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ARMY AIR FORCES HISTORICAL STUDIES: NO. 26

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INDIVIDUAL TRAINING IN AIRCRAFT MAINTENANCE
IN THE AAF

Lt. Colonel Weston
Prepared by
Assistant Chief of Air Staff, Intelligence
Historical Division
December 1944

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

The decision to make the information contained herein available for staff and operational use without delay has prevented recourse to some primary sources. Readers familiar with this subject matter are invited to contribute additional facts, interpretations, and constructive suggestions. To this end perforated sheets, properly addressed, may be found at the back of the study.

This study will be handled in strict compliance with AR 390-5.

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Individual Training in Aircraft Maintenance in the AAF

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Chapter I

BACKGROUND OF AIRPLANE MECHANICS TRAINING

Role of the Airplane Mechanic

In popular imagination it is the members of the aircrews--particularly the pilots--who are the heroes of aerial warfare. Yet everyone familiar with the reality of the situation--especially pilots and their fellow crew members--realizes his dependence upon the glamorous airplane mechanic, the lowly "grease monkey." As early as World War I Air Service officials were declaring that "without efficient mechanics the pilots' wings would soon be clipped and there would be few, if any, ships available with which they could take the air."¹ And two decades later Col. Rush B. Lincoln, chief of the Plans Section of the Office of the Chief of the Air Corps, declared that "all failures in the air can be directly or indirectly traced to failures on the ground."²

In the early days of the Air Service all technicians, whether they were concerned with the maintenance of the airplane itself or not, were known as airplane mechanics. But as the work these technicians performed became more and more specialized, and its importance gained wider recog-

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1. Unsigned statement on airplane mechanics training [1918], in AAG 353.9, Mechanics Training.
 2. Memo for Chief of the Air Corps by Col. Rush B. Lincoln, Chief, Plans Sec., 26 Apr. 1937, in AAG 353.9 A, Training, General.

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dition, the term "airplane mechanic" came to be applied only to men who maintained airframes, aircraft engines, and accessories which were an integral part of the plane, such as propellers, hydraulic and electrical systems, carburetors, and power plants. Such other technical functions as armament, photography, and radio operation and maintenance were taught in separate courses, usually in separate schools, and developed their own characteristics of training. It is with training in the maintenance of airplanes and engines and their closely related accessories that this study is concerned.

In the AAF the bulk of airplane maintenance is performed by enlisted men working under the direction of a noncommissioned officer known as a crew chief. For many years it was customary for the pilot, usually a commissioned officer, to supervise the work done on his own plane: work performed by the crew chief and his subordinates. Since 1941 responsibility for supervision of this work has fallen on the shoulders of a ground duty officer known as the squadron engineering officer.³

For administrative purposes the AAF has found it convenient to divide maintenance work into four levels or echelons, although it has been found impossible to define each echelon with any preciseness. First echelon maintenance is that normally performed by the aircrew itself—servicing aircraft and aircraft equipment, preflight and daily inspections, and minor repairs, adjustments, and replacements. Second echelon maintenance is that usually performed by the ground crew of

3. Commanding General, Technical Training Command to Director of Individual Training, 26 July 1942, in AAG 353.9 GI, Miscellaneous Training.

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operating units, air base squadrons, and airways detachments. Normally it consists of the servicing of aircraft and aircraft equipment, the performance of periodic preventive inspections, and certain minor repairs and adjustments. Third echelon maintenance is performed by specialized mechanics working, in continental United States, in the base maintenance shop or a sub-depot. It includes removal and replacement of major unit assemblies and all minor repairs to aircraft structures and equipment. Fourth echelon maintenance is performed by highly specialized mechanics, organized in operational theaters by air depot groups and in continental United States by air depots. It involves all operations necessary to restore completely worn or damaged aircraft to a condition of tactical serviceability, as well as a periodic major overhaul of engine, unit assemblies, accessories, and auxiliary equipment.⁴

The latter two types of work are relatively difficult to perform and require highly trained personnel. During the first part of the period of rapid AAF expansion it was the policy of the Air Service Command, to whom third and fourth echelons of work usually were charged, to engage civilians to perform them. Later, as ASC units moved into combat areas overseas, increasingly large numbers of military personnel were employed. Thorough training of this type of personnel, either in advanced courses at AAF technical schools or at factories, became⁵ necessary.

4. Technical Order No. CO-25-4, 16 Feb. 1944.

5. CG, AFTTC to AFRIT, 26 July 1942, in AAG 353.9 G1, Miscellaneous Training.

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Mechanics Training before 1939

When the United States entered World War I the Army possessed but an infinitesimal fraction of the mechanics it required to keep its air arm aloft. It needed not only great numbers of men but a great variety of them—"airplane mechanics," as they were called at the time; blacksmiths, cabinetmakers, carpenters, coppersmiths, electricians, fabric workers, sail makers, instrument repairmen, metal workers, "motor mechanics," machinists, propeller makers, vulcanizers, and welders.

To train such men the Air Service used technical schools of its own which it established almost overnight: schools in factories operated in cooperation with aircraft manufacturers; schools overseas conducted by the British and French governments; and courses in civilian technical schools, colleges, and universities. In addition, men were taught "on-the-job": formally, in classes conducted at their air bases; informally, as they performed their duties on the lines.

Numerically the bulk of airplane mechanics was trained at two Air Service mechanics schools—one established in a corner of Camp Kelly, San Antonio, Tex.; the other in rented buildings in St. Paul, Minn. Smaller schools offering similar training were operated at Selfridge Field, Mount Clemens, Mich.; Hazelhurst Field, Mineola, N. Y.; Chanute Field, Rantoul, Ill.; Scott Field, Belleville, Ill.; and Wilbur Wright

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6. Undated and unsigned account of World War I mechanics training in AAG 353.9, Mechanics Training; memo for Maj. E. H. Litchfield by A. J. H., Enlisted Mechanics Sec., 11 Feb. 1918, in AAG 353.9, Engineering.

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Field, Fairfield, Ohio. A large school was projected for Richmond, Va.,
 but never got into operation.⁷

The Air Service made use of other types of training as well. Civilian technical schools gave training under contract in all the specialties taught by the Air Service's own mechanics schools.⁸ Universities were found particularly useful for training officers in aeronautical engineering.⁹ To avoid overcrowding at technical schools, considerable numbers of men who had had experience in mechanical trades in civilian life were sent overseas to squadrons of the French and British armies.¹⁰

It is noteworthy that every one of these methods of training, with the exception of training by the air services of the Allies, was used by the AIF during World War I. Even the housing of students in civilian hotels, the acceleration of training through specialization

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7. "The Air Corps Technical Schools" in Air Corps News Letter, 1 Aug. 1939; R&R, Maj. H. H. Arnold to Capt. P. L. Ferron, 21 Aug. 1917, in MAG 370.5, Post Field; memo for Maj. E. H. Litchfield by A. J. H., Enlisted Mechanics Sec., 11 Feb. 1918, in MAG 353.9, Engineering; War Department, Office of the Director of Air Service: July 1, 1918 to June 30, 1919, in AIF Library, Pentagon; "Historical Sketch of the U. S. Army Mechanics School, St. Paul, Minn., 1918," prepared by the Historical Division (Technical Training), AFTRC, 18 Oct. 1943, in AFHFI files.
 8. Memo for Maj. E. H. Litchfield by A. J. H., Enlisted Mechanics Sec., 11 Feb. 1918, in MAG 353.9, Engineering.
 9. See Miscellaneous items in MAG 353.9 Engineering.
 10. Memo for Chief of Staff by Brig. Gen. Joseph E. John, Chief, War College Div., 2 July 1917; Maj. H. H. Arnold to Adjutant General's Office, 29 Aug. 1917; Brig. Gen. George O. Squier, Chief Signal Officer, to Excelsior Propeller Co., 19 Sep. 1917; L. A. Morgan, Vice-President, Curtiss Aeroplane and Motor Corp., to Col. S. D. Walden, U. S. Signal Corps., 19 Sep. 1917; telegram, Squier per Dade to CO's, Selfridge, Scott and Chanute Fields, 10 Jan. 1918, all in MAG 353.9, Engineering.

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on particular types of aircraft, and the emphasis of the "practical" over "theoretical" in conducting instruction, which were to be such notable features during the period of World War II, were made use of¹¹ during the 1917-1918 period.

The signing of the Armistice brought a quick closing down of all technical schools. It brought, too, a tremendous exodus of trained mechanics from the enlisted ranks. In September 1920 a study made by the Air Service recommended that four schools on the pattern of the St. Paul school be established in various sections of the country to provide a continuing source of mechanics.¹² No action was ever taken on this proposal, however, and training was continued at Kelly Field in an "Enlisted Mechanics Training Department." Shortly afterwards, to mark its recognition as an integral and permanent part of the Air Service,¹³ it was renamed the "Air Service Mechanics School."

During January 1921 the school was moved into improvised buildings at Chanute Field. A year later it was renamed the "Air Corps Technical School."¹⁴ During this period the school was conducted on a small scale and in an informal fashion. Classes began at any time a group of students was detailed to attend them. The length of the course was set at a maximum of six months; students were advanced as rapidly as possible and graduated before the end of that period if they

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11. "Historical Sketch of the U. S. Army Mechanics School, St. Paul, Minn., 1918," 3, 12, 13, 14.
 12. Unsigned paper on "Recommended policy to be followed by the Air Service to secure an enlisted mechanical personnel," 24 Sep. 1920, in AAG 221 B, Mechanics.
 13. "The Air Corps Technical Schools" in Air Corps News Letter, 1 Aug. 1939.
 14. Ibid.

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were able to complete the work satisfactorily.

The facilities at Chanute were limited, and during the years the Air Corps was on a starvation peacetime budget no effort was made to expand them. The school obtained its students from Air Corps fields requesting training for their enlisted men and from among recruits furnished by the Army Recruiting Service. Most of the latter came from the vicinity of Chanute. By 1930 the Army was "overstrength,"¹⁶ and only veterans sent by air fields were admitted to the school.

Concomitant with the recognition of the potential importance of air warfare that led to the creation of the GHQ Air Force in 1935, a plethora of plans was drawn up for increased training of mechanics. One such plan, written in 1936, estimated that the Air Corps would gain about 5,200 new enlistees worthy of technical training each year; approximately one-half of them, it proposed, should be given training at Chanute, the other half in tactical units. To accomplish this¹⁷ Chanute's capacity ought to be increased to 1,700 students by 1941.

While the Air Corps was expanding during these years, the economic situation grew steadily brighter. The result was that by 1937 the Air Corps was losing its trained enlisted mechanics to the booming commercial aviation industry at an alarming rate. In April 1937 Col. Rush B. Lincoln, chief of the Plans Section, estimated that the

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15. Chief, Air Service to CG, 3d Corps Area, 31 Aug. 1921, in AAG 353.9 D, Training, Miscellaneous.
 16. Maj. Gen. J. E. Fechet, C/AC, to David Hopkins, M. C., 12 Dec. 1930, in AAG 221 C, Mechanics.
 17. Memo for Maj. Gen. Oscar Westover by Col. H. H. C. Richards, Chief, Information Div., 19 Oct. 1936, in AAG 221 C, Mechanics; memo for AC/S, G-3 by Maj. Gen. O. Westover, 31 Dec. 1936, in AAG 353.9 A, Training, General.

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Air Corps sorely needed 2,753 new ground crew technicians a year. The facilities at Chanute were "antiquated and inadequate." A proposal was made that the technical school be moved to a new and large base at Denver, Colo.¹⁸ Ultimately, early in 1938, only the armament, photography, and clerical departments of the school were moved to Denver. This transfer allowed greater room for the airplane and engine mechanics courses remaining at Chanute.

