1944 and early 1945 Headquarters, AAF continued to
send directives and suggestions to Lowry to prepare a course of this
type, and even set a number of starting dates. The Lowry officials went
to great pains to get ready, drawing up a syllabus and coaching instructors;
by December 1944 they were in a position to begin the course as soon as B-32 equipment arrived.

All these plans were scrapped as a result of a conference held at Headquarters, AAF between officials of the Twentieth Air Force and the 40/C/S Training early in February 1945. It was agreed there that the operation of the guns of B-29 and B-32 planes so occupied the time of a gunner that he did not have time to perform maintenance work on such equipment as armament; therefore, it seemed inadvisable to give him armament training. Moreover, the requirement for gunners with armament training on B-17, B-24, and medium bombardment crews had now been completely met. Therefore, during April the B-29, B-17, B-24, and medium bombardment courses were all discontinued, and plans for the B-32 course were dropped.

At this time Headquarters, AAF set as a goal for the Lowry school a type of basic armament training which the school authorities had been urging since April 1943—a long, comprehensive, thorough course, covering all types of aircraft armament and given at an unhurried pace. Such a "token" course would keep intact a small corps of experienced instructor personnel and equipment, and by use of the "block system" make it possible for operational air forces to obtain instruction on part or all of the course for their assigned personnel. The re-organized course, with a curriculum calling for 20 weeks of instruction, was begun during the summer of 1945, with a new class of five men entering every two weeks. The course was as follows:
<table>
<thead>
<tr>
<th>Subject</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Orders and Supply</td>
<td>2</td>
</tr>
<tr>
<td>Chemical Warfare</td>
<td>3</td>
</tr>
<tr>
<td>Explosives and Ammunition</td>
<td>1</td>
</tr>
<tr>
<td>Bombs, Fuses, and Aircraft Rockets</td>
<td>4</td>
</tr>
<tr>
<td>Shop Practice and Basic Electricity</td>
<td>10</td>
</tr>
<tr>
<td>Bomb Racks</td>
<td>15</td>
</tr>
<tr>
<td>Weapons (small arms, machine guns, aircraft</td>
<td>30</td>
</tr>
<tr>
<td>cannon)</td>
<td></td>
</tr>
<tr>
<td>Fixed and Flexible Gun Mounts</td>
<td>1</td>
</tr>
<tr>
<td>Sights, Cameras, and Harmonization</td>
<td>9</td>
</tr>
<tr>
<td>Turrets (locally and remotely controlled</td>
<td>20</td>
</tr>
<tr>
<td>turrets and gun mounts)</td>
<td></td>
</tr>
<tr>
<td>Tow Targets, Windlasses, and Skeet</td>
<td>1</td>
</tr>
<tr>
<td>Final Phase Testing</td>
<td>4</td>
</tr>
</tbody>
</table>

With this curriculum, the Lowry school undertook to train the armorer necessary to maintain the "Postwar Air Force."
Chapter IV

POWER OPERATED GUN TURRET AND REMOTE CONTROL TURRET COURSES

The courses dealing with the maintenance of power operated gun turret and remote control turret (central fire control) systems are of peculiar interest because they were the only regularly given courses in the armament field exclusively concerned with equipment which came into use while World War II was being fought.

Power Operated Gun Turret Courses

First and second echelon. In the summer of 1940, reports reached Lt. Col. Early E.W. Duncan, Commandant of Lowry Field, that the RAF was experiencing considerable success in the use of power operated gun turrets and that the Air Corps was contemplating their installation on its bombers. These reports led Colonel Duncan to propose to the Chief of the Air Corps that steps be taken to establish a course in the maintenance of this type of equipment. Such training, he suggested, should be given not to all aircraft armormers, but only to men who would be concerned with the maintenance and operation of such equipment.¹

For six months no action was taken on his idea. Not until 5 December 1940 did the Air Corps make any definite plans for the procurement and installation of power operated gun turrets in its bombers.² Not until 27 March 1941 did a board composed of an officer from Lowry and one from Wright Field meet at Wright Field to formulate recommendations as to
how such a course should be established. Their chief proposals were:

(1) The course should be completely distinct from the current course.
(2) It should be approximately 16 weeks in duration.
(3) It should graduate approximately 40 students each month.
(4) Because turrets were extremely complicated equipment, great care should be exercised in the selection of students.
(5) Men already assigned to tactical units should not be sent to Lowry to take the course. Assigned personnel should receive instruction from civilian representatives of the factories manufacturing the turrets installed in the airplane used by their squadrons.
(6) In preparation for the course, eight Lowry enlisted instructors were to be sent to the four factories making the turrets adopted by the Air Corps as follows:

- 2 instructors to General Electric for 6 weeks' instruction
- 2 instructors to Sperry for 6 weeks' instruction
- 2 instructors to Bendix for 6 weeks' instruction
- 2 instructors to Consolidated for 2 weeks' instruction

(7) As it did not seem likely that more than one officer could be spared for the course, it would be necessary that he take training at each of the four factories. To estimate was made as to the amount of time this would require.
(8) The course should start just as soon as turrets necessary for instructional purposes had reached Lowry and the instructors had returned from their training at the factories.

With a single important exception, all of the board's recommendations were approved by the Training and Operations Division of the Office of Chief of the Air Corps. Owing to the critical times, Training and Operations felt that 16 weeks was too long a period for such a course; eight would be enough.

Capt. William F. Bay of Lowry was detailed to make arrangements for training eight instructors and himself at the manufacturing plants.
This was not easy to accomplish, for a complete set of the turret equipment was hard to come by, even at the factories. However, the manufacturers went out of their way to cooperate, and by the middle of September all eight instructors had had some sort of factory training. During the following inter Captain Day and his instructor corps paid several visits to the plants so as to keep abreast of the technical advances being made in this rapidly developing field.

Captain Day, who subsequently became supervisor of the Turret Division at Lowry, has left a vivid description of the conditions which prevailed when the new course was started. "On September 15, 1941," he wrote later, "this school, armed with six inexperienced turret instructors and no equipment, prepared to meet thirty-three (33) students who had been sent to Air Corps tactical organizations. The instructors had purposely avoided making a schedule of instruction to the tactical units, because they did not know the type of student who would appear, nor did they have any past experience as a base on which to allocate time of study on a given subject."

It required only a few weeks of experimentation to convince the Lowry officials that the Office of Chief of the Air Corps had made a mistake in setting the length of the course at eight weeks. On October 7 they requested permission to extend it to 12 weeks; three weeks later the O.C.O granted permission for a "temporary extension."
From the outset the school was handicapped by the "pitiful lack of sufficient power turret equipment." Some Martin turrets trickled in during the first month the school was giving instruction, but six months passed before any Bendix or Consolidated equipment arrived. "The Bendix instructors," Captain Day reported, "were forced to use the limited supply of blueprints, diagrams, and notes that were available. In short, the instructors were forced to teach a 'blackboard' turret for more than six (6) months. This tended to confuse the instructors as well as the students as only two of the instructors had actually seen or operated the Bendix. The students rapidly lost interest in the 'blackboard' turret . . . ."

The school had some equipment which was, in the words of Captain Day, "of great value, but only insofar as it was better than nothing. For instance, the Sperry sight is fourteen inches square, and only four instructors and one student can study it with semi-effective results. This acute shortage of sights not only lengthens our period of study, but, in addition, fails to give students a chance to 'tare it down' and gain a working knowledge."

The turret course was still in this embryonic state when the attack on Pearl Harbor plunged the nation into war. On December 1941 the Power Turret Division was directed by the Technical Training Command that the course was to be shortened to eight weeks, with a new class of 60 men entering each four weeks.

Under this new schedule, which went into effect on December, instruction time was allotted as follows:
<table>
<thead>
<tr>
<th>Phase</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pendaix Turrets</td>
<td>2 weeks</td>
</tr>
<tr>
<td><em>Introductory mater</em></td>
<td></td>
</tr>
<tr>
<td><em>ial, Pendaix lower turret,</em></td>
<td></td>
</tr>
<tr>
<td><em>and Pendaix upper turret.</em></td>
<td></td>
</tr>
<tr>
<td>Sperry Turrets</td>
<td>4 weeks</td>
</tr>
<tr>
<td><em>Sperry sights, maintenance, installation,</em></td>
<td></td>
</tr>
<tr>
<td><em>and harmonization, 9 days; caliber .50</em></td>
<td></td>
</tr>
<tr>
<td><em>machine gun, 1 day; Sperry upper local</em></td>
<td></td>
</tr>
<tr>
<td><em>turret; Sperry lo. or ball turret; and</em></td>
<td></td>
</tr>
<tr>
<td><em>Sperry lower ball retractable turret.</em></td>
<td></td>
</tr>
<tr>
<td>Martin Turret</td>
<td>3 days</td>
</tr>
<tr>
<td>Consolidated Tail Turret</td>
<td>4 days</td>
</tr>
</tbody>
</table>

At the start of the first phase, considerable time was devoted to explanations of the importance of turrets in bombardment warfare. This was done because it had been found that some students did not apply themselves to the course, declaring that they were not interested in the subject.

Early in 1943, the curriculum was reorganized, with the four weeks devoted to Sperry equipment being given as the first phase and the two-week period on Pendaix turrets becoming the last phase. Under this new arrangement, most of the first day of the course continued to be devoted to the caliber .50 machine gun. Experience had indicated that a "practical knowledge of machine guns" was so important to turret maintenance men in the field that this instruction was repeated on the first day of the Martin course, the second phase under the varied curriculum.

The course was lengthened to nine weeks the following September so that a week's instruction could be given on two new types.
of equipment, the London lower chin turret and the Emerson nose turret. The London officials had made elaborate, if not completely successful preparations for these new phases. As soon as they heard that the two new types of turrets were being installed in the bombers, they undertook to obtain some for the school; but as operational units had priority, none could be procured until instruction on them had commenced at Lowry. The school did succeed in arranging to have several enlisted instructors visit modification centers, the Armament Training School at Indianapolis, and the factory of the Emerson company to obtain data upon which to plan the course.

Then in the summer of 1943 the Training Command put into practice a policy of having all technical courses organized into "blocks of instruction" so that students on detached service from tactical organizations might take only the instruction which they would use when they returned to their units, it became necessary to rearrange the syllabus of the turret course more completely than was the case in other armament courses. The revision went into effect on 15 October, at which time the course was renamed "Power Operated Turrets and Gun Mechanic Sight Specialist Course" out of respect to the highly important sights used in connection with the turrets. Under this revision, the instruction was arranged as follows:

<table>
<thead>
<tr>
<th>Block</th>
<th>Subject</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Caliber .50 Machine Gun</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Consolidated Turret</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Sperry Upper Local Turret</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Sperry Local ball Turret</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Sperry Automatic Computing Sight</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>Electricity</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Martin Turret</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>Emerson Turret</td>
<td>6</td>
</tr>
<tr>
<td>9</td>
<td>Bendix Turret</td>
<td>6</td>
</tr>
</tbody>
</table>
Under this system, a student from a unit operating:

- B-17 F planes would take only Blocks 1, 3, 4 and 5;
- B-17 G " " " " " 1, 3, 4, 5, 6, and 9;
- B-24 D " " " " " 1, 3, 4, 5, 6, and 9;
- B-24 E " " " " " 1, 3, 4, 5, 6, and 7;
- B-24 G/H " " " " " 1, 3, 4, 5, 6, and 7;
- B-25 D " " " " " 1, 3, 4, 5, 6, 7, and 9;
- B-25 G " " " " " 1, 3, 4, 5, 6, 7, and 9;
- B-26 " " " " " 1, 3, 4, 5, 6, 7, and 9;

Unassigned students would take the entire course as previously.

The K-series of gun sights caused the Lowry officials a number of problems during the winter of 1943-44. The first case arose when a copy of AAF Training Standard No. 20-52, prepared by Headquarters, AAF and dated 20 September 1943, reached Lowry early in October. In an analysis of the standard convinced the school officials that their course prepared students to meet all the specifications except for the maintenance of the K-6, K-9, K-10, and K-11 computing gun sights, the Crocker-Heeler and Curtiss-Right turrets, and the Bell gun mount. These were not being taught because the school had never received a directive to teach them, and did not possess any of the equipment in question.

As a matter of fact, the Lowry officials had undertaken to anticipate the need for equipment on the K-6 several months earlier, but without success. In July one instructor was sent to the Fairchild factory to study the sight, and three were sent the following October. These units, which were used in conjunction with the Martin turret, were complex in design and operated on the electronic principle. It would be necessary
to devote two weeks to teach them adequately. But for some time the school could not obtain permission to lengthen the turret course to 11 weeks or to set up a special two-week I-8 sight course.