18. Memo for C/AC by Col. Rush B. Lincoln, Chief, Plans Sec., 26 Apr. 1937, in AAG 353.9 A, Training, General.

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Chapter II

AIRPLANE MECHANICS TRAINING PROGRAMS, 1939-1944

As the activities of the Fascist powers grew more menacing in 1938, the Air Corps began to take stock of its resources to determine its ability to meet any threat to the national interest. What it discovered was disturbing. As of 1 July 1938 the Air Corps was authorized to have a strength of 25,000 officers and enlisted men to operate 2,320 projected aircraft. Maj. Gen. Oscar Westover, Chief of the Air Corps, estimated that of the enlisted personnel, 16,250 ought to be trained technicians; at the moment the Air Corps actually had only about 3,000 trained technicians. A disturbing feature was the high turnover in personnel. Over the past eight years, 15.6 per cent of the enlisted personnel had been lost to the service through failure to re-enlist or through discharge by purchase; three-quarters of this number were skilled men, lured away by the high wages and greater opportunities available in the expanding commercial aviation industry.¹

To meet this situation, the Air Corps officials drew up, during the first days of 1939, a program designed to add 25,000 more enlisted men to the Air Corps by 30 June 1940. Of these, approximately 65 per cent or 16,250 were to receive training as technicians. Slightly more than

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1. Memo for C/AC by Col. Rush B. Lincoln, Chief, Plans Sec., 26 Apr. 1937; memo for Asst. Sec. of War by Maj. Gen. Oscar Westover, C/AC, 6 Aug. 1938, in AAG 353.9 A, Training, General.

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one-half, or about 8,750, were to be trained as airplane mechanics,²
 aircraft sheet metal workers, welders, and machinists.

While the program was in the discussion stage, a number of possible ways in which the training of these men might be conducted were discussed. The most logical first choice was through Air Corps technical schools-- at Chanute Field and at Scott Field, Ill., which had been an Air Corps establishment since World War I. Both of these fields, however, were inadequate for the huge program contemplated. A second possibility was training at troop schools in the units. A third was the use of privately owned mechanics schools. Still another was the use of govern-³ment-operated apprentice schools.

When the plan was placed in operation during the summer of 1939, all these possibilities with the exception of the last were made use of. Large building and modernization programs were carried out at Chanute and Scott so that 7,750 students might be accommodated in the course of the year;⁴ the facilities of seven civilian mechanics schools were engaged to train 1,000 men;⁵ and increasing use was made of "on-the-job" training in the tactical units.

In actual practice, under this program recruits were sent to one of six fields which had basic training centers. During their first month these men were given basic military training, inoculations, and tests to determine their capacity for technical training. Those found

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2. "Training of Aircraft Technicians," inclosure with memo for Lt. Col. Russell L. Maxwell, Office of Asst. Sec. of War, by C/AC, 20 Jan. 1939, in AAG 353.9 A, Training, General.
 3. Sec. of War to C/AC, 14 Jan. 1938, in AAG 353.9 A, Training, General.
 4. History of Chanute Field, 1 Jan. 1939 to 7 Dec. 1941, I, 33 ff; History of Scott Field, 1 Jan. 1939 to 7 Dec. 1941, I, 16 ff.
 5. New York Times, 6 Aug. 1939.

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qualified for training as airplane mechanics were sent to Scott Field for a one-month course in basic technical training; thereafter to Chanute or to one of the civilian mechanics schools for a course in airplane and engine mechanics or to Chanute for a course in one of a dozen aircraft specialties. Recruits not found qualified for technical training were sent to tactical units to serve as helpers. Many who showed particular aptitude on the job were sent later to technical schools⁶ for formal training.

Though this expansion program appeared ambitious at the time it was begun, it was succeeded by two even greater training programs during the following two and a half years. The first, the so-called 136,000-Man Program, adopted in September 1940 as a result of the overrunning of Western Europe and the threatened invasion of Great Britain by Germany, called for the increase of the enlisted strength of the Air Corps to 136,221 men. Under this program 25,348 airplane mechanics were to be trained by 1 January 1942.⁷ But long before this goal was reached, the increasing threat to American security offered by Germany, Japan, and Italy during 1940 and the remarkable demonstration of air power in the European conflict convinced the United States Army Air Corps that it must raise its plane production and also its training of mechanics. On 3 November 1941 the Air Corps began training enlisted men at a rate designed to produce 100,000 technicians a year. Of these, 65.5 per cent,⁸ or 65,500, were to be trained in airplane mechanics subjects.

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6. 1st ind., C/AC to AG, 25 Jan. 1939, in AAG 353.9 A, Training, General.
 7. R&R, J. E. F., Chief, Training and Operations Div. to [?], 19 July 1940, in AAG 353.9 C, Training, Mechanics.
 8. R&R, Training Div. to Chief, AAF, 1 Dec. 1941, in AAG 353.9 C2, Training, General.

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During this period, in spite of its enormously increased demands for enlisted men, the Air Corps made no use of the great numbers of men drafted into the Army after the start of the operation of selective service in the autumn of 1940. This policy was adopted in the face of an order of the Secretary of War that no restrictions should be placed against men inducted through selective service in assignment to special service schools.⁹ The attitude of the Air Corps was that selective service trainees were scheduled to remain in the Army only a year. It would be of no benefit to the Air Corps to give these men extended technical training, only to have them return to civilian life soon afterwards.¹⁰

To meet the increased production requirements, drastic changes were made at the airplane mechanics schools. The "basic mechanics" course at Scott Field was discontinued in September 1940. Recruits earmarked for airplane mechanics courses were sent directly to the Air Corps or civilian schools where the material formerly given them at Scott was presented in a brief phase added to the start of the course. The facilities of seven additional civilian mechanics schools were obtained in October 1940 and one more in January 1941. Two huge Air Corps schools to teach airplane mechanics were opened at Keesler Field, Miss. and Sheppard Field, Tex. in September and October 1941, respectively.

An important innovation of this period was the establishment in

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9. Sec. of War to Chiefs of All Arms and Services, 16 Oct. 1940, in AAG 220.66 A1, Detail of Students to Factory Training, Miscellaneous.
 10. 2d ind., C/AC to CG, ACTTC, 15 Sep. 1941, 5th ind., C/AC to CG, ACTTC, 27 Oct. 1941, in *ibid*.

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January 1941 of a course in maintenance engineering for men destined, as commissioned officers, to supervise the work of enlisted mechanics. Originally eliminees from the flying cadet's course were accepted for this training; subsequently promising enlisted men and men from civilian life with engineering training and technical experience were admitted. At first the course was given in two phases—a theoretical phase, given at New York University and Purdue University; and a more practical phase at Chanute Field. Beginning in June the entire course, somewhat shortened in length, was given at Chanute.

With the entrance of the United States into the war on 7 December 1941, training of Air Corps technicians was stepped up to what previously would have been considered impossible heights. The first step, taken within a few days of Pearl Harbor, was the tripling of production goals. Training facilities were to be expanded so that by January 1943 technicians would be turned out at the rate of 300,000 a year. This meant 185,000 to be trained in airplane mechanics categories. Supplemental directives issued by Headquarters, AAF in May and June 1942 made so many additional facilities available to the Technical Training Command—which bore primary responsibility for the attainment of the objectives—that the Director of Individual Training estimated production would far exceed the 185,000 goal by the end of the year. Early

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11. History, Chanute Field, 1 Jan. 1939 to 7 Dec. 1941, 62-64; Chanute Field, 7 Dec. 1941 to 1 Jan. 1943, 315, 316.
 12. Col. William W. Dick, AAG, to C/AG, 11 Jan. 1942, in AAG 353.9 C2, Training, General.
 13. Col. L. S. Smith, AFRIT, to CG, AFTTC, 8 Aug. 1942, in AAG 353.9 D2, Training, General.

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in 1943 increases in production ceased, and the AAF for some months was content to maintain training at a fairly even, though high, level.

Upon the entrance of the United States into the war, the AAF began availing itself of the great numbers of men brought into the Army through selective service. In general, any man eligible for Army service was considered physically qualified for training in airplane mechanics, although from time to time limits were placed on the number of "limited service" men acceptable in certain categories. A General Classification Test score of 100 and a mechanical aptitude score of 90--approximately average--were set as the minimum for training. As time went on these standards often had to be relaxed in order that quotas might be met. Most, although not all, of the men sent to schools during this period were unassigned personnel, which meant that they were recruits to the AAF.

During this period of tremendous expansion, schools of four types were added to the mechanics training program. Of the first type--the large AAF technical schools giving the basic airplane and engine mechanics course--four were opened during the summer and early autumn of 1942: Lincoln Army Air Field, Neb.; Seymour Johnson Field, N. C.; Gulfport Field, Miss.; and Amarillo Army Air Field, Tex. At the same time the basic mechanics course at Chanute was discontinued.

A second type of school was added during the first months of 1942 on behalf of the Air Service Command. At this time the Air Service Command was greatly expanding the number of its air base and service groups. To staff them it was recruiting a considerable number of men with civilian experience in aircraft mechanical specialties. When

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inducted into the Army, these men were assigned to the ASC. So that they might have third and fourth echelon maintenance training, the ASC contracted with 16 civilian mechanics schools for courses in some half dozen depot overhaul specialties. On 1 June 1942 these schools were made the administrative responsibility of the Technical Training Com-¹⁴mand, but they continued to train only assigned ASC personnel.

A third type was the factory school. Various commands of the AAF had long conducted sporadic training at the plants of equipment manufacturers; but it was not until April 1942 that an extensive program, involving the training of as many as 6,000 men at between 20 and 30 airframe, engine and accessory plants, was inaugurated. This training was done on various maintenance levels, although most of it was third and fourth echelon maintenance. The general practice was to send to the factory schools only unassigned graduates of AAF technical schools and assigned personnel sent by continental U. S. commands and air forces.¹⁵

A fourth type of school was the airline school, conducted for the ASC, the TTC, and the Air Transport Command by 14 commercial airlines during the latter six months in 1942. The number of men given this training was never more than 700 at a time, and the program was conceded by both airlines and the AAF to be a failure economically and pedagogically.¹⁶

14. Maj. Gen. W. H. Frank, CG, AFASC, to CG, AAF, 8 May 1943, in AAG 161, Contract Schools.

15. See monthly Rpt., AAF Technical Training Reports-Factory Training Programs, in AFTHI files.

16. R&R, Brig. Gen. L. S. Smith, AFTHI, to AFTHI, 14 Dec. 1942, in AG/AS, Training files.

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To make training facilities go farther, several other changes were introduced during this period. The maintenance engineers course was transferred from Chanute Field to Yale University, where all technical officer and cadet training was concentrated after 1 January 1943. Instruction at the basic mechanics schools was reorientated during the summer of 1942 to emphasize maintenance of a particular type of aircraft rather than the problems incident to all types. This step was an attempt to maintain instructional standards despite a shortening in the length of the course. Shortly after Pearl Harbor all schools switched from five instructional days a week to a six-day week. The training capacity if not the efficiency of many of the schools was further raised by the adoption of three shifts, with classrooms and laboratories in use 24 hours a day, seven days a week.

Some notion of the extent and variety of AAF airplane mechanics training at the height of the expansion period may be gained by a survey of the situation in December 1942. At that time the basic mechanics course was being given at six Air Corps schools and 24 civilian mechanics schools. Eight types of advanced specialists courses were being offered at Chanute and 22 civilian mechanics schools. Forty-seven factories were being utilized: 18 to teach 19 different types of airframes; 7 to teach 4 types of engines; 22 to teach such accessories as propellers, carburetors, and superchargers. At Chanute, training was being given men earmarked for service as maintenance engineering officers. Twenty-four mobile training units were touring tactical units and schools in the continental United States. During the month 98,162 men and officers were receiving aircraft maintenance training, plus a large but unknown

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number while performing jobs in tactical units.

In the spring of 1943 the AAF approached the 2,500,000-man size which had been estimated as necessary to win the war in the air. Need for a fairly high production rate of aircrew members still continued. On the other hand, losses among ground crew men such as airplane mechanics were extremely light, resulting in correspondingly moderate demands for replacements. Accordingly, the number of recruits made available to the AAF each month was reduced sharply.

The new situation led the AAF to change its mechanics training program in several important respects. Thereafter, emphasis was placed upon quality rather than quantity of training. The inefficient third shift, given during the night hours, was dropped at all schools. Aircrew members were to be given the basic mechanics course so as to be able to solve the simplest of their own maintenance problems. Moreover, as new types of aircraft and equipment came into use, new problems in maintenance arose. Experienced mechanics, instructors, and aircrew members were given "refresher" courses on the new equipment in factory schools and through mobile training units. As preparations were made to use the new heavy bomber, the B-29, for example, special courses were instituted to teach their aircrews how to maintain them.

For the training of men to replace ground crew mechanics lost to the service, a new procedure was developed early in 1944. On entering

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17. Hq. AAF Training Report--Technical Training, 31 December 1942, Hq. AAF Technical Training Report--Factory Training Program 31 December 1943 in AFTHI files; Brig. Gen. R. W. Harper to CG, AFTTC, 15 Dec. 1942, in AG/13, Training files.

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the AAF, such men were now all assigned to a tactical unit for training on the job. Mobile training units proved a great boon in conducting this type of training. If these men subsequently showed promise and a need existed for their further training, they were sent to advanced or specialist courses at Chanute and at factory schools.

The great curtailment and increased emphasis on quality inherent in this program led the AAF drastically to reduce the number of schools and courses in mechanics training. First to be discontinued were the civilian mechanics schools which had been giving basic courses for unassigned personnel and advanced courses for Air Service Command personnel. No classes were entered at these schools after 30 June 1943. Next the number of AAF technical schools giving basic mechanics courses was reduced, Sheppard, Lincoln, Seymour Johnson, and Gulfport fields being diverted to other purposes during late 1943 and early 1944. The number of specialists courses given at Chanute was reduced by about one-half, and the classes of those which were continued were made much smaller. Quotas for cadets and officers in the maintenance engineering course at Yale were diminished. On the other hand, the scope of some training activities was increased. The number of factory schools was reduced by about one-half, but the number of students trained in them increased from a rate of 80,000 a year during the latter part of 1943 to a rate of 120,000 a year by the middle of 1944. The number of mobile training units was tripled; now they were touring combat theaters in all

18. Memo for Col. R. M. Montgomery by Col. L. O. Ryan, 29 Feb. 1944; R2R, Brig. Gen. R. W. Harper to Deputy Chief of Staff, 7 Mar. 1944, in AC/AS, Training files.

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parts of the world, as well as establishments in continental United States.

The effect of this "levelling-off" policy on the training of airplane mechanics is well shown by a survey of conditions in May 1944. Then the basic mechanics course, for which only men destined for aircrew service were now sent, was being given only at Keesler and Amarillo fields. Five types of advanced and specialists courses were being offered at Chanute to experienced mechanics and graduates of on-the-job training. Twenty-four factories were teaching airplane and engine mechanics courses; five were teaching accessories maintenance. Only graduates of AAF technical schools and those qualified by on-the-job training were eligible. Cadets and officers were being trained in maintenance engineering at Yale, but in greatly reduced numbers. Some sixty-five mobile training units were touring stations and schools in all parts of the world and about thirty more were under construction. During the month only about 20,000 men and officers were being trained in airplane mechanics courses in AAF technical schools in the continental United States. It should be remembered, however, that in addition an unknown but considerable number were being trained on the job in this country and in foreign theaters.

19. Monthly training reports prepared by Statistical Control Division, Office of Management Control, Hq., AAF; interview with Capt. H. C. Freeman, 14 Aug. 1944.

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Chapter III

BASIC AIRPLANE MECHANICS COURSE

Probably the most important single course offered by the Army Air Forces to train its aircraft mechanics was the basic aircraft maintenance course. This was so because this course formed the basis upon which the entire structure of mechanics training was built, and because the number of men taking it was several times as great as that of any other course. In theory it was given to every man earmarked for any type of aircraft maintenance duty unless he had already received such training on the job or in a troop school conducted by the command to which he was assigned.

The role of the first and second echelon mechanic and the objectives of the basic mechanics course were well described in a training memorandum issued in 1941. This declared that the first echelon

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mechanic

should be able to diagnose and correct trouble in an airplane and its accessories according to the system in use in the Air Corps today. He is not required to make any major repairs which require shop work. He is required to perform routine maintenance, to diagnose trouble and see that the affected parts of an aircraft are replaced and sent to the proper agency for repair if necessary. Other Air Corps technicians are trained to accomplish repairs on specific parts of Air Corps equipment.

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1. Civilian Mechanics Schools Training Detachment Memorandum No. 1, 30 Aug. 1941, cited in History, AFTD Lincoln Aeronautical Institute, 7 Oct. 1940 to 15 Nov. 1943, 11.

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In 1938, before the beginning of the Air Corps' period of great expansion, all formal training of mechanics to perform first echelon airplane maintenance was conducted at Chanute Field. The number of men attending the course was small and the pace leisurely. During the school year 1938-1939 fewer than 900 men were graduated.² The course required 38 weeks--8 weeks devoted to a Basic Mechanics' phase which covered the fundamentals of mathematics and shop practice, 30 weeks devoted to the work of the course itself.³

To meet the demands of the first expansion program, which went into effect 1 July 1939, the Air Corps greatly stepped up the pace and volume of its training. Facilities at Chanute and Scott fields were improved and enlarged. Contracts were closed with seven civilian mechanics schools: Aero University, Chicago, Ill.; Casey Jones School of Aeronautics, Newark, N. J.; Curtiss-Wright Technical Institute, Glendale, Calif.; New England Aircraft School, East Boston, Mass.; Parks Air College, East St. Louis, Ill.; Roosevelt Field, Mineola, L. I., N. Y.; and Spartan School of Aeronautics, Tulsa, Okla. The civilian schools were to train 1,000 enlisted men, the Air Corps schools the balance. All the civilian schools engaged had been long established and were accredited by the Civil Aeronautics Administration.⁴

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2. History of Chanute Field, 1 Jan. 1939 to 7 Dec. 1941, I, 49.
 3. Lt. Col. Ira C. Eaker, Executive, OCAC, to AG, 21 June 1939, in AAG 352.11 F, Chanute Field Course of Instruction.
 4. New York Times, 6 Aug. 1939.

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The length of the course was reduced to 28 weeks--4⁵ for the Basic Mechanics phase, 24 for the course itself. Students in training at civil mechanics schools took the entire course at one school. Men in training at Air Corps technical schools took the Basic Mechanics phase at Scott Field and the course proper at Chanute, an innovation designed⁶ to increase the capacity of the schools.

Instruction was conducted according to syllabi prepared by the Commandant of the technical school at Chanute, who was responsible for all Air Corps technical training. The course these laid out was a modification of the course as it had been given at Chanute for years. It was designed to familiarize men with the construction and operation of a wide variety of aircraft so that they would be able to handle simple maintenance problems. The syllabus in effect at all civilian mechanics schools, which formed a part of their contracts with the War Department, was similar to that used at the Air Corps schools with only one exception--the Basic Mechanics phase. The following abstracts of the chief features of this phase as administered in both types of schools illustrate the differences:

<u>Air Corps Technical Schools</u> ⁷		<u>Civilian Mechanics Schools</u> ⁸	
Phase	Hours	Phase	Hours
I. Shop Mathematics	27	I. Shop Mathematics	35
II. Mechanical Drafting and Blueprint Reading	26	II. Mechanical Drafting and Blueprint Reading	35

5. Lt. Col. Ira C. Eaker to AG, 21 June 1939, in AAG 352.11 F, Chanute Field Course of Instruction.
6. History of Scott Field, 1 Jan. 1939 to 7 Dec. 1941, I, 31, 32; History of Chanute Field, 1 Jan. 1939 to 7 Dec. 1941, I, 49.
7. Lt. Col. Ira C. Eaker to AG, 21 June 1939, in AAG 352.11 F, Chanute Field Course of Instruction.
8. War Department: OC/AG, Washington, 21 April 1939, Appendix A, History of AFTD, Curtiss-Wright Technical Institute, in AFTHI files.

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III. Air Corps Fundamentals	27	III. Aviation Fundamentals	10
IV. Elements of Metalwork	40	IV. Elements of Metalwork	40
V. Elements of Electricity	40	V. Elements of Electricity	40
Total	160	Total	160

The dissimilarities arose out of the differences in the facilities available at the two types of schools. The civil schools employed as instructors civilians who were unfamiliar with Air Corps procedures; moreover, certain Air Corps equipment was not available to demonstrate these practices. For this reason, 10 hours of instruction on fundamental aviation practices was substituted for Air Corps Fundamentals. The 17 hours saved was divided between Shop Mathematics and Mechanical Drafting and Blueprint Reading.

The syllabus for the main body of the course was the same at all schools. The principal features were:

I. Airplane Structures	80 hours
II. Airplane hydraulic structures and miscellaneous equipment	80 hours
III. Airplane propellers	80 hours
IV. Airplane instruments	80 hours
V. Airplane engines	80 hours
VI. Airplane electrical systems	80 hours
VII. Engine induction, fuel and oil systems	80 hours
VIII. Engine operation and tests	80 hours
IX. Engine change and engine change inspection	80 hours
X. Airplane inspection and maintenance on complete serviceable airplanes	80 hours
Total Airplane Mechanics Phase	800 hours
Basic Mechanics Phase	160 hours
Total for Airplane Mechanics Course	960 hours

9. A brief description of the material given in each phase is given in the Appendix.

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It was specified in the contracts with the civilian mechanics schools that not more than 35 per cent of the instruction period was to be devoted to lectures and demonstrations. Laboratory work and practical types of instruction were to fill the balance of the time.¹⁰

Soon after the first class had been graduated from the civilian mechanics schools early in 1940, the OCAC undertook a survey to learn how the training they offered compared with that given at Chanute and whether it was satisfactory for Air Corps requirements.¹¹ An inspection of the New England Aircraft School in March 1940 convinced one Air Corps officer that the school's equipment, organization, and facilities were not up to Air Corps standards. In defense, the Commandant at Chanute pointed out that when the civilian facilities were engaged, it was recognized that though their equipment in many cases was very modern and expensive, it was inferior to that of Chanute as far as Air Corps needs were concerned. The Commandant pointed out that the instruction given at the civilian schools was rapidly being improved.¹²

Reports received from seven Air Corps units to which graduates of the civilian mechanics courses had been assigned were unanimous in approving of the product. "Graduates compare very favorably with those of the Air Corps technical schools"; "efficiency comparable in every respect"; "equal in training and ability," were typical comments re-

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- 10. Lt. Col. Ira C. Baker to AG, 21 June 1939, in AAG 352.11 F, Chanute Field Course of Instruction; Appendix A, History of AFTD, Curtiss-Wright Technical Institute, in AFTHI files.
 - 11. C/AG to CG, Scott Field, 16 Feb. 1940, in AAG 221 D, Mechanics.
 - 12. C/IC to Comdt., ACTS, Chanute Field, 13 Mar. 1940; 1st ind., Comdt., Chanute to C/IS, 23 Mar. 1940, in AAG 353.9 A, Training, General.