Early in December two Sperry I-11 gun sights arrived at Lowry. The school had no instructors qualified to teach their maintenance. They remained idle several months while Lowry made an effort to obtain civilian instructors from the Sperry Gyrocope Company, and finally sent five of its own instructors to the Sperry factory.

By early 1944 it had become apparent that in the future the Aaf would center its attention on very heavy bombardment. Inasmuch as this type of aircraft employed a central fire control system, with certain similarities to, as well as certain important differences from, the power operated turret systems, some modification of Aaf training in this field appeared necessary. On 16 February 1944 the Training Command issued a directive that the "Power Turret and Gun Sight Specialist Mechanic Course" be changed into a "Pre-central Fire Control Course" which would act as a feeder to a new "Central Fire Control Course."

The Lowry officials' efforts to offer in their Power Turret and Gun Sight Specialist Mechanic Course, only the first three covered material which would be useful to men destined to maintain central fire control systems. These were the phases devoted to the caliber .50 machine gun, basic electricity, and electricity as it applied to the amplitidyne system. Therefore, they thought, only these three phases should be given to central fire control students.
"The Central Station Fire Control System," the training Command wrote, "is still considered to be in the experimental stage, since it has not yet been proven in combat." There was considerable possibility that it might have to be scrapped and a more conventional turret system installed. If this should prove necessary, the Training Command added, it did not wish to have to re-train the men after the change was made. Therefore, it directed, men should be given the complete instruction on both power turrets and/central fire control system, although obviously redundant material might be eliminated.

With obvious reluctance, the Army and Navy authorities complied with the order, revising the power turret and gun sight specialist "chance course so that it could serve as a pre-central fire control course. Beginning on 10 April, the seven weeks of instruction was arranged as follows:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Electricity</td>
<td>6</td>
</tr>
<tr>
<td>Machine Guns and Martin Turret</td>
<td>6</td>
</tr>
<tr>
<td>Emerson Turret</td>
<td>6</td>
</tr>
<tr>
<td>.50 Cal. Gun at .30 (.30-06)</td>
<td>12</td>
</tr>
<tr>
<td>.30 Cal. Gun (.30-06)</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
</tr>
</tbody>
</table>

It will be observed that to reduce the length of the course from nine to seven weeks, instruction on Consolidated and anemis turrets was omitted. Basic Electricity was moved to the beginning of the course because it was felt that this material was fundamental to all turret instruction.
After this syllabus had been in use just about a month, the Lowry authorities returned to their earlier position that it wasted the student's time. Now they offered a rebuttal to the Training Command's objection that if there was a separate central fire control course delay in training might result, in the event that the central fire control system were scrapped and regular power turrets substituted in very heavy bombers—it would take only seven weeks to retrain Central Fire Control Equipment (CFCE) men, less time than would be required to modify the airplanes themselves. On May 20 the school officials were notified that beginning two days later they might substitute a three-week course in basic electricity and the caliber .50 machine gun for the seven-week course for men who were point to take a CFCE course. The three-week Pre-central Fire Control Course was consolidated with the Remote Control Turret course on 21 August 1944. Its vicissitudes after that date are discussed in the section on Remote Control Turret (RCT) courses.

This left Lowry officials still concerned about the students destined to maintain the conventional type of power operated turrets. In its streamlined seven-week form, the course neglected many types of turrets and gun sights which its graduates might later be called upon to service. To correct this, late in May 1944 the Lowry authorities recommended that the course be extended to 12 weeks, to include instruction on three types of equipment not previously taught, but which had come into general use—the Scarry gun sights K-9 and K-11, and the Norden Products turret wheel. It also provided for a full week of instruction on machine guns, instead of the one-day period, which Lowry
believed to be grossly inadequate.

Twelve weeks is too long, Headquarters, HAF ruled, when the request reached it; 10 weeks was all that could be allowed. In this 10-week period, all the equipment proposed by bergy Field, plus the 1-13 gun sight, must be taught:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Guns</td>
<td>3 days</td>
</tr>
<tr>
<td>Basic electricity</td>
<td>1 week</td>
</tr>
<tr>
<td>Appliances</td>
<td>3 days</td>
</tr>
<tr>
<td>Martin Turret</td>
<td>1 day</td>
</tr>
<tr>
<td>Emerson Turret</td>
<td>1 week</td>
</tr>
<tr>
<td>Bendix Turret (upper and lower)</td>
<td>1 week</td>
</tr>
<tr>
<td>Consolidated and Motor Products</td>
<td></td>
</tr>
<tr>
<td>Turrets</td>
<td>1 week</td>
</tr>
<tr>
<td>Sperry Turret (upper and lower)</td>
<td>1 week</td>
</tr>
<tr>
<td>Sperry Gun sights (1-3, 1-6, 1-9, 1-10, 1-11, 1-13)</td>
<td>3 weeks</td>
</tr>
</tbody>
</table>

This schedule was put into effect with the class entering on 3 July 1944.

From the middle of 1944 to the end of the war the school officials kept increasing the length of the course constantly—to 11 weeks in March 1945, to 13 weeks in May. These additions were made primarily to permit the incorporation of material on new types of equipment or turrets which the HAF was using—specifically the Sperry 1-17 and 1-17/F, 1-14 and 1-15 sights; the Sperry Upper Turret Type 1-10, equipped with 22X/50-5.

Not all the curriculum changes involved additions, however, for equipment which had been superseded or found inadvisable in use was dropped. By V-J Day the course had been lengthened to 16 weeks, and was operating on a token basis with only 12 men in each class.
Subject               Days
Caliber .50 Machine Gun  3
Basic Electricity       7
Amplidyne              4
Martin Turret          6
Emerson Turret (A-15 and A-15A) 6
Tendix Turret (Upper and chin) 6
Motor Products Type Turrets and Bell Gun 6

Punts

Sperry Turrets (Upper, lower, lower retractable, nose, and tail) 12


Third and Fourth echelon. In the spring of 1942, about the
time that the first and second echelon power turret course was get-
tting under way at Lowry Field, the field services division at Head-
quarters, AAF, became concerned about the need for training on a
third and fourth echelon level. Most of this work was to be performed
in the depots and sub-depots of the Air Service Command (ASC) by both
civilian and military personnel. At its direction a 10-week course
in first, second, third, and fourth echelon maintenance was estab-
lished at the AAF Storage Depot, State Fair Grounds, Indianapolis,
Ind., an installation of the Air Service Command. The course was
operated in two shifts, one for military personnel and one for civilian
employees. As far as practicable, civilian instructors taught civilians,
while enlisted instructors taught the military personnel. The principal
features of the course were:

I. Basic Fundamentals
   Mathematics, electricity, hydraulics

   Weeks

   2

   32

   32

   32
Subject--Contd.

II. Martin Turret (electrically operated upper) and Consolidated (hydraulically operated tail) Turret

II.1. 2

III. Flexor Turrets (electrically operated upper and lower)

III.1. 2

IV. Sperry Products
  Sperry sight, upper local and local ball turrets

IV.1. 4

Originally all personnel at the school--military and civilian, instructor and student--had been furnished by the ASC, the organization which would use third and fourth echelon maintenance personnel in depots and subdepots. Although the ASC exercised a certain degree of selectivity in assigning students to the course, the school authorities found that the students did not always have the knowledge of mathematics, elementary electricity, elementary hydraulics, and simple coloring and wiring methods which they considered indispensable for turret maintenance work. To cover this material they had incorporated the preliminary two-week phase known as "Basic Fundamentals."

When the school was transferred to the Technical Training Command and its name changed to Armament Training Center No. 3, on 1 February 1943, the TTC assumed the responsibility of providing the enlisted students for the course. The TTC decided that hereafter certain percentages of the graduates of the Lowry basic armament course would be selected for the Indianapolis course. The use of the Lowry armament course as a "feeder" for the Indianapolis turret course inevitably
produced a number of problems of coordination and friction between
the two schools.

The first arose from a desire to avoid duplication between the
two courses. During this period, it will be recalled, the last three
weeks of the lowry armament course were devoted to study of power opere-
ted turrets on a familiarization level. The Indianapolis school urged
that its quota of students be sent to it before taking this phase—in
other words, three weeks before graduating from the lowry course. The
lowry officials protested that this would lead to the loss of the IAF
of any potentially fine gunners. If a man had completed the lowry
course but was eliminated from the Indianapolis course, he was at least
qualified for service as a basic gunner. On the other hand, if he left
lowry before he had graduated and then failed the turret course, he would
be qualified neither as a basic gunner nor as a turret man. The IAF
ruled in favor of the Indianapolis school, and the men accordingly were
sent on to the turret course three weeks before graduating from lowry.

The second source of friction was the type of men which lowry sent
to indianapolis. In April 1943, after five classes had been received,
the officials of the indianapolis school protested that on the average,
the quality of the men sent was far below that of those previously
furnished by the air service command. Comparatively few had had any
mechanical experience or training before entering lowry. In analysis
of the fifth class, they declared, showed that seven of the 21 men had
not graduated from high school, and five had had no previous chemical
training. These shortcomings are felt particularly during the course on the turret turn. This turret employed the analoge system to master it a man had to have had "the equivalent of a full college course in electricity." It has been understood that only top-ranking students are sent to Indianapolis. However, the school authorities declare, "we are inclined to believe that these men are run of the course, we are selecting alphabetically only."

In defending themselves the locny officials pointed out that, acting on directives from higher authority, they were selecting their armament students into six categories when making assignments. Four of these types of assignments had been given higher priority than the Indianapolis school. They promise that hereafter they will select students for Indianapolis from the fourth as well as the fifth categories. The Indianapolis authorities have too haphazardly reconciled themselves to this situation. Their faculty board increased the rate of eliminations, although trying always to give the benefit of the doubt to men who were slow in grasping the subject matter, but who tried hard.

The increased use throughout the LP of two pieces of turret equipment made it necessary to extend the course by one week during September 1943. The first was the Bell 4-6 gun mount. Three days were devoted to familiarization training, complete dismantling, and brief practice in trouble shooting. Time for this instruction was taken from the phase covering Sperry turrets, which had to be reduced from three to two and one-half weeks.

The other was the Emerson turret, which resembled the Consolidated...
turret in many respects but used electrical rather than hydraulic power, and required a full week of instruction.

The problem of friction between the two schools ended when, as part of an AIF policy of centralizing all technical training, the Indianapolis school was ordered closed as of 31 January 1944, and all its military instructor personnel moved to Lorry.

There was a delay of several months in setting instruction on the third and fourth echelon level under way at the new location. The Lorry authorities protests that the Sperry sights were too "diversified" in nature to include them in the same course with turrets, and proposed that the separate courses be given. This notion was rejected by the training command, however, and an eight-week Power Operated Turret and Gun Sight Repairman Course was begun on 15 May 1944. Classes were small—usually four enlisted men to a group—selected from recent graduates of Lorry's first and second echelon course. Enlisted men sent by depots and subdepots on detached service were also accommodated after time to time. Subject matter covered was:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Fundamentals (tools, shop practice,</td>
<td>1</td>
</tr>
<tr>
<td>repair of Plexiglass, etc.)</td>
<td></td>
</tr>
<tr>
<td>Consolidated Turret</td>
<td>1</td>
</tr>
<tr>
<td>Bendix Turret</td>
<td>1</td>
</tr>
<tr>
<td>Martin Turret</td>
<td>1</td>
</tr>
<tr>
<td>Jaercoen Turret</td>
<td>1</td>
</tr>
<tr>
<td>Sperry Turret</td>
<td>1</td>
</tr>
<tr>
<td>Sperry Sights</td>
<td>1</td>
</tr>
</tbody>
</table>

It will be observed that although the new course at the outset was two weeks shorter than it had been at Indianapolis, it included...
instruction on the Emerson turret, which had not been given previously. This arrangement was soon recognized as being unsatisfactory, and the course had to be lengthened to permit more thorough instruction as well as the addition of new types of LAF turrets and sights—from 8 to 10, to 14 weeks. By V-J day the course was being operated on a token basis, 10 students in a class, and classes 16 weeks in length.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Shop Practices</td>
<td>8</td>
</tr>
<tr>
<td>Motor Products Type Turrets</td>
<td>6</td>
</tr>
<tr>
<td>Bendix Turrets (upper and chin)</td>
<td>6</td>
</tr>
<tr>
<td>Martin Turret</td>
<td>7</td>
</tr>
<tr>
<td>Emerson Turret (A-15 and A-15½)</td>
<td>6</td>
</tr>
<tr>
<td>Sperry Turrets (upper, lower, and lower-retractable)</td>
<td>12</td>
</tr>
</tbody>
</table>

Remote Control Turret Courses

First and second column. During 1942 the LAF started making plans to train men to operate a radically different type of airplane—the very heavy bomber, the B-29. The armament on this plane was to be unique—five turrets which might be controlled by any one of five operators. Two firms were making equipment for it at that time—the General Electric Company and the Sperry Company, although it was expected that for the time being only that manufactured by General Electric would be used.

The Los Angeles school was told to proceed with plans for training on the central fire control equipment (CFCE) in January 1943. The school authorities selected instructors experienced in teaching its Power Operated
Turrets Course to provide an initial instructional cadre. Groups of them were sent to the General Electric Factory at Schenectady, N.Y., and to the Boeing Aircraft plant at Wichita, Kans., for short periods of intensive training. In addition, the General Electric sent three of its employees to Loyly for a period to teach instructors there.

Because of the complex nature of the N-12, IAF training officials realized that enlisted men of unusually high quality would have to be selected for the student body. The first and second echelon POST course would provide an excellent background for the new course, they felt; hence the former was to be considered a prerequisite for the latter. But only the "cream" of the POST classes were to be selected: they must have an IAF score of 120, a grade of 120 in the mechanical movement test, and a score of 140 in the Army Mathematics test—and in addition, an understanding of the nature of radio, electricity, and mechanics. Since most of the students already possessed these qualifications were already assembled, the school found it difficult to find enough men to meet the quota. Because of the high priority of the B-29 project, basic qualification centers were forced that they must scrupulously fill all quotas for the course.

The number of men trained in 1943 was guided closely to the changing requirements of the B-29 program, which in turn were controlled by the production rate of the B-29 factories. At the outset a new class of 34 men was entered every two weeks. The length of the course was likewise tentative; when it started on 1 March 1943 it ran...


<table>
<thead>
<tr>
<th>Subject</th>
<th>Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Electricity</td>
<td>2</td>
</tr>
<tr>
<td>Selecting: Use of Tools; Rotating Machines; Gun Chasers</td>
<td>2</td>
</tr>
<tr>
<td>Vacuum Tubes; Selzyn Function; Servo-amplifier</td>
<td>2</td>
</tr>
<tr>
<td>Selzyn-zeroing; Follow-up System; Sighting Stations; Radio L-29 Wiring Diagram</td>
<td>2</td>
</tr>
<tr>
<td>B-29iring Districts</td>
<td>2</td>
</tr>
<tr>
<td>B-29 Malfunctions</td>
<td>4</td>
</tr>
<tr>
<td>Malfunctions; Demagnetization; Test Operation</td>
<td>2</td>
</tr>
</tbody>
</table>

During the last two weeks of the course the students worked on a mock-up of the B-29 under simulated warfare conditions. These included sudden gas drills, exercises in slit-trench digging, inadequate lighting, rain, bombing and strafing attacks, etc. etc.

During its first year the size of the classes has increased enormously—on. class which entered in August 1943 numbered 124 cadets.

Even more of a problem from an administrative point of view was the fact that the size of the classes fluctuated greatly. Owing to the difficulty of the subject matter, the elimination rate ran high—as high as 15 per cent.

These mounting cadet and high elimination rates soon made it impossible for the Lowry officials to find enough qualified students among the graduating classes of the other operated turret courses. To provide the needed number, additional courses were opened: the Lowry Field basic armament course; the school at Buckley (during the period the armament course was being given there); and Irux, Scott, and Sioux Falls,
where courses in radio and electronics were conducted. To meet their quotas, some of the schools sent men whose ASET scores were below 120. The failure of so large a percentage of men caused the Army officials to screen incoming students carefully and to accept only as many below the 120 mark as was absolutely necessary. Students who professed no interest in the course were also eliminated, so far as possible, by screening.

During 1944 the course underwent a series of revisions designed to obviate the necessity of students having an armament, radio, or electronics background to benefit from the training. This was accomplished first by the institution as a preliminary course of a three-week Fire Control Course consisting of instruction in basic electricity and the caliber .50 machine gun. Then, beginning in August 1944, the Central Fire Control Course (which is now coming to be called the Remote Control Turret Mechanic Course) was lengthened to 18 weeks to permit the incorporation of the Fire Control Course material. About a year later the course was again lengthened, this time to 20 weeks:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caliber .50 Machine Gun</td>
<td>5</td>
</tr>
<tr>
<td>Principles of Electricity Applied to AFT</td>
<td>20</td>
</tr>
<tr>
<td>Drive Units</td>
<td>10</td>
</tr>
<tr>
<td>Servo-Incliner</td>
<td>20</td>
</tr>
<tr>
<td>Basic System</td>
<td>20</td>
</tr>
<tr>
<td>Wiring Diagrams and Auxiliary Equipment</td>
<td>20</td>
</tr>
<tr>
<td>Malfunctions</td>
<td>20</td>
</tr>
<tr>
<td>Inspection and Maintenance</td>
<td>5</td>
</tr>
</tbody>
</table>

Third and fourth echelon. In November 1942—three months before the end of the war—Lowry Field started its first and second echelon OCS course—the
started a four-week course in depot overhaul at the Ammunition Training School at Indianapolis. The school chose graduates from each of its classes in power-operated gun turret depot overhaul for this training.

Two major difficulties were experienced in conducting the course. One grew out of the fact that a four-week period was much too short to cover adequately the difficult subject matter involved. This was aggravated by the manner in which the school selected students: men receiving top grades in the Power Operated Gun Turret Depot Course were assigned to OCM training even though they had no particular interest in OCM and in many cases—so it was charged—had obtained their high grades "through dubious means." Instructors at the school had the feeling that as a result many men were graduated from the course who were not actually qualified. Another difficulty was that the school did not have enough or the right kind of equipment. It had four sets of P-61 equipment—probably enough for the four-to-eight-student groups which composed the first classes, but far too few for the 30-to-40-man classes which followed.

The needs of the AOC for increased numbers of maintenance personnel and the policy of concentrating depot overhaul training at Lowry brought a drastic revision early in 1944. The school at Indianapolis was closed down, and Lowry was directed to start a new course, to last 12 weeks, on the third and fourth scholastic level. The General Electric Company dispatched a representative to Lowry to assist the school authorities in setting up the new course. New classes of seven men each, graduates of the Lowry Power Operated Gun Turrets Departed Course, were
entered weekly. Lowry had the benefit of a quantity and variety of equipment which the Indianapolis school had never enjoyed.\textsuperscript{51}

One part of the CRCS—or remote control turret system—which created considerable maintenance problems was the computer. Most of the time of the Lowry course was devoted to explanation of this computer.\textsuperscript{52} In addition, the General Electric Company conducted at its Schenectady factory a six-week course in fourth echelon maintenance of the computer for key maintenance personnel who had graduated from the Lowry first and second echelon remote control turret course.\textsuperscript{53}
Chapter V

BOSIGHT MAINTENANCE COURSE

The Airmen Training Program, first of the Air Corps expansion program, provided that between March 1939 and June 1940 an average of 12 bosight mechanics was to be graduated from the Air Corps technical schools each month. Responsibility for meeting this goal fell upon the school at Lowry Field, which during the entire calendar year of 1938 had graduated a total of only 24 bosight men, but by stretching material, personnel, and school housing facilities, Lowry nearly was able to achieve the pace which the higher authorities had set for it. By October 1939 it was entering 12 students a month; by November 1940 it was enrolling well over 24 students a month.

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 Lowry authorities had to labor. In late 1939 and early 1940 they had substituted instruction on the new Sperry 0-1 sight for the now outdated Sperry 1-1 sight; they also began giving instruction on the new automatic pilots used in connection with Sperry and Borden sights. Although those pilots required considerable explanation, it was believed that the length of the course ought not to be extended beyond the 12-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.

In this form, however, the course pleased neither the Navy officials nor the Air Corps officials in Washington. Both agreed that 12 weeks was too short a period for the amount of material the course attempted to cover. As the Director of the NavyArmament 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 12 weeks of training on the Norden sight and its pilot plus the Sperry sight and its pilot; and the results in the Air Corps were not considered satisfactory by the school authorities.

One possible solution was to train students only on the particular type of pilot and sight they were to be assigned to maintain. The drawback to this, as expressed by the Office of the Chief of 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 Navy authorities, was to lengthen the course to four months, devoting three months to the Norden sight and pilot, as well as to the mathematical and scientific principles necessary to its understanding, one month to the Sperry sight and pilot. Admittedly this plan had its shortcomings: it would require one-third more time, 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,
It is believed that instruction on Sperry equipment should be as accurate and as thorough as that given for the Norden Bombight, even though fewer sets of Sperry equipment are available to the Service. It is the experience of the current crunch that the Sperry sight is the more difficult of the two types to teach and that instruction is simplified if the course in Norden follows.

Out of these discussions a new curriculum was developed which was put into effect 1 July 1940:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory Problems</td>
<td>44</td>
</tr>
<tr>
<td>General Course Problems</td>
<td>4</td>
</tr>
<tr>
<td>Elementary Electricity</td>
<td>16</td>
</tr>
<tr>
<td>Principles of Gyroscopic</td>
<td>16</td>
</tr>
<tr>
<td>Disassembly of Norden '41 Bombight by Instructor</td>
<td>16</td>
</tr>
<tr>
<td>Clock, Theory and Maintenance</td>
<td>12</td>
</tr>
<tr>
<td>Trainer '11, Theory and Practical</td>
<td>12</td>
</tr>
<tr>
<td>Complete Disassembly of '41 by Instructor</td>
<td>16</td>
</tr>
<tr>
<td>'1''-series sight, Operation by Trainer</td>
<td>24</td>
</tr>
<tr>
<td>Norden Automatic Sight Control Equipment</td>
<td></td>
</tr>
<tr>
<td>(N.C.1) Course work; study of Units and their Function</td>
<td>36</td>
</tr>
<tr>
<td>A.F.C.3 Maintenance and Inspection of equipment in plane</td>
<td>16</td>
</tr>
<tr>
<td>A.F.C.4 Adjustment in Flight</td>
<td>16</td>
</tr>
<tr>
<td>'1''-3 Disassembly by Students</td>
<td>16</td>
</tr>
<tr>
<td>'1''-3 Maintenance and Cleaning</td>
<td>16</td>
</tr>
<tr>
<td>'1''-4 Maintenance and Cleaning</td>
<td>16</td>
</tr>
<tr>
<td>'1''-3 Calibration by Instructor, Students</td>
<td></td>
</tr>
<tr>
<td>Observing, Taking Notes, and Practicing Adjustments</td>
<td>16</td>
</tr>
<tr>
<td>'1''-3 Calibration by students</td>
<td>64</td>
</tr>
<tr>
<td>'1''-4 Calibration by students</td>
<td>64</td>
</tr>
<tr>
<td>'1''-series Summary</td>
<td>2</td>
</tr>
<tr>
<td>Sperry O-1 General Study of Units and their Function</td>
<td>64</td>
</tr>
<tr>
<td>O-1 Calibration by Instructor, Students Observing and Practicing Adjustments</td>
<td>8</td>
</tr>
<tr>
<td>O-1 Calibration by students</td>
<td>32</td>
</tr>
<tr>
<td>O-1 Trainer Operation</td>
<td>24</td>
</tr>
<tr>
<td>O-1 Installation in Airplane</td>
<td>4</td>
</tr>
<tr>
<td>Flying (dry runs)</td>
<td></td>
</tr>
<tr>
<td>O-1 Summary</td>
<td>16</td>
</tr>
</tbody>
</table>

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Late in November 1940 the Army authorities recognized that the Sperry G-1 sight was no longer being used in the Air Corps, and discontinued giving instruction on it. The dropping of this equipment permitted them to revise the syllabus to meet a criticism that had frequently been made that the G-1 equipment was so complicated that only superior students could master it in two weeks. With the omission of Sperry material, the length of the course was made 16 weeks, with four weeks—the sixth to ninth inclusive—devoted to...

Under this revision, during the eighth and ninth weeks 24 hours were designated "flying time." Although the eight-week maintenance men are 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 make the final flight a sort of culmination in which the student would be called upon to demonstrate his 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 at Lorry. In actual practice, only one-half of an eight-man class could fly at one time, with the result that only 12 hours were actually spent on the aerial instruction of each student.