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ceived. The consensus of opinion was that civilian schools did a poorer job than Chanute in teaching practical aspects of the subjects, but did a superior one on the theoretical side. Civilian school graduates were apt to be inferior in military discipline and bearing; but--as one report put it--the "more pleasant living conditions," absence of K. P. and fatigue details, and "the low number of students per instructor" enabled students who were seriously interested in mechanical work to learn more than was possible at Chanute. All heartily recommended
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use of the schools.

These generally satisfactory reports, plus the rising needs of the Air Corps, caused the War Department not only to continue its use of civilian schools but to double the number employed. In October 1940 seven additional schools were engaged to give the course: Boeing School of Aeronautics, Oakland, Calif.; California Flyers School of Aviation, Inglewood, Calif.; Dallas Aviation School, Dallas, Tex.; Isaac Delgado Central Trades School, New Orleans, La.; Lincoln Aeronautical Institute, Lincoln, Neb.; Missouri Aviation Institute, Kansas City, Mo.; and Rising Sun School of Aeronautics, Philadelphia, Pa. In January 1941 the Academy of Aeronautics, New York City, was added to the list. The contract of the Parks Air College was not renewed after 30 June 1941.

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13. Lt. George D. Campbell, Jr., Comdg., Flight C, XII Observation Sq., Ft. Sill, Okla., to C/AC, 10 Apr. 1940; Lt. Hilivert S. Streeter, Comdg., I Balloon Sq., Ft. Sill, Okla., to C/AC, 26 Apr. 1940; Col. C. W. Russell, C/S for CG, GHQ AF to C/AC, 22 May 1940; 1st ind., Comdt. AC Tactical School, Maxwell Field, to C/AC, 27 May 1940; 1st ind., Maj. Harvey J. Frosser, Comdg., AC Advanced Flying School, Kelly Field, Tex., to C/AC, 28 May 1940; 1st ind., Col. V. B. Dixon, AC Troops, Pope Field, Fort Bragg, N. C., to C/AC, 28 May 1940, in AAG 221 D, Mechanics.

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CLASSROOM INSTRUCTION IN MAINTENANCE AS CONDUCTED AT ONE OF THE CIVILIAN CONTRACT SCHOOLS

STUDENTS BEING TAUGHT UNDER SIMULATED "ON-THE-FLYING-LINE" CONDITIONS AT A CIVILIAN SCHOOL.



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No additional civilian mechanics schools were engaged to give the basic airplane mechanics courses, as there were no other long-established schools in the country considered competent to give the training.

From this time forward the Air Corps met demands for additional basic airplane mechanics by opening a series of great schools at its own air fields. The first two of these, at Keesler Field and Sheppard Field, were activated in September and October 1941, respectively. Thus, at the time of the Japanese attack on Pearl Harbor, three Air Corps technical schools and 14 civilian mechanics schools were giving the basic airplane mechanics course.

Only a few changes were made in the content of the course before 7 December 1941. All were designed to train an ever growing number of men in an ever shorter period. The length of the course was reduced twice. In August 1940, by cutting the preliminary Basic Mechanics phase from four to two weeks,¹⁴ the course was shortened to 24 weeks.¹⁵ A year later, by a reduction of the number of hours devoted to each of the principal phases by one-eighth, the course was compressed into 770 instructional hours, or 22 weeks. Arranged into 11 phases, the course was now¹⁶ as follows:

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|------|--|-------------------|
| I. | Aircraft Fundamentals (Basic Mechanics) | 70 hours, 10 days |
| II. | Airplane Structures | 70 hours, 10 days |
| III. | Airplane Hydraulic Systems and Miscellaneous Equipment | 70 hours, 10 days |

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14. At the same time the Basic Mechanics course was discontinued at Scott Field. Chanute students thereafter took all their work at Chanute.
 15. Col. G. C. Brant, Comdt., Chanute, to C/AC, 1 Aug. 1940, in AAG 353.9 E, Training, Miscellaneous.
 16. Program of Instruction, Airplane Mechanics Course, Chanute Field, School Year 1941-1942, in History of Chanute Field, 7 December 1941 to 1 January 1943, V, 29-43.

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IV.	Aircraft Propellers	70 hours, 10 days
V.	Aircraft Instruments	70 hours, 10 days
VI.	Aircraft Engines	70 hours, 10 days
VII.	Aircraft Electrical Systems	70 hours, 10 days
VIII.	Engine Induction, Fuel and Oil Systems, etc.,	70 hours, 10 days
IX.	Engine Operation and Test	70 hours, 10 days
X.	Airplane Inspection and Maintenance (Daily and Freflight)	70 hours, 10 days
XI.	Airplane Inspection and Maintenance (25 hour and 50 hour)	70 hours, 10 days
	Total	770 hours, 110 days

Upon the activation of Keesler and Sheppard fields, the same course¹⁷
given at Chanute and the civilian mechanics schools was offered at them.

The shortage of airplanes and engines available for instructional purposes caused an important modification of the course at Chanute in July 1941. A phase known as Airplane Inspection and Maintenance (Multi-engine), calling for less practical work, was substituted for Engine Change and¹⁸
Engine Change Inspection.

In the months following Pearl Harbor a number of radical and fundamental modifications were made in the course. To make room for larger classes in the advanced, specialized courses at Chanute Field, no classes in the basic airplane mechanics course were entered at that¹⁹
school after 15 June 1942. To offset this loss and to expand training ever farther, four great new AAF schools were opened during the following summer and autumn: Lincoln Army Air Field, Neb., in July; Seymour Johnson Field, N. C., in August; Gulfport Field, Miss., and

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17. History of Keesler Field to 7 December 1941, 174-175; History of Sheppard Field to 7 December 1941, I, 68-74.
18. CG, ACTTC to C/AC, 11 July 1941, in AAG 352.11 F, Chanute Field Course of Instruction.
19. History of Chanute Field, 7 December 1941 to 1 January 1943, II, 313.

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Amarillo Air Field, Tex., in September. The AAF schools at Keesler and Sheppard fields and the 14 civilian mechanic schools continued as before.

With the opening of these schools, an important new policy was adopted: instead of attempting to prepare mechanics for service on all the principal types of AAF aircraft, hereafter each school was to train men for work on a particular model or type of plane. Under this plan, the school at Amarillo was to train B-17 mechanics; that at Keesler, B-24 mechanics; that at Sheppard, medium bombardment mechanics; that at Seymour Johnson, light bombardment mechanics; and that at Gulfport, cargo plane mechanics.²⁰ Two schools were to give heavy bombardment instruction because the need for mechanics on this type of plane was so great and because the two important heavy bombers, the B-17 and B-24,²¹ were so unlike in their principal characteristics.

In putting this specialization into effect, the Technical Training Command directed each of the AAF schools to draw up a syllabus for a specialized course, subject to approval by the appropriate TTC district headquarters. Inasmuch as each school used the traditional Chanute outline as a point of departure, the syllabi drawn up were similar in their general outlines. Most of the specialization which the courses now stressed was provided by the fact that--theoretically at least--each school was equipped with airframes, engines, accessories, manuals and mock-ups for the appropriate type of aircraft, and extensive use

20. Unsigned list dated May 1942, in AG/AS, Training files.

21. History, Keesler Field, 7 Dec. 1941 to 31 Dec. 1942, II, 210.

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was made of them in the classroom and laboratory. It should be pointed out, however, that in actual practice materiel shortages necessitated the temporary substitution of other types of equipment, and in some schools manuals were not ready for general use until a year after the adoption of the specialization policy.

The manner in which the AAF schools adapted their training schedules to the specialization policy and other problems attendant on the period of great expansion, autumn 1941 to mid-1943, can best be understood by following the evolution of the course at a typical school. The case of Keesler Field, which trained B-24 maintenance mechanics, will serve as such an example.

The Keesler officials were notified during May 1941 that their school was to specialize in heavy bombardment, but not until 27 August were they told that they were to concentrate on the B-24. Instruction under the new plan started on 19 October. The syllabus used was a modification of the course of instruction they had been using previously, which in turn was an adaptation of the old Chanute course of instruction. The subject and the order of the phases remained as before, but the specialization permitted the shortening of each from 12 to 8 days, making possible a reduction of the entire course from 110 to 96 instructional days and an increase in the production rate of the school. ²²

Early in 1943 two important modifications were made in the course. In January an eight-day phase known as the Graduation Field Test was added at the end of the course. Reports from combat areas had indicated

22. History, Keesler Field, 7 Dec. 1941 to 31 Dec. 1942, II, 209-11.

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that mechanics in training greatly needed the experience of working under the sort of conditions they would meet in tactical units. At Keesler a wooded area in a far corner of the field was set aside, and for eight days students set up tents; did field kitchen police details; performed camouflage work; and did trouble-shooting, maintenance, and repair work on planes, using only the type of tools and equipment that would be available at an advanced air base.²³

The second important modification, which was introduced in February 1943, was the splitting of the first phase of the course--Aircraft Maintenance Fundamentals--into two phases known as Airplane Mechanics Tools and Air Forces Fundamentals, each eight days in length. The Airplane Mechanics Tools phase was devoted to the care and use of tools, tool and hardware nomenclature, and safetying procedure. Air Force Fundamentals dealt with the use of Technical Orders, the AAF supply system, and the preparation of forms and reports. This change was a tacit admission that a mistake had been made in reducing so greatly the Basic Mechanics phase at a time when so many men with little or no previous mechanical experience were taking the course.²⁴

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In February 1943 the following curriculum was in effect:

I.	Airplane Mechanics Tools	56 hours, 8 days
II.	Air Force Fundamentals	56 hours, 8 days
III.	Airplane Structures	56 hours, 8 days
IV.	Airplane Hydraulic Systems	56 hours, 8 days
V.	Airplane Engines	56 hours, 8 days
VI.	Aircraft Electrical Systems	56 hours, 8 days

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23. History, Keesler Field, 1 Jan. 1943 to 7 July 1943, II, 270-76.
 24. Ibid., 209-18.
 25. Ibid., 209-76.

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VII.	Aircraft Fuel Systems	56 hours, 8 days
VIII.	Airplane Instruments	56 hours, 8 days
IX.	Aircraft Propellers	56 hours, 8 days
X.	Airplane Engine Operation	56 hours, 8 days
XI, XII, XIII.	Aircraft Inspection: Preflight, Daily, 25-hour, 50-hour, 100-hour	168 hours, 24 days
XIV.	Graduation Field Test	56 hours, 8 days
	Totals	784 hours, 112 days

Recognition of the fallacy of arbitrarily allotting the same number of hours to each phase without regard for the quantity or difficulty of the material presented in it was given in a series of directives issued by the Technical Training Command during the spring and summer of 1943. The school's director of training was authorized to revise the curriculum so that each phase would be allotted a proportionately adequate amount of time. Several limitations, however, were imposed upon him in doing this. The course had to be kept down to 112 instructional days, with only six hours of school work each day, as was now the general practice throughout the TTC schools. The phase known as Air Force Fundamentals was to be dropped, and the material previously offered in it--use of Technical Orders, preparation of forms and reports--was to be given in connection with other phases.