In the face of Air Corps expansion quickness in the autumn of 1941, increasing numbers of men who had had no previous experience in flight or sight work in technical units arrived at Lorry to take the course.
Recognizing that the course was too short and limited in scope to turn a novice into an expert, the Director of the Armament Department gave an order that thereafter the fact that a man was not fully qualified was to be entered on his qualification card when he graduated. The entrance of the United States into World War II brought a reduction in the calendar length of the course from 14 to 12 weeks. Actually, the curriculum remained substantially unchanged, and as the school operated on a six- rather than a five-day week after 13 December, the number of training hours was increased from 560 to 576.

By the summer of 1942 production of the new Sperry S-1 bombsight and L-5 automatic pilot was well under way; it was planned ultimately to install them on 50 per cent of all new combatant planes. To be foreseen for the expected demand, training on the Sperry instruments was inaugurated on 20 July. At first all students were given eight weeks of first echelon training in both Sperry and Lorden equipment, while certain ones continued for an additional four weeks of second echelon training on either Sperry or Lorden equipment.

This arrangement, it soon was realized, was far from satisfactory. Tactical units expected all their mechanics to be able to perform at least second echelon maintenance. Thus, beginning 10 October 1942 all bombsight mechanics were given a 12-week course which covered second echelon maintenance of either Sperry or Lorden equipment. All students took the first three phases:
First week, 42 Hours
- Mathematics; Vacuum Tubes; TF 1-277 "Theory of Bombing";
  Bombing Problems; Cross Irlul; X-8 Sight.

Second week, 42 Hours
- Physics of Pyroscopes; DC Electricity.

Third week, 42 Hours
- DC Electricity and Vacuum Tubes.

At the end of this period, half of the class was assigned to nine weeks of further study on Horden equipment, the other half to an equal period on Sperry equipment. The schedule for Horden students was:

Fourth week, 42 Hours
- Course and Shop Mechanics; "Series 101"; Partial Disassembly; and Wire Diagrams.

Fifth week, 42 Hours
- Partial Disassembly of Late No; Telescope Focus; Wiring Diagram; Disassembly of Sight; Mechanical Operation and Disassembly of Stabilizer; Maintenance of L-3; Freilicht, LeLly, 15 Hours; 15-day Checks of Stabilizer gyro; Maintenance and Operation of D-8 Sight.

Sixth week, 42 Hours
- Changes between L-3 and H-6; Familiarization, Procedures in Handling, Interchange of Units, Maintenance Covered by Students and Instructor; Operation, Wiring and Filing of the Sight; Field Check of the Site and Assembly of Low-Altitude attachment.

Seventh week, 42 Hours
- Calibration; Use of Synchronizing Beam; Practical Examination.

Eighth week, 42 Hours
- Free-Choice Units; Field Calibration; Trouble Shooting.

Ninth week, 42 Hours
- Flight and Operation of Control Services; Stabilized Sight;
  ...etc.; Operation of ...etc.; Lock-up Tests; Miscellaneous
  Aids and Servo Units; Inspection and Installation of Equipment
  in Airplanes.

Tenth week, 42 Hours
- Ground and Flight Adjustments; Inspection and Maintenance of
  ...etc.; in Airplanes; Wiring Diagram; Practical Examination.
Eleventh week, 42 hours
Operation, wiring, Circuits; Inspection, installation, and removal of Units; Ground adjustments; Practical examination.

Twelfth week, 42 hours
Ground adjustments; Wiring and Air adjustments; Inspections; Practical examination.

The schedule for Sperry students after the first three weeks was:

Third Week, 42 hours
Course and Name: TECHNICIAN, S-1 Aim; Partial Disassembly; Firing positions.

Fourth Week, 42 hours
Sectional Drills, Operation and Technique of S-1 Aim; Checking Sight for Proper Calibration and Operation; Practical Examination.

Fifth Week, 42 hours
Calibrations and Operations; Inspections; Firing Position; Routine Maintenance; Practical Examination.

Sixth Week, 42 hours
Trainer Operations; Air Operation; Disassembly, Production; Lamps and Pendulum, Alliance; Practical Examination.

Seventh Week, 42 hours
Disassembly Adjustment; Reassembly and Adjustment; Intermittent, Firing and Storage; Practical Check and Trouble shooting; Practical Examination.

Eighth Week, 42 hours
Unit Unit and Control Panel of A-5 Pilot; Amplifier; Vertical Unit; Block Diagrams; Lock-up; Practical Examination.

Ninth Week, 42 hours
Million Control Operation and Adjustment; Elevator Control, including Trim Tab and Constant Altitude Control; Practical Inspection and Routine Maintenance; Trouble shooting; Practical Examination.

Tenth Week, 42 hours
Maintenance and Adjustment of Unit Unit and Follow-up Amplifier; Disassembly, Maintenance, and Adjustment of Vertical Gyro Unit, Sere Unit, Constant Altitude Control Unit, Follow-up Amplifier, and Trim Tab Control Unit; Practical Examination.
10th week, 42 hours
Ground Check and Adjustment; Serial Flying Adjustments;
 Trouble Shooting and Maintenance; Practical Examination.

Of the total hours, students still spent only 12 hours in the air.

Another drastic revision of the curriculum took place in the
summer of 1943, one designed in response to a curious combination of
needs. Prominent among them was the desire of Headquarters,
AAF, that "overspecialization" be discontinued so that every mechanic
would be able to service both Lorden and Sperry equipment. This seemed
practicable because the production rate which Army had attained
since it is likely that there would be a surplus of mechanics by the end
of the year. Headquarters, AAF, insisted that 12 weeks, or at most
20, would be sufficient for such training. Another factor was the
need of the Air Service Command for 1,022 bombing repairmen, capable
of performing third and fourth echelon maintenance in its depots and
subdepos by the end of 1943.

The new syllabus called for all students to worry to take a
four-week "preliminary phase" dealing with electricity, tools, and
the maintenance of the 5-9 bombight. Then half of the group devoted
eight weeks to a Lorden first and second echelon course, the other
half to an eight-week Sperry first and second echelon course. At the
end of these 12 weeks of training, students in both groups were
screened. The half of the Lorden group which had demonstrated partic-
ular aptitude was then given eight additional weeks of Lorden third
and fourth echelon training, becoming qualified Lorden depot overhaul
men. The half of the Sperry group with unusual aptitude was given eight weeks of advanced training to qualify them as Sperry depot overhaul men. The remaining half of the Sperry group was given Norden first and second echelon training, the remaining half of the Norden group was given Sperry first and second echelon training, and thus were produced men qualified in the maintenance of both sights.\textsuperscript{19}

Another modification to the course was the inauguration of an on-the-job training program following graduation from the course. Need for practical experience before assignment to tactical units became apparent as early as May 1941, when recruits were first admitted to the course. The situation became more acute as many organizations were shipped overseas and many additional ones activated. In June 1942 the Directorate of Bombardment made two proposals calling for Lowry graduates to serve on-the-job at bombardier schools for four weeks before proceeding to their permanent tactical units.\textsuperscript{20} But nothing was done because it was difficult to decide who should be administratively responsible for the men during the on-the-job training period. Equally important was the feeling that the shortage of mechanics made any lengthening of the training period inadvisable.\textsuperscript{21}

By the summer of 1943 both objections had disappeared. There was no longer an acute shortage of mechanics; the Flying Training Command and the Technical Training Command had been merged into the new Training Command. Under a directive from Headquarters, AAF, beginning early in September 1943, bombsight mechanics, upon their graduation from the Lowry course, were assigned to one of eight bombardier schools for eight weeks of practical experience. Only when this eight-week period had been satisfactorily completed...
could a man be assigned to a tactical unit.

During 1944 bombsight maintenance training was modified considerably to conform to new developments in equipment and methods of operation. The most profound change was wrought by the recommendation of a board of officers that use of the Sperry sight and pilot be discontinued by the AAF. Beginning with the class entering Lowry on 19 January 1944, all students received Lorden training. Another notable development was the adoption by the AAF of the "Glide Angle Bomb," an ingenious device used in connection with the Lorden sight to control the flight of the bomb after it had left the plane.

To conform to these changes, the Lowry curriculum underwent constant modification during the first half of 1944. By 1 August 1944 the situation had become sufficiently stabilized to permit the announcement of the following syllabus:

For all Students, First and Second Schelon

Phase 1, 2 weeks:
- Manual skills, tools, letters, DC electricity, electrical devices, supply lothoos, technical crews; the Lorden Stabilizer; UR Digest.

Phase 2, 6 weeks:
- Bombing Problem; D-5 Sight; Lorden M-Series Sight; AFB Computer; Bomb Sight Box; Field repair; Bombing Trainer, Operation and Maintenance; Bomb Release Internal Controls; the Ipaetz.

Phase 3, 2 weeks:
- Glide Bombing attachment, all schelons of maintenance and calibration.

Phase 4, 6 weeks:
- Automatic Pilot, Type 0-1, Maintenance and Calibration.
For Men Selected To Do Third and Fourth Echelon Work

Phase 5, 4 weeks:
- Lorden "17" Series Sight, Depot Overhaul.

Phase 6, 4 weeks:
- Automatic Pilot, Type C-1, Depot Overhaul.

In September, on orders from Headquarters, ASF, all discussion of the D-8 bomb sight was dropped, in recognition of the fact that this non-precision type of sight was no longer being used by the ASF. Time previously devoted to the D-8 was now given to a more extended treatment of the C-1 Auto Pilot Formation Stick.

As in the case of all armament courses, those devoted to bomb-sight maintenance were gradually lengthened so as to include new material and to give a more thorough presentation of subject matter already offered. At the same time, the first and second echelon phase and the third and fourth echelon phase came to be considered as distinctly separate courses once again, although successful completion of the former was still considered a necessary prerequisite for admission to the latter. For convenience' sake, the first and second echelon course became known as the Bomb Sight Mechanic Course, while the third and fourth echelon course was called the Bomb Sight and Automatic Pilot Repairman Course. By V-J Day the length of the Bomb Sight Mechanic Course was 20 weeks.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Electricity and H-Series Stabilizer</td>
<td>15</td>
</tr>
<tr>
<td>Basic Electricity</td>
<td></td>
</tr>
<tr>
<td>Precision Instruments</td>
<td></td>
</tr>
<tr>
<td>Classification and Custody of Military</td>
<td></td>
</tr>
<tr>
<td>Information</td>
<td></td>
</tr>
<tr>
<td>Technical Publications</td>
<td></td>
</tr>
<tr>
<td>IF Supply and Maintenance</td>
<td></td>
</tr>
<tr>
<td>H-series Stabilizer</td>
<td></td>
</tr>
</tbody>
</table>
Subject—Contd.  

Days—Contd.

M-Series bomb sight
The Levin problem
Functions of a boomsight
M-Series boomsight
Intervalometers
Microflex Timer
M-Series landing Trainer

M-Series Chino bombing attachment
(1st to 4th echelon maintenance)

C-1 Automatic Pilot
(Calibration and Maintenance)

Formation stick Control System
(Calibration and Maintenance)

The boomsight and automatic pilot repairmen Course lasted 10 weeks:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-Series boomsight and stabilizer</td>
<td>25</td>
</tr>
<tr>
<td>C-1 Automatic Pilot</td>
<td>20</td>
</tr>
<tr>
<td>Formation stick</td>
<td>5</td>
</tr>
</tbody>
</table>
Chapter VI
CADET ARMAMENT COURSE

The course for armament officers, given for many years at Lowry Field, was discontinued early in 1939 when the Chief of the Air Corps directed that all the personnel and facilities of the technical schools should be used to train enlisted men under the Augmentation Program. 1 This action soon produced a new problem: From where were the large numbers of armament officers to be obtained to man the greatly expanded Air Corps? The 54-Combat Group Program, adopted late in 1940, called for 392 additional armament officers. 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.

To the Office of the Chief of Air Corps it occurred that a likely source of officer material was the ranks of eliminees from the cadet flying schools. The notion was that these men would be given an armament course at Lowry Field; after they had successfully completed it and had spent at least nine months in the Army, they would be commissioned second lieutenants and normally would be assigned as armament officers. 2

Asked for suggestions as to the course of training for such men, Maj. Lawrence A. Lawson of the Lowry school submitted three plans: (1) a 14-week course almost identical in scope with the
basic or sound course for enlisted men for 75 per cent of the 
cadets; (2) a 16- to 19-week bombard maintenance course to be 
given 25 per cent of the cadets commencing for service in bombard-
ment squadrons; and (3) a scheme calling for 25 per cent of the 
cadets to be selected for the 16- to 19-week bombard maintenance 
course after completion of the 14-week course.

The third of Major Davidson's plans was adopted, i.e., in line with 
a class entering on 3 March 1941 on every four days thereafter, 32 
(23 on and after 23 June) bombard cadets began a 14-week course in 
a course; upon completion, eight of the cadets entered on a bomb-

<table>
<thead>
<tr>
<th>Phase</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Aircraft Administration</td>
<td>16</td>
</tr>
<tr>
<td>II. Aircraft Administration</td>
<td></td>
</tr>
<tr>
<td>III. Aircraft Administration</td>
<td></td>
</tr>
<tr>
<td>IV. Aircraft Maintenance</td>
<td>40</td>
</tr>
<tr>
<td>V. Aircraft Maintenance</td>
<td>32</td>
</tr>
<tr>
<td>VI. Aircraft Maintenance</td>
<td>24</td>
</tr>
<tr>
<td>VII. Aircraft Maintenance</td>
<td>40</td>
</tr>
<tr>
<td>VIII. Aircraft Maintenance</td>
<td>120</td>
</tr>
<tr>
<td>IX. Aircraft Maintenance</td>
<td>40</td>
</tr>
<tr>
<td>X. Aircraft Maintenance</td>
<td>80</td>
</tr>
<tr>
<td>XI. Aircraft Maintenance</td>
<td>80</td>
</tr>
<tr>
<td>XII. Aircraft Maintenance</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>560</td>
</tr>
</tbody>
</table>
The copy has been located of the syllabus for the 16-week bombsight course, to which 25 per cent of the graduates of the gunnery course were sent. It is recommended to assume that the heavy official carry out their intention of using a curriculum almost identical with that employed for the enlisted men's bombsight course, with some added features from the discontinued officers' course.

A further degree of specialization was introduced a few months after the course got under way. Beginning in June 1941, the Director of Ordnance had the class divided into three groups as soon as possible after they entered: (1) 35 per cent of the men were to be earmarked for service with pursuit squadrons; (2) 40 per cent with light bombardment squadrons; and (3) 25 per cent with heavy bombardment squadrons. During the latter part of the training period, especially during the field exercises phase, instruction was centered on the type of equipment with which the men would have to deal in their ultimate assignment. The addition of this feature did not affect the 16-week bombsight maintenance course which the 25 per cent earmarked for service with heavy bombardment squadrons continued to take after graduation from the armament course.

The entry of the United States into the war in December 1941 had a more marked intermediate effect on the pace and extent of cadet training than it did on the curricula employed. The length of the armament course was reduced from 14 weeks to 12, a new class was started every three weeks instead of four, and the size of the class
was raised from 53 to 74 men. In the case of the boat-sight maintenance course, the work previously given in 16 weeks was given in 12 after 5 January 1942. A new class was entered every four weeks, as previously, but the size was raised from eight to 12 men. As before, all students were men who had recently graduated from the armament course.

The enormous expansion in the Army Air Forces which took place in the months immediately before and after Pearl Harbor made it necessary repeatedly to modify the prerequisites necessary for admission to cadet training. In June 1941 the War Department specified that in addition to eligibles from flying training, men might be admitted who had successfully completed two years in college, preferably in engineering or physical science. Provided they are especially recommended by the CO (commanding officer) of the Air Corps school or training detachment for such training because of their evidence of outstanding mechanical aptitude as shown by their record at flying school or by previous experience. This relaxation made it necessary—so the armament department authorities believed at the time—to endorse the records of all graduates of the course with a statement that the men could not be considered as qualified to hold a position as armament officers until they had had a certain amount of practical armament experience on the line.

Another change, this one ordered further to facilitate the admission of eligibles to the course, was ordered by the Chief of
the Air Corps late in November 1941. Then any cadet who qualified physically and educationally for the cadet armament course could make application directly for it. Those who had been eliminated from another cadet course for unsatisfactory progress could be admitted without prejudice. By early 1942 an estimated 93 per cent of the students taking the course were eliminations from the flying schools.

Lt. Col. Charles C. Feurly, Director of Armament asserts:

"About 75% of this number bring with them a kind of 'defeated' attitude. They lack enthusiasm and ambition, and their morale is not the best. It is evident that their chief ambition is to become commissioned officers, and not to fit themselves professionally for the serious responsibilities ahead."

The close similarity between the content of the cadet course and the enlisted men's course naturally led the Army officials to compare the two types of students, and the comparison was not in favor of the cadets. A survey of a board of three officers appointed for the purpose declared that

there are among the enlisted men's classes an average of 75 per cent whose basic educational backgrounds are comparable to the aviation cadet average, and those 25 per cent [while] taking the armament course are higher than the cadet classes. This, in turn, indicates that there are among the enlisted men's classes a large number of students who possess higher qualifications than the aviation cadet average. It is assumed that the higher 11.5% of the enlisted men's classes would be later officer material, since this group is statistically higher than the aviation cadet average.

Seventeen per cent of the enlisted men's grades were one or more per cent higher than the cadet's grades. The situation had become so
notorious locally at Lowry, according to Maj. Gen. John F. Lawry, Co., commanding General of the 4th District of the Technical Training Command, that it was seriously holding the morale of the students taking that course.

During the spring of that year Capt. J. P. Jansen, who presides at the survey mentioned above, also criticized the caliber of the students along the same general line, but more pointedly. Requirements for admission to the course at that time, he observed, called for 'minimum of one year in college, one year of which must be spent in the study of physics as a major subject.' He continued:

In checking through the educational records of the aviation cadets sent to this school, it is found that most of them have the bare two years of college at the very least, and that have been in an engineering. It is believed that the two years of majoring in sociology, psychology, history, etc., does very little to qualify aviation cadets to fly a technical and mechanical course such as aircraft handling. A large number of the cadets enter and fail to graduate at flying schools who do not give the fair break, or the any less than commission as second lieutenants as a reason for making out of the flying school. It has been noted that morale and the work done of certain classes is very low, or practically nonexistent. In every case in which a commission is attained by aviation cadets, it is observed also have a direct bearing on the number of men who are sent to fly in flying schools. Since the rumor is prevalent at all flying schools that any cadet is practically assured a commission merely by being posted in the rear of the school. Of approximately 950 cadets entered in this school, more than 900 have been eliminated, showing distinctly that those men are not making an honest effort to master the material work, but are merely making theulletin for the commission.

In June, General Lawry proposed two methods by which the situation might be improved: (1) regulations governing aviation
credits would be credited so that civilians and enlisted men outside the present NROTC would be admitted to the course; and (2) at least one-half of the quotas for annual cadet classes should be reserved for the top ranking halt of each enlisted class. Men in the second category would not be obliged to take the entire cadet course, but only those covering officer administrative duties not given in the enlisted course.

The second request as treated by Headquarters, NROTC, was beginning 21 October 1942 a quota of 20 enlisted men out of each annual aviation cadet class of 74 or place at the disposal of the Lowry school. The change was noted enthusiastically by Colonel Pearcy, by then Director of Training at Lowry. "The next progressive step that has been taken since the organization of the Cadet Detachment . . .," he called it; "I believe the ultimate result will be superior officers . . . ."

The addition of instructors and graduates of the enlisted aviation cadet classes to cadet training was necessary a revision of the curricula so that this type of student would not waste time repeating as a cadet the same course of instruction he had studied as an enlisted man. During the autumn of 1942 training for cadets at Lowry was revised so that three separate courses were offered:

(1) A 14-week course known as "12," assigned for men recently inducted into the army, with little military experience, but with two years of civilian college training. A class of 12 men entered each
week. Before coming to Lowry, these men had completed nine to
12 weeks of basic military training, designed especially for cadets,
at Boca Raton, Florida. Their training at Lowry consisted of 10
phases, based on a seven-hour day, seven-day week schedule:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Basic Aircraft Electricity</td>
<td>49</td>
</tr>
<tr>
<td>II. Drill and Maneuvers</td>
<td>49</td>
</tr>
<tr>
<td>III. Explosives and Incendiary</td>
<td>49</td>
</tr>
<tr>
<td>IV. Chemical Warfare Materials</td>
<td>93</td>
</tr>
<tr>
<td>V. Aircraft Machine Guns and Cannon</td>
<td>96</td>
</tr>
<tr>
<td>VI. Aircraft Machine Gun Sights and Gun Cameras</td>
<td>49</td>
</tr>
<tr>
<td>VII. Armament</td>
<td>96</td>
</tr>
<tr>
<td>VIII. Aircraft Machine Gun Sights and Gun Cameras</td>
<td>49</td>
</tr>
<tr>
<td>IX. Administrative and Technical Duties of an</td>
<td>49</td>
</tr>
<tr>
<td>Armament Officer</td>
<td></td>
</tr>
<tr>
<td>X. Base and Field Operations</td>
<td>49</td>
</tr>
<tr>
<td>TOTAL</td>
<td>686</td>
</tr>
</tbody>
</table>

(2) A six-week course, known as "AM," designed for instructors
or recent graduates of Lowry and Buckley fields. A class of six men
entered each week. Before embarking upon this course, they had taken
six weeks of basic military training of the cadet type, at Valley
Forge Military Academy, Wayne, Pennsylvania. These men took only
phases IV (Chemical Warfare Materials), VI (Aircraft Machine Gun
Sights and Gun Cameras), VIII (Power Operated Gun Turrets), and X
(Base and Field Operations) of the "AM" course. These four phases
treated material which the students during their enlisted training
had either studied not at all or in insufficient detail to perform
the duties of an armament officer.
(3) A six-week course, known as "57," for men who had taken the regular洛y enlisted men's bombsight course followed by the six-week Valley Forge course. A class of six men entered each week. The course was designed to supplement the enlisted training so as to qualify the students for service as bombsight officers:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Calibration</td>
<td>49</td>
</tr>
<tr>
<td>II. Maintenance</td>
<td>49</td>
</tr>
<tr>
<td>III. Chemical Warfare</td>
<td>92</td>
</tr>
<tr>
<td>IV. Small arms, Machine Guns, and bomb mucks</td>
<td>49</td>
</tr>
<tr>
<td>V. base and Field Operations</td>
<td>14</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>294</td>
</tr>
</tbody>
</table>

In January 1943 the three courses were moved from Loey to a new technical school at Yale University, where all AAF ground duty bombsight training was being centered. The extra facilities available there made it possible, the months later, to increase the quotas of each of the classes by more than 100 per cent—the "57" course to 25 new men per week, the "45" course to 12 per week, and the "57" course to 12 per week.

During the spring of 1943 Headquarters, AAF concluded that, in order to facilitate the assignment of officers and to conform to recent tables of organization, the category of "bombsight maintenence officer" should be eliminated. Thereafter, warrant officers were to be charged with responsibility for the maintenance not only of general armament, but of bombsights and power operated turrets as well. Accordingly, on 31 May Headquarters, AAF ordered the Technical
Training Corps to discontinue the separate bombardment course and to lengthen the armament course to include phases on both various and maintenance, making the transition as quickly as possible but gradually enough to produce an even flow of graduates.

The Yale school authorities took the opportunity to propose a thorough revision in the cadet program. Instead of three separate courses, only one could be given. The "2N" course was to be discontinued entirely; and the chief features of the "3N" and "4N" courses were to be combined into one 20-week course, three weeks of which were to be devoted to Chemical Warfare. Headquarters, AAF cut the time devoted to this topic to one week, however, raising the course only 13 weeks in length.

Training under this new curriculum began on 1 July 1943.

Subsequent minor modifications produced the following syllabus, which was placed in effect on 12 October 1943:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Armament Administration</td>
<td>36</td>
</tr>
<tr>
<td>II. Machine Guns and Small Arms</td>
<td>36</td>
</tr>
<tr>
<td>III. Aircraft Cannon</td>
<td>36</td>
</tr>
<tr>
<td>IV. Engineering Physics</td>
<td>36</td>
</tr>
<tr>
<td>V. Bombs, Fuses, Ammunition and Racks</td>
<td>36</td>
</tr>
<tr>
<td>VI. Synchronizing, Aircraft Machine Gun Sights and Gun Cameras</td>
<td>36</td>
</tr>
<tr>
<td>VII. Power Operated Gun Turrets</td>
<td>44</td>
</tr>
<tr>
<td>VIII. Bombardment Maintenance</td>
<td>120</td>
</tr>
<tr>
<td>IX. Chemical Warfare</td>
<td>72</td>
</tr>
<tr>
<td>X. Armament Field Operations</td>
<td>72</td>
</tr>
<tr>
<td>TOTL</td>
<td>624</td>
</tr>
</tbody>
</table>
The phase are worthy of comment because they represent
the first of considerable experimentation and modification by the
Yale school authorities. The four-week phase on power operated
gun turrets included two weeks of the material which had been taught
for some time plus two weeks on the central fire system.