The course, as revised and put into operation in late June and
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early July, was as follows:

I.	Airplane Mechanics Tools	8 days, 48 hours
II.	Airplane Structures	10 days, 60 hours
III.	Airplane Hydraulic Systems	8 days, 48 hours
IV.	Airplane Engines	8 days, 48 hours
V.	Airplane Electrical Systems	10 days, 60 hours
VI.	Aircraft Fuel Systems	8 days, 48 hours

26. Ibid., 172-73, 175-77; History, Gulfport Field, 1 Jan. 1943 to 7 July 1943, Sec. 2, 557-60.

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VII.	Airplane Instruments	8 days, 48 hours
VIII.	Aircraft Propellers	6 days, 36 hours
IX.	Airplane Engine Operation	12 days, 72 hours
X, XI, XII.	Aircraft Inspection	24 days, 144 hours
XIII.	Graduation Field Test	10 days, 60 hours
	Totals	112 days, 672 hours

When the principle of specialization was being introduced into AAF schools during the autumn of 1941, some attempt was made to apply it to the civilian mechanics schools as well. In general, this did not mean a thorough revision of the syllabus, but merely increased emphasis during instruction on the particular type of aircraft the school had available. Thus the Rising Sun School of Aeronautics gave particular attention to the P-39.²⁷ On the other hand the Curtiss-Wright school officials considered "not feasible" a proposal to give specialized instruction on the P-38, and the general course there was continued.²⁸

Specialization of another type was found to be particularly useful at three civilian schools located in the New York City metropolitan area: the Academy of Aeronautics, the Casey Jones School of Aeronautics, and Roosevelt Field. The amount of equipment and number of instructors available at these schools were found to be inadequate for the increasing student loads. To make most efficient use of what facilities they had, the Headquarters of the First District of the Technical Training Command late in November 1942 developed a plan by which the course was divided among the three schools. Students assigned to the course took the first three phases at the Academy of Aeronautics, transferred to the Casey Jones School of Aeronautics for the next six phases, and

27. History, AFTD Rising Sun School of Aeronautics, 14.

28. History, AFTD Curtiss-Wright Technical Institute, 53.

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attended the school at Roosevelt Field for the final phases. Such an arrangement was possible because the schools were so close together geographically that the transfers could be made without any loss of school time.²⁹

As the AAF approached the limit of its expansion in the spring of 1943, far-reaching changes, designed to meet the new conditions, were introduced in airplane mechanics training. The first change was a rapid reduction in the numbers of men in training. To this end, use of the civilian mechanics schools was discontinued. On 14 April 1943 Headquarters of the Technical Training Command notified the 14 schools that their contracts would not be renewed beyond 30 June 1943. The choice of three methods of bringing the training to an end was offered to the contractors: (1) The contract might be cancelled immediately upon receipt of the letter. Students who had not yet graduated would be sent to another school to complete the course. (2) No more students would be sent to the school, but the training of students already at the school would be completed according to a previously arranged schedule. (3) Training and entrance of students would continue according to schedule, but would cease on 30 June 1943.³⁰ Apparently the majority of the schools availed themselves of the second option. All training in civilian schools had been terminated according to plan by 1 July 1943.

29. History, AFTD, Academy of Aeronautics, 11-12; History, AFTD Casey Jones School of Aeronautics, 15-16.

30. Hq., AFTTC to CG, 4th Dist., AFTTC, 14 Apr. 1943, cited in History, AFTD Curtiss-Wright Technical Institute, 18-19.

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At the same time training in the AAF's own technical schools was being sharply curtailed. During the calendar year 1943 the number of students under instruction was reduced by nearly one-half.³¹ In the spring of 1944 four of the schools were closed: Gulfport, Sheppard,³² and Lincoln in April, and Seymour Johnson in May.

Inasmuch as a demand for heavy bomber mechanics continued, both the Amarillo and Keesler schools were continued, although their enrollments were cut by more than one-third during the fiscal year 1944. At Amarillo instruction in maintenance of the new giant bomber, the B-29, was given concurrently with that of the B-17 beginning in February 1944. During the same month the B-24 course at Keesler was broadened in scope to include instruction on another heavy bomber, the B-32. In spite of the added material, the length of the two courses remained 112 instructional days. At the same time the type of student and the emphasis of the instruction were changed to meet the new need of the AAF for aircrew mechanics rather than ground maintenance men. From this time forward, only men physically qualified for service as mechanic-gunners were sent to the schools. Flight operations and emergency flight procedures were stressed in the course of instruction.³³

31. Monthly reports of Statistical Control.

32. Brig. Gen. R. W. Harper, AC/AS, Training, to CG, AFTRC, 25 Nov. 1943, in AAG 352.11, Technical Schools, Miscellaneous.

33. Headquarters Progress Report, Feb. 1944, Hq., AFTRC, in AFTHI files; TC Memo No. 50-32-1, 15 July 1944.

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Chapter IV

ADVANCED TRAINING AND COURSES FOR SPECIALISTS

For men already familiar, through training or experience, with first echelon maintenance of all parts of aircraft, the AAF has long offered a variety of advanced and specialist courses. Each of these courses is designed to train personnel for second, third, and even fourth echelon maintenance work on some particular part of the plane. Between the inception of the Air Corps expansion program in 1939 and the "levelling-off" of training in 1944, eight such courses were offered: (1) Airplane Machinists; (2) Aircraft Welders; (3) Aircraft Metal Workers; (4) Propeller Specialists; (5) Power Plant Specialists; (6) Hydraulics Specialists; (7) Electrical Specialists; and¹ (8) Instrument Specialists. All of these courses were offered at Chanute Field and many of them at civilian contract schools as well.

In addition, for short periods the AAF offered three other courses for advanced or specialist trainees. Two were courses for depot overhaul mechanics--airplane and engine mechanics capable of performing fourth echelon maintenance--which were given at a number of civilian schools to meet the peculiar needs of the Air Service

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1. The training of electrical specialists and instrument specialists is to be subject of a separate study prepared by the AAF Historical Division and will not be discussed here.

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Command during a period in which it was undergoing rapid expansion. The third was a short-lived course for glider mechanics given at Sheppard Field during the early period of the AAF glider pilot training program.

Aircraft Machinists Course

A course designed to train enlisted men to perform the general machine work and heat treating necessary for second and third echelon maintenance and repair had been given at Chanute Field long before the start of the expansion program in 1939. It was conducted in such a fashion that it could be taken by men who had had no previous Air Corps technical training, but who had had experience in mechanical work² either in the Air Corps or in civilian life.

Like all Air Corps technical training courses, its length was reduced constantly once expansion got under way. During the school year 1938-1939 it lasted 36 weeks, including the basic mechanics phase; in 1939-1940 it was reduced to 23 weeks; for the school year 1941-1942 it was shortened to 20 weeks; and with the adoption of the³ six-day school week in December 1941, to 16 $\frac{2}{3}$ weeks.

Despite these repeated reductions, the fundamental structure and content of the course remained constant throughout the period. For

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2. History of Chanute Field 7 Dec. 1941-1 Jan. 1943, 352.
 3. Lt. Col. Ira C. Eaker to AG, 21 June 1939; CG, ACTTC to C/AG, 11 July 1941, in AAG 352.11 F, Chanute Field Course of Instruction.

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this reason, an outline of the course as given during the school year 1941-1942 may be taken as characteristic:

I. Basic Instruction

70 hours, 10 days

This phase was identical with that given at the start of the basic mechanics course.

II. Lathes

245 hours, 35 days

Operation and adjustment of the lathe were studied. Most of the time was devoted to lathe operation, including such operations as turning, facing, filing, drilling, boring, reaming, thread cutting, knurling, and winding.

III. Milling Machines and Shapers

245 hours, 35 days

Operation and repair of both instruments were covered. On the milling machine, the student performed such operations as slab, straddle, end, slot, and spiral milling, and gear cutting. On the shaper the student learned to machine plane surfaces and dovetails and to cut keyways.

IV. Heat Treating

70 hours, 10 days

This phase covered the care and operation of heat treating and such operations as hardening, tempering, annealing, testing, and inspection of metals.

V. Grinding Machines

70 hours, 10 days

This covered the use of grinding machines, with practice in tool, surface, cylindrical, and internal grinding.

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As given at Chanute, instruction was divided between the classroom and the shop. To augment the material offered in classroom lectures and technical manuals, students were given study guides consisting of a number of questions with spaces for inserting answers. For work in the shop during the autumn of 1941, 42 lathes, 17 milling machines, 17 shapers, and 23 grinding machines were available.⁴

As the number of machinists required in the Air Corps was relatively small, most of such work being performed by civilians in the sub-depots,⁵ enrollment in the course at Chanute was always comparatively light. During 1940 an average of about 20 students took the course at one time; during 1941 this increased to approximately 150. Between March 1942 and March 1943, when the AAF was attaining the greatest limits of its expansion, the number of students leaped from 229 to 946.⁶ This taxed the facilities of the school to the utmost, making it necessary for the AAF to supplement them by entering contracts with a group of eight varied schools and factories for aircraft machinist training.

These schools were as follows: The National School of Aeronautics, Inc., a civilian mechanics school of Kansas City, Mo., entered its first class on 31 March 1942. Two state universities, Ohio State

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4. History of Chanute Field, 7 Dec. 1941-1 Jan. 1943, 353-54.
 5. Maj. R. J. Higgins, Chanute Field, to CG, AFCTTC, 31 July 1943, in AC/AS, Training files.
 6. Monthly reports of Statistical Control.

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University of Columbus, Ohio, and the University of Wisconsin of Madison, Wis., and an endowed charitable institution, the Williamson Free Trade School of Media, Pa., began giving the course on 8 June 1942. Two schools operated by the Connecticut State Board of education--the Connecticut State Vocational Trade schools at New Britain and Hartford--began on 2 August 1942. A course was inaugurated at the factory of Thomas A. Edison, Inc., of West Orange, N. J., on 17 August 1942. The Paterson Vocational Trade School, operated by the Board of Education of Paterson, N. J., started instruction on 10 September 1942.

The content of the course given at these eight schools was identical with that given at Chanute. Indeed, enlisted men who had had experience teaching the course at Chanute were sent to act as instructors at every one of them. This was true even in the case of the National School of Aeronautics, which, as a long-established civilian mechanics school, furnished a corps of experienced civilian instructors to supplement the enlisted personnel. Most of the teaching devices were likewise sent from Chanute, although the civilian contractors furnished such equipment as lathes and milling and grinding machines.

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7. Summarized from Histories, AFED National School of Aeronautics; AFED Ohio State University, 27 July 1942 to 10 Mar. 1943; AFED University of Wisconsin, 18 July 1942 to 3 Apr. 1943; AFED Williamson Free Trade School, 2 June 1942 to 13 Mar. 1943; AFED Connecticut State Vocational Trade School, Hartford, 21 July 1942 to 13 Mar. 1943; AFED Connecticut State Vocational Trade School, New Britain, 21 July 1942 to 13 Mar. 1943; AFED Thomas A. Edison, Inc., 17 Aug. 1942 to 22 Dec. 1942; AFED Paterson Vocational Trade School, 12 Sep. 1942 to 13 Mar. 1943, all in AFIMI files.

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The quality of the instruction at these schools varied from poor to excellent. Thomas A. Edison, Inc. failed to furnish all the tools and equipment the AAF deemed necessary for proper instruction; almost all it did furnish, according to AAF inspectors, was old and in a generally poor condition. When efforts made by the firm failed to correct the situation to the satisfaction of the inspectors, the contract was cancelled, effective 21 December 1942.⁸ At Ohio State University the AAF's continued dissatisfaction with the old machines and inadequate housing facilities provided by the contractor led to the discontinuance of the school early in January 1943.⁹ There is reason to believe that the authorities of neither of these civilian enterprises were very enthusiastic about giving the course in the first place and consciously or not withheld the cooperation necessary to make them a success.¹⁰

On the other hand, two of the schools distinguished themselves in the eyes of the AAF for the quality of their instruction. The First District of the Technical Training Command granted banners of excellence to the Williamson Free Trade School for the quarters ending 30 September and 31 December 1942. With the first banner went

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8. History, AFTD Thomas A. Edison, Inc., 8-10.
9. History, AFTD Ohio State University, 13-14.
10. Ibid.; History, AFTD Thomas A. Edison, Inc., 8-10.

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the remark that "from the standpoint of administration, instruction, and employment of available facilities, the school . . . is outstanding among machinist schools." In September the school made a rating of 92 per cent, in December 86.2 per cent--both well above ¹¹ that of the other four machinist schools in the district. In the Fourth District of the TTC the National School was awarded a banner in February 1943 for its work in training machinists as well as ¹² mechanics.

By early 1943 the AAF's requirements for machinists were being well provided for. Accordingly, contracts with six of the eight schools were terminated during March. The contract of Thomas A. Edison, Inc., as has been mentioned, had been cancelled in December 1942, while that of the National School was not terminated until May 1943.

The use of the civilian schools does not appear to have been an unqualified success. While two of the schools made excellent records, two were poor and the other four barely satisfactory. Probably without realizing it, the AAF had talked several of the contractors into accepting the mission against their better judgment, with the result that ¹³ they did not cooperate as fully as they might have. The number of

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- 11. History, AFTD Williamson Free Trade School, 16-17.
 - 12. Maj. Gen. John F. Curry, CG, 4th Dist., AFTTC, to National School of Aeronautics, 23 Feb. 1943, reproduced in History, AFTD National School of Aeronautics, 130.
 - 13. History, AFTD Ohio State University, 13-14; History, AFTD, Thomas A. Edison, Inc., 8-10.

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students in training at these schools was quite small (the greatest number was 872 in the month of September 1942); in consequence, the administrative and other overhead expenses raised the cost to the AAF far above that prevailing at Chanute. The reason for the use of these schools was, of course, the rapid expansion of the AAF with a resulting sudden increase in the requirements for machinists. Yet a more careful selection of the schools to be used and more thoughtful planning of the entire program in advance would have removed most of these causes for dissatisfaction.

While the civilian schools were being discontinued, the fate of the course at Chanute was allowed to hang in the air by AC/AS, Training and the Training Command. A survey made in Headquarters, AAF in June 1943 indicated that there were 4,200 machinists in the AAF at that time, and that at the rate training was then being conducted, there would be a surplus of 255 machinists by June 1944. Brig. Gen. R. W. Harper, the AC/AS, Training, felt that enough machinists should be continued to be trained "to keep this facility in operation and provide machinists for assigned personnel status."¹⁴

For a time General Harper's suggestion was carried out. The course was still given, although the enrollment was reduced somewhat, from 456 in early July 1943 to a bit less than 400 the following

14. R&R, Brig. Gen. R. W. Harper to /i/, 20 June 1943, in AC/AS Training files.

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December. A new syllabus, calling for changes in the Milling Machines and Shapers phase and the Grinding Machines phase was put into use in the middle of February 1944. On directions from the Training Command, Chanute officials made elaborate preparations for a Depot Overhaul Machinists course, designed to train unassigned graduates of the regular machinists course for duty in depot repair squadrons.

Then a sudden reversal of policy was adopted by AAF officials as to machinists training. The Depot Overhaul Machinists course began on 5 February 1944, only to be discontinued abruptly four days later on verbal orders from higher headquarters. The regular machinists course was ordered discontinued effective 8 June. Thus came to an end in the middle of wartime one of the oldest of the AAF's specialists courses.

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Aircraft Welders Course

The training of enlisted men to perform the welding necessary for first and second echelon aircraft maintenance and repair was the purpose of the Aircraft Welders course given at Chanute Field. Thirty-two weeks in length in 1938-1939, it was reduced to 20 weeks in 1939-17
1940, and to 14 weeks in 1941-1942.

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- 15. History, Chanute Field, 8 July 1943 to 31 Dec. 1943, I, 124.
 - 16. History, Chanute Field, 1 Jan. 1944 to 29 Feb. 1944, I, 82-83.
 - 17. Lt. Col. Ira C. Eaker to AG, 21 June 1939, in AAG 352.11 F, Chanute Field Course of Instruction; History, Chanute Field, 7 Dec. 1941 to 1 Jan. 1943, 364.

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The fundamental structure and content of the course did not change much throughout the years. The following outline of the course as given during the school year 1941-1942 is characteristic, with the exception that the phase on Heat Treating was not given before this time:

I. Basic Instruction

70 hours, 10 days

This phase was identical with that given at the start of the Basic Mechanics course.

II. Basic Gas Welding

140 hours, 20 days

In this phase the student learned how to use gas equipment to perform welding jobs and became acquainted with the characteristics of various metals used in aircraft welding.

III. Electric Welding

140 hours, 20 days

This phase covered the elements and practice of electric welding, as well as the care of electric welding equipment.

IV. Heat Treating

21 hours, 3 days

In this phase a brief survey was given of the principles of heat treating and the inspection of metals.

V. Aircraft Welding

119 hours, 17 days

This phase was concerned with welding in the fabrication and repair of aircraft structural units, shop tools, and equipment and in the repair of various types of castings. It was climaxed by an aircraft welders qualification test.

18. History, Chanute Field, 7 Dec. 1941 to 1 Jan. 1943, 1642-1643

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Judged by the number of men trained, the Aircraft Welders course was one of the more important Air Corps specialists courses. During 1939-1940 the number of men taking it averaged about 45, but at the start of the calendar year 1941 the enrollment began to grow by leaps and bounds. To meet the increases, extra classroom and shop space was provided during the summer of 1942. An average of 200 students was accommodated between January 1941 and June 1942. In the summer of 1942 the quantity of training was stepped up even further, with the result that in September 403 men were taking the course at Chanute,¹⁹ and in the following December, 929.

These increases, however, did not satisfy the needs of the Air Service Command. Late in 1941 this command began an enormous expansion in the number of its air depots and service groups, with the result that it required considerable numbers of men trained to do third and fourth echelon welding above the level taught at Chanute. As the Technical Training Command was reluctant to assume the burden of this additional training, the ASC engaged the facilities of five civilian schools to train welders.²⁰ These schools were: Aero Industries Technical Institute of Los Angeles, Calif., which began training early in February; the Ohio Institute of Aeronautics of Columbus, Ohio, which entered its first class on 9 February 1942; the

19. Ibid., 365; monthly reports of Statistical Control.

20. Maj. Gen. W. H. Frank, CG, AFASC to CG, AAF, 8 May 1943, in AAG 161, Contract Schools.

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Embry-Riddle School of Aviation of Miami, Fla., which matriculated a class on 9 March 1942; the Robertson Aviation School of St. Louis, Mo., which inaugurated its training on 27 April 1942; and the Curtiss-Wright Technical Institute of Glendale, Calif., which joined the program on 4 May 1942. The program had barely gotten under way, however, when Headquarters, AAF ruled that, to avoid duplication of effort, in general the training of all military and civilian personnel for the AAF was to be the responsibility of the TTC.²¹ Accordingly, all but one of the schools was turned over to the TTC on 1 June 1942; the exception was Aero Industries, which was transferred on 17 June.²² The number of men trained at these schools was not large, the total capacity of all five being about 375.²³

In its main outlines the course as given at the civilian schools was similar to that taught at Chanute. There were, however, two significant differences. There was a variation in the amount of time devoted to each phase, and the duration of the entire course was 15 rather than 14 weeks. These changes had been introduced because the objective of the course was to teach welding on a higher maintenance level and because of the variation in the facilities available at the civilian schools and those at Chanute. The five phases of the course

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21. CG, AAF to CO's of all AAF stations in the United States, 25 June 1942, in AAG 353.9 G, Factory Training..
 22. Summarized from histories, AFTD Aero Industries Technical Institute; AFTD Curtiss-Wright Technical Institute; AFTD Ohio Institute of Aeronautics, 9 Feb. 1942 to 31 Dec. 1942; AFTD Robertson Aviation School, 17 Apr. 1942 to 20 Aug. 1943; AFTD Embry-Riddle School of Aviation, 7 Dec. 1941 to 7 July 1943.
 23. Monthly reports of Statistical Control.

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were given at the civilian schools as follows:

I.	Basic Instruction	52 hours, 6 1/2 days
II.	Basic Gas Welding	188 hours, 23 1/2 days
III.	Aircraft Welding	288 hours, 36 days
IV.	Heat Treating	48 hours, 6 days
V.	Electric Welding	144 hours, 18 days

The instruction provided by the five schools appears to have been adequate but not outstanding. Reports of inspections of three of the schools indicated that their work was considered adequate. Following an inspection of the Ohio Institute of Aeronautics in May 1942, that school was declared to rate "lowest" in the Second District of the TTC. Sole responsibility for the organization and policies of the school was then concentrated in the hands of its president, a civilian; the following October and December the school rated third, with grades of 92.02

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per cent and 94 per cent, respectively. Financial difficulties prevented the Robertson school from doing a creditable job. The War Department underwrote this school's contract, but apparently did not sufficiently supervise the expenditure of the funds; perhaps as a result the first few months' instruction was definitely below standard. Later this condition was corrected enough to warrant a rating of "superior."²⁶

In line with its policy of discontinuing use of civilian schools once the "levelling-off" in training had begun, the Technical Training Command during the spring of 1942 notified the five schools that their

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- 24. History, AFTD Curtiss-Wright Technical Institute, Appendix, Syllabus of Original Depot Overhaul Course.
 - 25. History, AFTD Ohio Institute of Aeronautics, 24-25.
 - 26. History, AFTD Robertson Aviation School, 33-35, 50-51.

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contracts would not be renewed after 30 June. The Robertson school, which had been having not too happy an experience with the course, stopped training on 3 July, and the other schools wound up their work in late September and October.²⁷

This curtailment of training was carried out over the protests of Maj. Gen. W. H. Frank, Commanding General of the Air Service Command, who said that the ASC had found the quality of the training "in most cases excellent" and the need for it continuing.²⁸ To meet such objections, Chanute Field raised the level of its course to third echelon maintenance. To do this no major revision of the course was necessary, according to the school authorities.²⁹

A Headquarters, AAF survey in June 1943 indicated that the TTC up to that time had trained 4,660 welders and that by June 1944 there would still be a shortage of 795 welders.³⁰ This suggested to the Chanute authorities that the welding course would be a continuing feature of AAF technical training for some time to come, and they accordingly went ahead with plans to improve it. Late in February 1943, during the revision of the course syllabus, the question arose as to what amount of time should be devoted to the welding of aluminum fuel and oil tanks. An instructor was dispatched to Wright Field and

27. Histories of the five schools.

28. Maj. Gen. W. H. Frank, CG, AFASC to CG, AAF, 8 May 1943, in AAG 161, Contract Schools.

29. CG, Chanute Field to CG, 2d Dist., AFMTC, 6 Apr. 1943, in AC/AS, Training files.

30. R&R, Brig. Gen. R. W. Harper to /?/ 20 June 1943, in AC/AS, Training files.

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Fairfield Air Depot to observe the welding done there as a basis for a decision. This threw no light, however, on what types of welding work were common in overseas repair units. Questions were forwarded to Headquarters, AAF in the hope that a review of interviews with personnel returning from overseas and reports of operations in combat areas might provide useful answers. These, unfortunately, were not received in time to be of much value to the course.