Five weeks were devoted to bombsight maintenance. The first
week dealt with the "theory of bombing"; the second week with the
Borden bombsight 1-5; the third week with the Sperry 3-1 bombsight;
the fourth week with the Honeywell 0-1 automatic pilot; and the fifth
week with the Sperry 1-5 automatic pilot.

Two technical developments in the field of bombsights led to
further modifications in the cadet course during the first half of
1944. Some months after Headquarters, POL decided that the Sperry
bombsight and 1-5 automatic pilot equipment was to be discontinued by
POL units, it directed the Training Co. to give only "familiariza-
tion" training to this type of equipment and use the time thus saved
to add instruction on the Borden 1-3 bombsight and the 0-3 automatic
pilot. As the Yale school worked it out, starting early in February,
two days were devoted to the Sperry equipment. The 10 days saved by
the reduction permitted two extra weeks on Borden equipment, greatly
increasing the thoroughness of that training.

At about the same time the POL adopted the use of the "slice bomb," a
device used in connection with the Borden sight to control the flight
of the bomb after it had left the plane. A sixth week was added to
the bombsight maintenance phase to cover familiarization training on

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this equipment, raising the over-all length of the cadet course to 32 weeks.

By the spring of 1944 Headquarters, ASF became convinced that with the peak of 11F expansion already reached, it was unavoidable to continue commissioning men on any large scale. Future needs for technical officers, it was felt, could best be met by giving technical training to men already commissioned for whom no suitable assignment existed in their previous specialty. Ultimately it was determined that the men selected for this re-training should be rated pilot officers returned from overseas duty. This decision produced a new problem: To maintain at least minimum flying efficiency, these pilot students would require far better facilities than were available at Yale, where the air base was several miles away from the main part of the school. The solution reached was that technical training should be moved to regular AAF fields; the cadet course was to be moved to Buckley Field, Colorado.

The transfer of the cadet department was made phase-by-phase during the summer of 1944. As the instructors of each phase completed teaching their last class at Yale, they and their equipment moved to Buckley and resumed instruction there. Thus it was possible for the first class of 14 officer pilots to start the course at Buckley on 24 July, while the last class of cadets.claire rede were from Yale until 15 November.

With the change in purpose of the course and in type of student, certain modifications in the curriculum were necessary. At Yale
some enlisted personnel had been used to teach the cadets; at Buckley, as the students were officers, the instructors all had to be officers. Although the content of the course remained basically the same, the order and manner of presentation was drastically reorganized. Over a 19-week period, the following topics were presented:

I. Theory of Bombing
   (a) Handling of Classified Material
   (b) Handling of Bombsight Equipment
   (c) Trigonometry of the Bombing Problem: Square Root and Trigonometry of Right Angles
   (d) Indicated, Calibrated Indicated, and True Air Speed
   (e) Ground Speed and Velocity of Closing
   (f) Physics: Increasing Speed of Falling Objects
   (g) Physics: The Vacuum Bomb
   (h) Actual Bomb: Actual and Hole Range
   (i) Actual Bomb Trail
   (j) Actual Bomb Crosstrail
   (k) Bomb Ballistic Charts: Use of Charts
   (l) Gyroscopes: Characteristics and Laws
   (m) Gyroscopes: Use of Gyros in Precision Bombing Equipment
   (n) Precision Bombing Equipment: Solution of Trail, Crosstrail, and Range on L-9 Bombsight
   (o) Precision Bombing Equipment: Manual Computers: X-6-8, ABC

II. Machine Guns and Small Arms
   (a) Pistol Caliber .45, Carbine Caliber .30, Submachine Gun M-3
   (b) Small Arms Ammunition: Storage, Handling & Target
   (c) Browning L.G.: Assembly, Disassembly, Nomenclature
   (d) Headspace and Headspace Adjustment
   (e) Operation of Feeding Mechanism
   (f) Operation of Firing Mechanism
   (g) Inspection, Maintenance, Cleaning and Lubrication
   (h) Requisition of Spare Parts

At Buckley instruction was carried on in a large hangar which had been partitioned into classrooms. Proximity of the classrooms to the flying line made it possible to give practical demonstrations of...
the material covered during each phase instead of reserving it for a "field exercise" period at the end of the course. When the school at Buckley was activated, plans called for the training of 39 classes there, with the last class graduating on 8 December 1945.
Chapter VII

INSTRUCTIONAL AND CURRICULUM POLICIES

The foregoing chapters have described in some detail the vicissitudes of the principal courses in aircraft armament. In theory, the function of Headquarters, HAF, the Training Command, and the Western Technical Training Command was to establish the over-all requirements and standards of armament training upon the school authorities at Lowry, Buckley, and Yale rested the responsibility of determining the detailed methods by which these objectives were to be achieved.

As the chapters on the particular courses have shown, these principles were not always strictly adhered to. Although in almost every instance the syllabus was drawn up by the school giving the course, in many cases subsequent modifications ordered by higher headquarters altered it tremendously. This was particularly true when higher headquarters would order the addition of considerable bodies of new subject matter to the curriculum but would deny the school any extension in the over-all length of the course.

Oftentimes school authorities complained that this occurred because the officers at the higher headquarters were unfamiliar with the problems of their school. They made such complaints in spite of the fact that, during the war years at least, every one of the CO's and headquarters had on its staff at least one former official of an
armament school whose responsibility was the monitoring of the armament training program. What the school authorities forgot, when they complained, was that the decisions of higher headquarters were in most cases guided by factors of which they had no knowledge. At the same time there was considerable merit to the school authorities' contention that after a tour of duty of a year or more on a headquarters staff, the most experienced former armament school official lost touch with the changing conditions at the schools, and that such might be gained by a more frequent rotation of headquarters personnel.

The personnel of both school and headquarters seem to have agreed that the armament courses might have been conducted on a more realistic and efficient level if the training officers had been permitted to make rather frequent trips to operational units in combat areas. In one or two instances such trips were made, but they were the exception rather than the usual practice. Intelligence reports and written suggestions submitted through channels by the using organization required a long time to reach the armament schools; by the time they did reach their destination, conditions usually had altered or the suggestions had been so watered down by the numerous forwarding organizations as to make them of relatively little value. During the last months of the war, as part of the AAF's personnel rotation policy, men who had had combat experience began to reach the armament schools as students and instructors; but the narrowness of the experience of most of them and the constantly changing conditions of warfare
limited the value of this practice.

Although the armament school officials were responsible for drawing up the syllabus which they provided their students and instructors, they deliberately refrained from making them very detailed. They did this for three reasons: to permit the instructors to exhibit individual initiative in their teaching; to allow constant modification of the course in the light of new equipment and techniques; and to avoid the numerous "gigs" they felt inspectors would be certain to submit if they observed any deviation from the announced standards. But the school authorities did succeed in maintaining definite standards of instruction by giving students examinations at the end of each phase and at the end of the course.

There was one particularly notable instance of a higher headquarters undertaking to establish detailed teaching procedures without the concurrence of the armament schools. At the start of the Air Corps expansion period, armament training tended to be theoretical. Much of the instruction was presented to large class sections through the traditional lecture and blackboard method. Supplementary aids included Air Corps technical manuals and a few training films, none of which had been prepared specifically for the purpose of the course. Such methods caused the armament officer of the Third Wing, GHQ Air Force to complain in the spring of 1940 that graduates of the Lowry bombsight course assigned to his wing appeared to know far more about what happened to a bomb after it was dropped and the relative merits of the Norden and Sperry sights than they did about the actual maintenance of the equipment. But armament instruction was not all
theoretical. In most phases there was an adequate amount of equipment for teaching purposes; and since the courses were given at a leisurely pace, students had fair opportunity actually to practice maintenance work in the classroom.

During 1941 and 1942, when current training was expanding, by leaps and bounds, the trend toward the theoretical grew stronger and stronger. With larger classes, inadequate numbers of experienced instructors, and a greatly shortened course, such a development was almost inevitable. In some phases the officials undertook to counteract this by preparing additional schematic charts, oriented or mis-oriented student manuals and guides, and similar educational devices. Short answer true-and-false examinations were substituted for essay-type examinations. But at best the efforts to prevent excessive theory were only partially successful.

During the autumn of 1942 Maj. Gen. Walter C. Beaver, Commanding General of the Technical Training Command took drastic step to move the pendulum back in the direction of the practical. He ordered an increase in the ratio of instructors to students so that there would never be more than eight students in a class room. His directive further forbade the use of lectures, the handing out of notebooks by students, and the testing of students by written or oral examinations. It ordered the removal of all chairs and blackboard from classrooms. Use of current training aids used to be increased.

Under the impetus of the directive, more charts and student guides were prepared for all phases. More training films and film
strict illustrating such thin a proper lesson of disassembly, assembly, and cleaning are obtained from motion picture services. Additional cutaway models of machine guns and cannon were obtained from the manufacturer to demonstrate how the equipment operated. "Instructional" and "mock-up" were constructed by faculty of the school staff to illustrate such things as the malfunctions common to the electrical system controlling equipment and the internal construction of both guns. Exhibits of early ammunition and belts were prepared so that students become familiar with their appearance. More "machine gun malfunction" laboratories were built, where students could learn to recognize the symptoms of the most common type of malfunctions. Additional sheds were constructed so that students might practice the synchronization of guns. Additional three .50 caliber airplanes were procured from the exterior authorities and installed in the school hangars so that students might practice such routine duties as the arming of the loading of machine gun ammunition and the arming and loading of bombs. This practice was adhered to in the early course at Yale, in spite of the inconveniences created by ivy-covered buildings and an airport seven miles from the classrooms.

Many of the armament school officials believe that although the purpose behind the directive abolishing theoretical instruction was worth while, its provision went too far and were better suited for aircraft-maintenance training than for armament. In such phases as explosives and ammunition, and electrical armament control, where the
nature of the subject matter made advisable the use of the lecture method, supplemented by occasional demonstrations through charts and blackboards, the ban on lectures and chairs was lifted. In phases decline with increasing runs and congestion, groups of eight students and an instructor traveled about around a cannon or run for the six hours of a school day.

The discontinuance of examinations eased considerably the problem of the instructors in grading the students. But by 1943 the elimination rate allowed most academic courses as so tiny that students had to be graduated whether their work actually met any standard or not. The directive had one positive benefit: the ban on blackboards are student notebooks hastened the preparation of additional charts and blackboards to take their place.

Now time after the absorption of the Technical Training Command by the Training Command in July 1943, permission was granted the armament school officials to deviate from some of the provisions of the directive instituting practical methods, at first unofficially, and later officially. Written examinations of the objective type were reinstated; a moderate amount of lecturing to small groups was concomitant; and chairs were returned to the classrooms for many of the phases. But the pedagogical efficacy of blackboards, mock-ups, and charts having been demonstrated, there was no abatement in their use. As the supply situation gradually eased, cutaway as well as regular models of equipment became more generally available, further improving the effectiveness of the courses.
In its effort to stress the "practical," the armament school at Lowry conducted an interesting experiment during the first half of 1943. In an area known as Camp Bizerte, simulating conditions characteristic of an advanced tactical base, was opened on the Colorado plains some miles east of Lowry. Following the completion of the phases at Lowry, students spent a week at Camp Bizerte living in tents, eating and working in the open, and practicing under "rugged" conditions the things they had learned in the classroom. Reports received from the North African theater were used to teach methods of armament maintenance under desert conditions. The camp was abandoned after about six months, when the production "hung-up" of armors had been surmounted. Undoubtedly the students who took this training benefited from the lessons in improvisation which it taught. It is doubtful, however, whether the information they acquired about African conditions was of particular benefit; by the time these students were sent overseas, the USAF was fighting from Italy and northeastern Europe.