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In January 1944 the Training Command directed the school to begin a course in depot overhaul welding. The course started on 5 February, only to be abruptly cancelled three days later. About the same time the school was informed by higher headquarters that the regular welding course would be discontinued after the class graduating 27 April 1944.

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Thus another long-lived AAF specialists course came to an end.

Aircraft Sheet Metal Workers Course

One of the most important of the specialized courses, from the standpoint of numbers of men trained, was that for sheet metal workers. This dealt with a field that had been developed almost completely since World War I. The object of the course was the repair of damage done to the metal skin, radiators, and fuel tanks of AAF aircraft caused by enemy gunfire or by accidents in flight. The course has been conducted

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- 31. History, Chanute Field, 8 July 1943 to 31 Dec. 1943, I, 148-149.
 - 32. History, Chanute Field, 1 Jan. 1944 to 29 Feb. 1944, I, 89-90.
 - 33. History, Chanute Field, 7 Dec. 1941 to 1 Jan. 1943, 357.

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on two levels--on the second echelon maintenance level at Chanute Field and one civilian mechanics school; and on the depot overhaul level at seven civilian schools.

Second Echelon. The second echelon course was organized at Chanute Field in 1930, under the direction of Burt Anderson, a civilian, who remained in charge of it until the time this account was written (July 1944). Before Pearl Harbor the course was conducted on a modest scale, with an average enrollment of about 75 during 1940 and an average of 275 during 1941. This number was augmented by an average of 100 men who were trained at Curtiss-Wright Technical Institute, a civilian mechanics school at Glendale, Calif., from August 1940 to June 1941. As with other specialist courses, the enrollment bounded after America's entry into the war. In the 14 months between January 1942 and March 1943 the number of students taking the Chanute course rose from 313 to ³⁴ a high of 2,271.

While the number of students increased, the length of the course was steadily shortened. Thirty-two weeks in length in the school year 1938-1939, it was reduced to 20 weeks in 1939-1940, ³⁵ and to 14 weeks ³⁶ for the year 1941-1942. No copy of the Chanute curriculum for this period appears to have survived. The little information available about the course given at Curtiss-Wright indicates that it was the

34. Monthly reports of Statistical Control.

35. Lt. Col. Ira C. Eaker to AG, 21 June 1939, in AAG 352.11 F, Chanute Field Course of Instruction.

36. History, Chanute Field, 7 Dec. 1941 to 1 Jan. 1943, 360.

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same as the school had previously been giving to civilians. As it lasted 20 weeks--the same length as the Chanute course at the time--and was supervised by the Chanute authorities, it seems reasonable to assume that the two courses bore much in common.

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The 14-week curriculum adopted at Chanute for the school year 1941-1942 remained in effect for several years with only minor changes and so may be considered characteristic. The principal features were as follows:

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I. Basic Instruction

70 hours, 10 days

This was the same introductory phase given to all students in specialized courses.

II. Basic Metal Work

105 hours, 15 days

In this phase the student learned more about tools, the properties of metals, and the fabrication of simple sheet metal articles.

III. Heat Treating

35 hours, 5 days

The scope of this phase was the same as that of the comparable phase of the welders course.

IV. Aircraft Metal Work, I

140 hours, 20 days

This phase covered (1) the specifications and use of sheet metals, rivets, and screws; (2) the fabrication of wire and cable assemblies and small sheet metal parts; (3) the repairing and testing of radiators; and (4) electro-cleaning and plating.

37. History, APTD Curtiss-Wright Technical Institute, 11-12.

38. History, Chanute Field, 7 Dec. 1941 to 1 Jan. 1943, 1627-1628.

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V. Aircraft Metal Work, II140 hours, 20 days

This phase covered (1) the bending of various kinds of metal tubing; (2) the repair of fuselage and wing structures; (3) the repair of metal fuselage and wing covers; (4) the fabrication and repair of cowlings; (5) the repair of fuel and oil tanks; and (6) the forming and repair of plexiglass.

The course was subsequently modified in one important respect. In the fifth phase, instruction on the repair of fuel and oil tanks dealt with tanks made of aluminum and such alloys as brass and terneplate. With the widespread adoption of self-sealing fuel cells by the AAF, the necessity for this instruction disappeared. As the repair of the new cells was assigned to the sheet metal worker, it was decided to substitute instruction on this subject for that on fuel and oil tanks. To this end, Chanute Field sent a group of instructors to the factories making the cells in October 1942. The information they gathered was incorporated into lectures and given as part of the fifth phase. Later, as old cells and repair materials on which the students could work were obtained, the instruction took a more practical turn.

The sheet metal course was modified in a number of ways once AAF technical training began to level off in early 1943. Enrollment saw-sawed during the balance of that year--from 1,714 during July, down to 591 in October, back to 1,571 in December. During 1944 the decline

39. Ibid., 362.

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became steady, reaching a low of 236 in June.

The length of the course was increased to 78 days. The phase on heat treating was reduced to three days, while the instruction on self-sealing fuel cells was taken from the last phase and made a six-day phase of its own. Instruction on certain machine shop practices was dropped from Aircraft Metal Work I, making possible a reduction of that phase to 18 days. The scope of Aircraft Metal Work II was broadened to allow for six days of training under conditions simulating those in combat areas. This last phase now required 24 days. Other allotments of time were readjusted to fit into the six-day-week schedule. Thus⁴¹ the curriculum in effect early in 1944 was as follows:

I.	Basic Instruction	12 days
II.	Basic Metal Work	18 days
III.	Heat Treating	3 days
IV.	Self-Sealing Fuel Cells	6 days
V.	Aircraft Metal Work I	15 days
VI.	Aircraft Metal Work II (including 6 days of Field Training)	24 days

Depot Overhaul. Early in 1942 the Air Service Command engaged seven civilian mechanics schools to give depot overhaul training in sheet metal work to men destined for service in its air depots and service groups. Indeed, five of the seven were schools it engaged at the same time to train welders. The additional schools were the Anderson Organization of Los Angeles and the Boeing School of Aeronautics

40. History, Chanute Field, 1 Jan. 1944 to 29 Feb. 1944, I, 135-136; monthly reports of Statistical Control.

41. History, Chanute Field, 8 July 1943 to 31 Dec. 1943, I, 139-140.

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 of Oakland, California. Aero Technical Institute and Ohio Institute
 of Technology began their courses in February 1942, the Embry-Riddle
 School in March, the Robertson Aviation School in April, and the
 Curtiss-Wright Technical Institute in May. All the schools were trans-
 ferred to the administrative control of the Technical Training Command
 during June. 43 In June 1942, 979 students were under instruction in the
 seven schools; in the following December they reached a high of 1,533. 44

The course differed markedly from the second echelon course at
 Chanute, being longer and more comprehensive. The principal phases
 were as follows: 45

I. Basic Instruction 96 hours, 12 days

Similar in scope to that given at Chanute.

II. Basic Metal Work, I 96 hours, 12 days

Sheet metal hand and machine tool operation; sheet metal pattern
 development; and soldering.

III. Basic Metal Work, II 96 hours, 12 days

Layout of aircraft sheet metal parts and the handforming of these
 parts.

IV. Basic Metal Work, III 96 hours, 12 days

Riveting; use of metal fasteners, nut plates, rivnuts, dzus

42. The date on which these schools began training sheet metal workers
 is obscure. Presumably it was about the time the other schools
 began.

43. Summarized from Histories AFIT Anderson Organization; AFIT Boeing
 School of Aeronautics; AFIT Aero Industries Technical Institute;
 AFIT Curtiss-Wright Technical Institute; AFIT Ohio Institute of
 Aeronautics 9 Feb. 1942 to 31 Dec. 1942; AFIT Robertson Aviation
 School 17 Apr. 1942 to 20 Aug. 1943.

44. Monthly reports of Statistical Control.

45. History, AFIT Curtiss-Wright Technical Institute, Syllabus of
 original Denot Overhaul Course.

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fasteners, drill screws, and safety pin.

V. Aircraft Metal Work, I

96 hours, 12 days

Heat treating and testing; bending, flaring and fitting of tubing; plexiglass cleaning, forming, and handling; fuel and oil tank repair.

VI. Aircraft Metal Work, II

96 hours, 12 days

Repair of small sheet metal parts; repair of fuselage and cowlings.

VII. Aircraft Metal Work, III

144 hours, 18 days

Repair of wings, control surfaces, and empennages.

The demand for depot overhaul sheet metal workers remaining acute, the contracts for the advanced course at the civilian mechanics schools were not terminated at the end of June 1943 as were the other courses that had been arranged for the convenience of the Air Service Command. Later in the year, however, Headquarters, AAF decided that this type of instruction should thereafter be concentrated at Chanute Field, and the courses at the seven schools were accordingly discontinued during the first quarter of 1944. The Chanute authorities began giving an advanced course on 5 February 1944, but three days later it was cancelled by Headquarters, AAF on the ground that the Training Command did not have sufficient personnel and equipment to offer instruction on this level.

Propeller Specialists Course

Second Echelon. Unlike most of the other specialists' courses at Chanute, the "advanced propellers" course was virtually non-existent

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for a year and a half after the start of the Air Corps expansion program in July 1939. Once it got under way, its history can be conveniently divided into three periods. The first covered the period from early 1941 to the middle of 1942. During this period classes were small, with an average monthly attendance of 80. The instruction, lasting eight weeks and requiring 280 classroom hours, was tailored to meet the needs of men already assigned to work in propeller shops at the various air bases. Approximately 60 per cent of the time was devoted to practical work in the laboratory, shop, and hangar.

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The main features of the course were as follows:

I. Propeller Maintenance Fundamentals 70 hours, 10 days

Construction principles, assembly, adjustment, repair, and test of: (1) Ground adjustable and fixed-pitch types of propellers; (2) Propeller anti-icer systems; (3) Magnetic inspection apparatus; (4) Lycoming-Smith controllable types of propellers and their installation units.

II. Hydraulically Operated Propellers, I 70 hours, 10 days

Construction principles, assembly, adjustment, repair, and test of hydraulic two-position and constant-speed types of propellers and their installation units.

III. Hydraulically Operated Propellers, II 70 hours, 10 days

Construction principles, assembly, adjustment, repair, and test of hydraulic constant-speed and full-feathering types of propellers and their installation units.

IV. Electrically Controlled Propellers 70 hours, 10 days

Construction principles, assembly, adjustment, repair, and test of electrical constant-speed and full-feathering types of propellers and their installation units.

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46. Monthly reports of Statistical Control; History, Chanute Field, 7 Dec. 1941 to 1 Jan. 1943, 333-335; testimony of T/Sgt. Wm. H. Brown, 6th Bombardment Sq., Board of Officers, Knollwood Field, 22 Aug. 1943, in AFTHI files.
47. History, Chanute Field, 7 Dec. 1941 to 1 Jan. 1943, 1608-1609.

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The second period, roughly from the middle of 1942 to the middle of 1943 saw enrollment increase tenfold, reaching a high of 946 in May 1943.⁴⁸ The emphasis of the course was shifted so that training would be beneficial to men who recently had been graduated from the basic airplane mechanics course and were earmarked to perform all the propeller maintenance within a tactical squadron.⁴⁹ As men in this category worked on a lower echelon of maintenance than the air base propeller shopmen who formerly had made up the classes, this change reduced the thoroughness of the training.