By the end of the war the armament school officials were inclined to believe that they had achieved a happy solution to the "theoretical versus practical" instruction problem. Much of this was made possible by the improvement in the supply and personnel situations. In most instances each student could be provided with his own piece of equipment. There were enough instructors so, for at least one instructor for every five students in the depot overhaul courses, and one instructor for every eight students in every first and second echelon course.
instructor gave a brief explanation of the theory which lay behind an operation, and followed it with a series of demonstrations and exercises which were participated in by all the students. The ratio between "practical" and "theoretical" instruction was then estimated at 80 to 20, with "practical" instruction running considerably higher during the phases on the bomb sight, the C-1 pilot, and the E-29 computer. Precautions were taken to guard against the natural tendency of instructors to become extremely voluble.

One administrative problem which vexed armament training officials more than it did those in charge of other technical courses was that of student- and instructor morale. That this was so is illustrated by the elimination rate which obtained at Lowry Field, the only school then giving the course, during the school year 1941-42. The elimination rate for students entering the basic armament course was 22.33 per cent; for those entering the bomb sight maintenance course, 12.81 per cent; and for those entering the power operated gun turret course, 6.32 per cent. The rates of the first two courses were considered undesirably high; the goal for technical training was to keep eliminations well below 10 per cent. Particularly unsound was the rate in the basic armament course; this was not a particularly difficult subject and could easily be mastered by an eighth-grade graduate.  

Morale was such a trying problem because aircraft armament was a strictly military specialty. When a man studied aircraft maintenance or communications or photography in an AAF technical school, he did it with the realization that the knowledge he was acquiring would have some utilitarian value in the civilian world to which he would ultimately
return. It could not comfort himself with any such thought in the case of aircraft armament, as some students sarcastically expressed it: "After the war I'll get a job taking care of a Cal. 40's machine gun."

Moreover, one went lacking the glamour of the combat crew specialties. The pilot, the bombardier, the navigator, even the flexible gunner, were romantic heroes of the movies, the radio, and the comic strips. But about the greatest degree of mortality the ground armorer ever achieved was an enthusiastic tribute from the late Ernie Pyle published in his syndicated column early in 1944. The situation was well summed up by Col. Julian L. Travis of A-2, Training, formerly of the Lowry Air Force Base, as he wrote in November 1943:

The deadly status in which armament has ridden is due to the tremendous amount of publicity given surgery, bombing, etc., and an impression that knowledge of armament is unnecessary to such popular jobs. The Wartime Schools have reducted just one fill-in to whom to entrust students for specific purpose of insulating interest. The scenarios have been turned in and turned down in the first three years, and the schools referred to other fills on armament. Any of our mortars will never become gunners, and the use of such fills indicated to a substitute could escape the normal which is already low. The present position is that the biggest instructor fills is typical of the present volume to air armament, six little gone including the chart. There is no definite need for an educational program on insulant for all unit commanders, pilots, and armament technicians.

There is no record that any action was taken on Colonel Travis' suggestion.

One that the '43's might have been all the more real toward '44's would have been that the men destined to become armament...
During the classification period of basic military training. But questioning by school officials or recruits went to the undisclosed fact that the classification interviewers at basic training centers not only were ignorant about the nature of a recruit's work, but were actually promoting misdirection. Some interviewers appeared to believe that in war or in combat actual work. Others told recruits that the course led to or covered aerial weaponry—which had to destroy spirits when the men arrived at school to learn that only a few schools ever operate a machine gun or cannon. Even when interviewers were better informed, the ever-present "distracting rumors" accentuated the same illusion.

Another factor which led to misdirection was the quota system under which the ... classification system operated. At classification centers recruits were allowed to state three choices as to courses. They can pick airplane mechanics or radio as their first or second choice, listing aircraft as third choice only because there was no other likely possibility. They are bitter when they learn that, in order to fill a large class at Ledy or Buckley, their reluctant third choice has been made their assignment.

The failure of headquarters, ... and the classification centers to improve the morale situation placed the burden almost entirely upon the shoulders of the current schools. In the main operated on turret course, considerable time was devoted to explanations of the importance of turrets in bacterial warfare. In the even more critical case of the anti-aircraft course, a day or two before articulation.
students were given an orientation lecture during which an effort was made "to impress upon the student the importance of the armorer's job in a tactical organization." Throughout the course, too, instructors were expected to reiterate this point to the students. But as the school authorities grimly observed, most of their efforts went for nought when students received letters from friends who had been assigned to miscellaneous post and squadron duties at their next station.

The armament schools adopted a number of improvisations to control student morale. During the period in which the schools were expanding, there was great need for enlisted personnel to perform clerical and other administrative chores around the post—the so-called "permanent party" assignments. This need led post officers to detail eliminatees from the schools to such duties. As the practice became common, many students, none too eager for assignments as armorer and attracted by the Colorado climate, deliberately sought to be eliminated so that they might become permanent party members. Then it was realized that this was pulling down the morale of the student body as a whole, an order was issued that henceforth no eliminatees were to be retained at the schools for such assignments. But by this time most of the mischief had been done, and all of the permanent party assignments were filled.

A fresh incentive to basic armament students to set themselves eliminated from the course was provided by a directive of the Training Command issued in December 1943 which required that all enlisted men hereafter cropped from basic courses and qualified for combat crew training, were to be transferred to auxiliary schools at once.
as they learned this, students desiring arial gunnery training began deliberately to fail their work, sometimes even remaining absent from class. Where it was clear that failure was deliberate, the authorities entered the fact that the student had been dropped "with prejudice" on his service record.

The situation grew so distressing that the Lowry officials proposed to higher headquarters that deliberate failures be transferred immediately to the Ground Forces, or at least be permanently deprived of the privilege of taking flexible gunnery training. But the training go and refused to authorize either proposal on the grounds that no means then existed for transferring men to the Ground Forces and that the need for flexible gunnery was so acute that they must be given high priority.

In the circumstances, the best the school was able to do was establish an elaborate system of boards of officers to interview men whose work was not satisfactory. If there was any reason to suspect that the cause of a man's failing work was his desire to obtain another assignment, he was to be disciplined under the 104th Article of War, or threatened with it. But the Lowry authorities doubted whether these measures did any more than mitigate the situation. In the spring of 1944 the elimination rate of the basic course dropped to the vicinity of 10. The students during this period, however, were mostly eliminated flying cadets earmarked for aerial gunnery training, whose morale, though low upon arrival at the school, improved rapidly "through orientation and judicious handling."

Another type of student morale problem developed during the spring of 1943, when a number of enlisted men who had already been graduated
From aerial gunnery school we sent to training level to take
the basic gunnery course. At gunnery school, according to the
ammunition course authorities, there had been ideas with the
belief that they were the most important cog in the ICU, and that
their ammunition trains had taught them all they needed to know
about ammunition. Many of them already held higher rank than the ammunition
instructors, which created problems of discipline. This situation
was ultimately improved by the adoption of a policy that all men picked
to be ammunition were to receive their ammunition training before going
to gunnery school.

In the case of the control and control course, very difficult
on, which could be entered only by men with unusual qualifications,
student morale was generally very low. The reason for
this is that, with one final exception, only men with 1200 scores
of 1.0 were over—will have to any course—are either the mechanical
experience were enlisted. But an authorization to promote all
recruits of the course to the rank of corporal, unless their already
hit that ranks or a higher rank, unconditionally was worse deal to im-
prove the spirit of the students.

One of the most successful steps to raise student morale was
that of selecting outstanding students in each class to take the actual
ammunition course leading to a commission and assignment to an ammuni-
tion officer. Although exact figures are not in the, there is evidence
to suggest that proportionately more ammunition instructor than students
were given the opportunity of taking actual training. For this reason,
the worst progress probably boosted the morale of the instructors even more than that of the airmen.

Because they dealt with delicate subjects, the bomb sight maintenance, power operated turret, and central fire control system courses all involved an administrative procedure found in few other types of technical training: security. The problem first appeared and was acute in the case of bomb sight maintenance, a subject classified as "confidential." In 1942 the Chief of the Air Corps established a rule that the loyalty of every prospective student must be checked; he must "be a citizen of the United States of unimpeached 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 the soldier was stationed in his file list this requirement for any sufficient proof.

The revelation in July 1941 that an enlisted instructor had a dubious record so disturbed the Air Corps local division that it erred in giving staidness to the requirements. The Chief of the Air Corps responded with a new regulation specifying that no person could be trained as a bombardier or bomb sight maintenance man until his application, together with a set of his fingerprints, had been submitted to C.O. and approved. Before granting this approval, the Chief of the Air Corps had military intelligence check the candidate's record and fingerprints with the Federal Bureau of Investigation.

In practice, this investigation of loyalty qualifications took a long time—so long that it became customary to sink at the letter of
the regulation are allow students to start the course while their
records were still under investigation. It was uncommon occurrence.
at the layy 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, as received the day before he
was to vacate.

Col. E. S. Smith, Director of Individual Training, made a radical
change, because of American losses of heavy bombers, he believed
it reasonable to assume that some bombers had fallen into enemy hands.
Thus, he thought, there was no longer any need for investigating the
loyalty of men who maintained and operated bombers any more than those
who maintained and operated the planes.

 Authorities were not yet ready to accept a suggestion as novel as
Colonel Smith's. The revision of AAF Regulation No. 25-13 issued in
April 1942 continued to require that an investigation be made into a
prospective student's loyalty, but prescribed a procedure designed to
expedite the investigation. A few more months of experimentation with
this regulation, however, convinced the War Department of the validity
of the point of view expressed by Colonel Smith. In November 1942 the
Secretary of War directed the commanding generals of the various air
forces and commands to cease demanding prospective students' finger-
print reports. Headquarters, AAF. Early in 1943 the classification of
bombers and literature relating to them was lowered to "restricted" and
the investigation dropped entirely.
Despite the lowering in classification, for some time afterward the officials at Lowry continued to treat eavesdropping materials and information as confidential matter. As before, at the start of the course, M-300-5, dealing with the handling of classified matters, and Lowry Field rules in respect to social huts were read to the students, who were then required to sign a certificate indicating their willingness to abide by these security regulations. The students were given passes permitting them to the eavesdropping division buildings, which were separated from the rest of the field by a fence. They were warned not to discuss the subject matter of the course with any outsider, military or civilian. Only on rare occasions were students permitted to remove textbooks and class notes from the classroom area, although this rule was later liberalized to permit their use in the barracks. With the inauguration in 1943 of the central fire control course, which dealt with secret material, the Lowry school followed in general the same practices then in effect in the eavesdropping division and course.
### Glossary

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<tr>
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<th>Description</th>
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<tr>
<td>AAF</td>
<td>Army Air Forces</td>
</tr>
<tr>
<td>AAG</td>
<td>Air Adjutant General</td>
</tr>
<tr>
<td>AC/AS</td>
<td>Assistant Chief of Air Staff</td>
</tr>
<tr>
<td>AC/S</td>
<td>Assistant Chief of Staff</td>
</tr>
<tr>
<td>ACTS</td>
<td>Air Corps Technical School</td>
</tr>
<tr>
<td>ACTTC</td>
<td>Air Corps Technical Training Command</td>
</tr>
<tr>
<td>AFSC</td>
<td>Air Service Command</td>
</tr>
<tr>
<td>A.F.C.E.</td>
<td>automatic flight control equipment</td>
</tr>
<tr>
<td>AFCTG</td>
<td>AC/AS-3, Training Division, Technical and Services Training Section</td>
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<tr>
<td>AFFIT</td>
<td>Directorate of Military Personnel</td>
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<tr>
<td>AFRDB</td>
<td>Directorate of Bombardment</td>
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<tr>
<td>AFITT</td>
<td>Directorate of Individual Training</td>
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<tr>
<td>AFSOH</td>
<td>AAF Historical Office</td>
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<tr>
<td>AFTRG</td>
<td>Air Forces Training Command</td>
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<tr>
<td>AFTRB</td>
<td>Air Forces Technical Training Command</td>
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<tr>
<td>AG</td>
<td>Adjutant General</td>
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<tr>
<td>AGCT</td>
<td>Army General Classification Test</td>
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<tr>
<td>ASC</td>
<td>Air Service Command</td>
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<td>C/AAF</td>
<td>Chief, Army Air Forces</td>
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<td>Chief of the Air Corps</td>
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<tr>
<td>CFCE</td>
<td>central fire control equipment</td>
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<tr>
<td>CG</td>
<td>Commanding General</td>
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<tr>
<td>CO</td>
<td>Commanding Officer</td>
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<td>ETRC</td>
<td>Eastern Technical Training Command</td>
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<td>Comdt.</td>
<td>Commandant</td>
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<tr>
<td>C-2</td>
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<tr>
<td>CNO, AF</td>
<td>General Headquarters Air Force</td>
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<tr>
<td>ind.</td>
<td>endorsement</td>
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<tr>
<td>L/M/D</td>
<td>Material, Maintenance, and Distribution</td>
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<tr>
<td>n.d.</td>
<td>no date</td>
</tr>
<tr>
<td>OASS/AF</td>
<td>Office of the Assistant Secretary of War</td>
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<tr>
<td>OCA/AF</td>
<td>Office of Chief of the Air Corps</td>
</tr>
<tr>
<td>OCMR</td>
<td>Operations, Commitments, and Requirements</td>
</tr>
<tr>
<td>POGT</td>
<td>power operated gun turret</td>
</tr>
<tr>
<td>R &amp; R</td>
<td>routing and record sheet</td>
</tr>
<tr>
<td>RCT</td>
<td>remote control turret</td>
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<tr>
<td>SSN</td>
<td>specialist serial number</td>
</tr>
<tr>
<td>TAG</td>
<td>The Adjutant General</td>
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<tr>
<td>TC Lemo</td>
<td>Training Command Memorandum</td>
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<tr>
<td>TS</td>
<td>technical school</td>
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<tr>
<td>TTC</td>
<td>Technical Training Command</td>
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<tr>
<td>TX</td>
<td>telegram</td>
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<td>T&amp;O</td>
<td>Training and Operations</td>
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<td>UR</td>
<td>unsatisfactory report</td>
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<tr>
<td>USAAF</td>
<td>United States Army Air Forces</td>
</tr>
<tr>
<td>WTTT</td>
<td>Western Technical Training Command</td>
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1. Base on mechanics training during World War I, until the war united in A.F. 353d Y. Technical Train.


9. Ibid., pp. 1-2, 4, 5.

10. Ibid., pp. 13-16.


14. Ibid., op. 2, 3.

15. Ibid., pp. 13-19.
NOTES

Chapter II


3. C/G to NAR., C/O, 29 Dec. 1942, in RG 353.95, NAR., Col.


10. CC/C monthly reports of Stat. Control Sec.

11. 2d Ind., C/G to CG, LTC, 15 Sep. 1941; and 5th Ind., C/G to CG, LTC, 27 Oct. 1941, in RG 353.66, NAR., Col.


cry, Supervisory Force, Turret Plate, Ammunition Sch., to Dir. of Ammunition Fld., Lovery Fld., 15 Nov. 1941, quoted in ibid., p. 166; Capt., Lovery Fld. to C/O, IGTS, 13 Oct. 1941, quoted in ibid., p. 167.


18. CG, Buckley Fld., quoted in History of Buckley Field Ammunition School, 7 June-31 Dec. 1942, ch. 6, p. 11.


26. See p. 54 ff., this study.

27. Hq. AAF, monthly reports of Stat. Control Sec.


30. TNX, ETTC to CO, TS, Yale University, 10 June 1944, reproduced in History of TS, Yale University, 1 May-30 June 1944, incl. 11.

31. Hq. AAF, monthly reports of Stat. Control Sec.

32. Ibid.

2. Proc., Lory Field to Dir. of Armament, 19 Aug. 1940, quoted in ibid., p. 21.


9. Capt. K. S. Brown, Ph. C., 4th Dist., FFC to CC, T.G., Lory Field, 29 April 1943, quoted in ibid., p. 80.

10. Col. D.C. G. Robey, CC, Ph. C., Lory Field to CC, 4th Dist., FFC, 29 April 1943, quoted in ibid., p. 81.

11. Col. D.C. G. Robey, CC, Ph. C., Lory Field to CC, 4th Dist., FFC, 6 May 1943, quoted in ibid., pp. 82-84.


17. Rstg., Col. A. Montgomery, Dir Chemical Officer, 1st to 30/3, Tn. (Tech. Tn'), 2 June 1943, in US 353 Armament Tn.

18. Fixed-forward-firing 75-mm. cannon (Type P-4) has been installed on B-25's in April 1943, and a demand immediately appeared for armorer qualified to maintain them. At the outset it was felt that this large-size cannon could not be used widely enough to warrant including it in the basic armament course. Accordingly, in March Lorry started offering a special six-day course for an average of 25 armorer on detached service from units which used this cannon. Subsequently a few unserviceable graduate armorer were also detailed to the i.c.s. (History of Lorry Field, 1 Dec. 1937 to 31 Dec. 1943, vol. 2, ch. 1, pp. 119-127.) Several months of experiment convinced the Lorry authorities that the cannon could be taught adequately in three school days. During that time the need for the cannon has been more widely than had been expected, and so a three-day phase was incorporated into the 12-week basic armament course. History of Lorry Field, 1 Dec. 1937 to 31 Dec. 1943, vol. 2, ch. 16, pp. 27-28.

19. ibid., p. 28. First and second echelon maintenance of these turrets was being taught in the nine-week armament course.

20. lst Ind., Capt. ... S. From, set. T3, to CG, TIC, 26 Oct. 1943, cited in ibid., pp. 70, 71.


22. ...P Armament Standard 60-51, 2 Oct. 1943.


29. 29 March 1944, cited in ibid., p. 19.


31. 5 April 1944, cited in ibid., p. 21.

32. In ibid., p. 20.

33. From 2 July 1943 to 16 April 1944: Four-week "special 1-29 training course" was conducted to teach airframe mechanics, electric plant specialists, and power plant specialists how to make minor adjustments of airplane and central-fire-control equipment. Principal features included:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
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<tbody>
<tr>
<td>50-caliber machine gun</td>
<td>26</td>
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<tr>
<td>30-caliber machine gun</td>
<td>26</td>
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<tr>
<td>Aircraft cannon</td>
<td>30</td>
</tr>
<tr>
<td>Explosives and ammunition</td>
<td>30</td>
</tr>
<tr>
<td>Electric power control system</td>
<td>30</td>
</tr>
<tr>
<td>Tools and equipment</td>
<td>30</td>
</tr>
</tbody>
</table>

In March 1944 the Air Force, which was charged with development of the 1-29 training program, concluded that it might be better to cover the various subjects in the course of flexible summary training. Accordingly, Lowry discontinue the 1-29 Ordnance course.

55. Ibid., 1 Nov.-31 Dec. 1944, pp. 155-156.


58. For a description of the "block system," see p. 44, this study.

59. 0T. 17 to CO, ...A.D., 7 March 1945, in FOG files; History of Herry Field, 1 March-30 April 1945, pp. 182, 183.

60. 16 Nov. 50-35-2, 29 Oct. 1945, in FOG files.
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2. ibid., p. 156.

3. Proceedings, Board of Officers convened at A & A Field for the purpose of studying and submitting recommendations relative to the training of maintenance personnel for Power Operated Gun Turrets and AFTs, 27 March 1941, reproduced in ibid., op. 174-179.


5. Ibid., op. 161-162.


16. Ibid., pp. 62-64.


25. .TTC to CS, Lo.ary Fl., 13 May 1944, cited in ibid., p. 22.


...
27. Lorry AID to J, 11 Jun 1944 and 1st Inc., 116 to . . . AIDC, 5 June 1944, in . . . files.

28. 2nd Ind., 1914. . . . 33.4 lbs. . . . to 22. . . . AIDC/1944, in . . . files.


30. . . . AIDC to CG, 7 Aug. 23 Dec. 1945, in . . . files; . . . files.

31. . . . Ind., 1914 to 22, . . . 1944, in . . . files; TE was 50-50-1, 16 Oct. 1943, in . . . files.


33. Ibid., 1 Jan-7 July 1943, p. 22.


35. Interview with Capt. Charles ... Stanley, Marion turret instructor, dated, reproved in History of Mun. Training School, 1 Jan-7 July 1943, p. 32 (hereinafter cited as Stanley interview); Capt. G. L., Ind. CG, 4th Dist., AIDC, 31 March 1943, cited in History of Lorry Field, 1 Jan-7 July 1943, vol. 2, ch. 2, pp. 223-23.

36. 4th Ind., Capt. Illis T. . . . Ind. CG, School Secretary, 42, Lorry Field to CG, 4th Dist., 7 Jan. 1943, quoted in Ibid., p. 327.

37. Stanley interview.


39. Ibid., pp. 34, 37, 38.

40. . . . AIDC to CG, 116, 5 Jan. 1944 and ind., in . . . files.


43. FC Form 50-25-8, 10 Oct. 1945, in FPCO files.


47. FC Form 50-33-6, 27 Oct. 1945, in FPCO files.

48. History of recent training school, 1942, p. 34.


50. GL, GA to CC, 5 Sep. 1943, in FPCO files.


52. FC Form 50-35-7, 9 Oct. 44, in FPCO files.

Chapter V


3. Ibid., pp. 280-281.

4. Ibid., p. 129.


7. 2d ind. (to above 1st.), OCAC to Comdt., ACTS, Chanute Fld., 16 Feb. 1940.


9. Ibid.

10. Ibid., p. 145.


12. SG, AFTTC to SG, AAF, 25 July 1942, in AAG 353.11, Lowry Fld.


15. Ibid.

17. 5th ind., .A.FTC to CG, 4th Dist., AFTC, 21 May 1943, cited in History of Lowry Field, 1 Jan.--7 July 1943, vol. 2, ch. 11, p. 134.

18. Eric, Gen. ---- Harper to CG, AFTC, 30 March 1943; and A.AFTC to CG, 4th Dist., AFTC, 9 April 1943, cited in ibid., p. 139.

19. CG, A.FTC to CG, 4th Dist., AFTC, 21 July 1943, in AFTC files; syllabus of course of instruction, reproduced in History of Lowry Field, 1 Jan.--7 July 1943, vol. 2, ch. 11, pp. 144-50.

20. HQ. A.F., I.0., I.0.D to A.F.T, 8 June 1942, in I.G 353.9-1, Berberight Inc.


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6. School Circular No. 6, 10 June 1941, cited in ibid., p. 100.


10. Lorry Field Armament Dept. 6 of Field, 11 June 1942, cited in ibid., p. 102, 103.


15. Capt. WJ. Simon, Admin. Officer, Lanfranc, Jan. 44.


20. Syllabus of instruction, 75 Course, Dept. of Aeronaut, 75, Yale Univ., ibid., incl. 79.

21. Ibid., pp. 126, 127; syllabus of instruction, 75 Course, Dept. of Aeronaut, 75, Yale Univ., ibid., incl. 80.


23. Ibid., pp. 131, 132.


25. CO, AMC to CO, AMC, 31 May 1943, in AMC files.


28. History of 75, Yale University, 6 July 1943-1 March 1944, p. 156.


30. 1st Ind., CO, AMC to CO, AMC, 16 Jan. 1944, in AMC files.
31. History of TS, Yale University, 6 July 1943-1 March 1944, p. 165.

32. Ibid., p. 165; Daily Diary, "TMX, 31 Dec. 1943, in IFSX30 File.

33. T.X, CG, ATRC to CO, TO, Yale Univ., 10 June 1944, reproduced in History of TS, Yale University, 1 May-30 June 1944, incl. 11.

34. History of TS, Yale University, 1 July-31 Aug. 1944, p. 6; CO, ATRC to CO, A.F., 30 June 1944; and memo RefSec, CO, ATRC to CO, 15, Yale Univ., 12 July 1944, both cited in Ibid., p. 7.

35. Ibid., op. cit., 36.


37. Ibid., vol. 2, p. 207.

Chapter VII

1. This discussion of supply and their administration is based on the minutes of a conference of training officials conducted in late 1943 by the Training Research Committee of these writers.


3. CQ, 151 BN, to CQ, 4th BN, 24 Oct. 1943, in 1303-34-1, hist. ind., 4th BN.

4. The discussion which follows is based on interviews with Maj. Robert H. Spencer, 201 BN.


8. Photograph of Larry Field, 7 April 1944.


11. Training Instruction report, Larry Field, 1st BN, 1st BN, 1st BN, and 26 BN, 1st BN, 2nd BN, quoted in History of Larry Field, 1st BN, 1st BN, and 26 BN, 1st BN.


13. Larry Field, 1st BN, 1st BN, 1st BN, all cita. in 70-4, ch. 14-4, p. 116-117.


17. The circumstances which led to the adoption of this policy have already been discussed in the section on the training of officers and cadets. (See op. 76-78, this study.)


22. Secretary of War to CGS, Selective Service Acts, Depots, and Service Camps, 15 Nov. 1942, in NIH Files.

23. CG, L.J.S. to CG, NIH, 3 June 1943, in NIH 452-26, Fentray Files.

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