During this period the syllabus was modified a bit, so as to cover four principal phases in 42 instructional days. The following syllabus was in use in April 1943:

- I. Propeller Maintenance Fundamentals
- II. Hydraulically Operated Propellers
- III. Electrically Controlled Propellers
- IV. Propeller Control Systems

Under this plan, the disassembly and assembly of hydraulically operated propellers was one distinct unit,--that of electrically operated propellers, another. The control system, field maintenance, and service operation of both types of propellers were included in the fourth and final phase. In the course of the final phase more practical experience in trouble shooting and adjusting propellers at the test blocks was introduced, making it possible for students to learn

48. Monthly reports of Statistical Control.

49. Memo for J. S. Canterbury by W. Mitchell, 20 Apr. 1942, in Bureau of Budget, Administrative Management Div. files.

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more readily how to recognize defective equipment and to adjust and in-
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stall propellers.

In the year after July 1943, the third period in the history of the course, enrollment was cut sharply, almost to the level of the first period. During December 1943 it had fallen to 397, and by the following
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May only 43 men were attending the course. The emphasis of the course reverted to what it had been during the first period--the training of assigned enlisted men to perform second and even third echelon maintenance.
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To keep abreast with the many new developments in the propeller industry, the school authorities made a practice of sending instructors on detached service to attend lengthy courses at propeller and engine plants.
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The most drastic change in the curriculum was brought about late in 1943, not by the school authorities, but upon the instigation of higher headquarters. This called for the arrangement of subject matter into blocks, each block to be devoted to a specific type, model, or class of equipment. In this way assigned propeller mechanics sent to the school would have to take only the block or blocks they would need specifically to perform their duties in their own organization.

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- 50. History, Chanute Field, 7 Dec. 1941 to 1 Jan. 1943, 336-337; History, Chanute Field, 8 July 1943 to 31 Dec. 1943, I, 88.
 - 51. History, Chanute Field, 1 Jan. 1944 to 29 Feb. 1944, I, 41; monthly reports of Statistical Control.
 - 52. Brig. Gen. R. W. Harper to CG, AFTRC, 28 July 1943, in AC/AS, Training Files.
 - 53. History, Chanute Field, 8 July 1943 to 31 Dec. 1943, 94; History, Chanute Field, 1 Jan. 1944 to 29 Feb. 1944, I, 42-43.

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To accomplish this the course was reorganized in December into three phases, the over-all length remaining 42 instructional days:

- I. Aero-products Propellers, 6 days
All in the shop.
- II. Hamilton Standard Propellers, Governors, and Accessories, 18 days
Twelve days shop work, 3 days on testblocks, 3 days on service maintenance of propellers installed on airplanes.
- III. Curtiss Electric Propellers, Governors, and Accessories, 18 days
Twelve days shop work, 3 days on testblocks, 3 days of service maintenance of propellers installed on airplanes.

The advantage of this curriculum lay in the fact that it was possible, for example, for a propeller mechanic from a bomber base where Hamilton Standard propellers were used exclusively, to obtain the in-⁵⁴struction he required in 18 days rather than 42.

This rearrangement did not completely satisfy the Chanute officials, however. Soon after its use was begun they proposed that inasmuch as speed and quantity were no longer a primary consideration in technical training, the over-all length of the course should be increased by 12 days. Six of these days would be devoted to repair and maintenance of airplane propellers under conditions simulating arctic, desert, and tropical fields. The other six days would be spent on Aeroproducts propellers, the maintenance of which was causing the air forces considerable difficulty. Headquarters, AAF however, had adopted the general policy that no further extensions be

54. History, Chanute Field, 8 July 1943 to 31 Dec. 1943, I, 83-89.

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made to courses, and the request was refused.

Depot Overhaul. From May 1942 to June 1943 the AAF conducted fourth echelon maintenance training in propellers at two civilian mechanics schools. The facilities of the Curtiss-Wright Technical Institute of Glendale, Calif., and the Parks Air College of East St. Louis, Ill., were contracted for by the Air Service Command as part of its program to train men for work at its bases and depots. Both schools began teaching propeller mechanics early in May. A few weeks later responsibility was assumed by the Technical Training Command. In conformance with the TTC policy of discontinuing use of civilian schools in the middle of 1942, no classes were entered in either school after

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30 June 1942. During the slightly more than 11 months in which the schools conducted propeller mechanics training, combined enrollment

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averaged about 50 students a month.

The courses at these schools was almost twice as long--15 weeks--and far more thorough than that given at Chanute. The principal features of the syllabus were as follows:

I. First Phase

96 hours, 12 days

Use of hand tools, templates, repair equipment. Blade repair. Anti-icing equipment. Installation of fixed types of propellers.

II. Second Phase

96 hours, 12 days

Inspection, repair, assembly, etc., of controllable and constant-speed propellers.

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55. Brig. Gen. R. E. O'Neill, Commdg., Chanute Field, to CG, AFCTTC, 30 Dec. 1943, and indorsements, in AC/AS, Training files.
56. Histories, AFID, Curtiss-Wright Technical Institute, 14; AFID, Parks Air College, 26 May 1942 to 12 Oct. 1943, 8.
57. Monthly reports of Statistical Control.

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III. Third Phase144 hours, 18 days

Principles, inspection, repair, assembly, etc., of Curtiss-electric propellers. Electric systems and liquid-cooled engines used in connection with electric propellers.

IV. Fourth Phase144 hours, 18 days

Principles, inspection, repair, assembly, etc., of hydromatic
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propellers.

Several months after the discontinuance of the fourth echelon course, the Training Command directed Chanute to start offering such instruction as part of its regular activities. Accordingly, plans were drawn up for a 36-day course with a student strength of approximately 24. Students were to be highly rated graduates of the regular course. Instruction began on 6 February but was terminated two days later on
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orders from headquarters of the Technical Training Command.

Power Plant Specialists Course

A course which has had a checkered career is that for power plant specialists. An outgrowth of the Carburetor course, which was given at Chanute and Kelly fields since World War I, it was developed into a full-length, well-attended technical school course during the height of World War II expansion, only to be split into three highly specialized and ephemeral courses during the period training was being "levelled off."

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58. History, AFIT, Curtiss-Wright Technical Institute, Appendix.
59. History, Chanute Field, 1 Jan. 1944 to 29 Feb. 1944, I, 43-44.

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Upon the inauguration of the Air Corps expansion program in July 1939, the course on carburetors was reduced from eight to four weeks.⁶⁰ The change was of little significance, however. Recent developments in field organization practices were such that there was little need for carburetor maintenance on a second echelon level. As there were no requests from the air forces for carburetor training, the course was permitted to become inactive. An attempt was made to revive it during the first half of 1941,⁶¹ but the Chanute authorities soon became convinced of its futility. Accordingly, they recommended that the course be discontinued.

In its place they proposed that a new course be established for power plant specialists--enlisted men assigned to the maintenance not only of carburetors, but engines and such engine accessories as turbo-superchargers, fuel and ignition systems, generators, and compression and oil systems. Some instruction on these subjects was given in the Basic Mechanics course, but the shortness of the time available prevented it from being thorough. Although substantially all the material previously presented in the carburetor course was to be given in addition to instruction on these other features of power plants, the course was to last only eight weeks. Permission was granted by the Chief of the Air Corps, and the ^{new} course started 1 July 1941.⁶²

60. Lt. Col. Ira Eaker to AG, 21 June 1949, in AAG 352.11 F, Chanute Field Course of Instruction.

61. Monthly reports of Statistical Control.

62. Col. R. E. O'Neill, Comdg., TS, Chanute Field, to CG, ACFTC, 30 June 1941; CG, ACFTC to C/AC, 11 July 1941, in AAG 352.11 F, Chanute Field Course of Instruction.

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The following syllabus for the school year 1941-1942 gives a
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 notion of the scope of the course:

I. Engines

70 hours, 10 days

The constructional features and operating principles of standard type engines, minor repairs, adjustments, maintenance, and inspection.

II. Ignition, Fuel and Oil Systems

70 hours, 10 days

The construction, operation, repair, and maintenance of carburetors, superchargers, injectors, fuel and oil pumps, tanks, plumbing, ignition units, and material on the properties and use of aircraft fuels and lubricants.

III. Power Plant Installation and Operation

140 hours, 20 days

The removal and installation of engines and accessories on both radial and in-line engines.

During the first two years of its existence, July 1941 to July 1943, the enrollment of the course rocketed--to 59 in January 1942 and to 303 in the following December. Although officials at Headquarters, AAF desired that it be maintained at about this level indefinitely, they had considerable difficulty in accomplishing this objective. The power plant specialist was a new category and therefore there was no provision for this type of worker in the table of organization of many AAF units. This led AC/AS, Training to propose in June 1943 that a circular letter be sent to all air forces, commands, and exempted stations in the United States pointing out that all organizations were authorized to fill up to 10 per cent of their quotas for airplane

63. History, Chanute Field, 7 Dec. 1941 to 8 July 1943, 1601.

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and engine mechanics with power plant specialists. It suggested further that these units be asked to advise Headquarters, AAF if training at Chanute were desired for any of their men and if they desired any unassigned graduates of the course.

At the same time the course underwent a series of thoroughgoing revisions designed to make it more attractive to AAF units. The first of these divided it into four phases with an over-all length of 42 days:

I. Aircraft Engines

72 hours

Included 22 hours of partial disassembly, inspection, and assembly of Pratt and Whitney R-1830 Series engine, 6 hours on timing Wright R-1820 engine, 22 hours of partial disassembly, inspection, and assembly of Allison V-1710 Series engine, 6 hours on timing and control settings on Rolls-Royce V-1650 Series engine, and 12 hours on disassembly, adjustment, and assembly of turbosupercharger.

II. Engine Accessories

72 hours

Included 3 hours each on disassembly, assembly, and adjustment of Eclipse and Inertia Starter, Jack and Heintz Electric Starter, Scintilla Magneto, American Bosch Magneto, 12-volt generator and 24-volt generator; 3 hours on adjustment and operation of the 12-volt and 24-volt generator control panels; and 6 hours each on partial disassembly, assembly, and flow bench testing of the Stromberg Injection Carburetor and the Holly Carburetor.

64. R&R, Brig. Gen. R. W. Harper to AC/AS, OCS&R, 9 June 1943, in AC/AS, Training files.

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III. Power Plant Operation72 hours

Included 4 hours in operation procedure, 2 hours on trouble shooting, 2 hours on fuel and induction system troubles, 4 hours on generator ignition system troubles, 3 hours on system troubles, 3 hours on starter and booster system troubles, 2 hours on compression troubles, 2 hours on oil system troubles, 2 hours on cooling system troubles, 6 hours on general troubles, and 6 hours of turbosupercharger operation.

IV. Power Plant Installation72 hours

Included 36 hours on the removal, inspection, and installation of a liquid-cooled engine and 36 hours on removal, inspection, and installation of an air-cooled engine.

V. Line Maintenance Procedure36 hours

Included 36 hours in general line maintenance procedures, including 25- and 50-hour inspections.
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In February 1944, acting on orders from Headquarters, AAF the course was again revised, this time even more drastically. Thereafter instead of a general course covering all the principal engines and accessories, three separate courses, each concentrating on one type, were to be given. One was to be known as "Radial Engine and Accessories Specialist (right) Course" with an enrollment of 56; another was "Radial Engine and Accessories Specialist (Pratt and Whitney) Course" with 7 students; the third was "In Line Engine and Accessories Specialist (Allison and/or Rolls Royce) Course," also with

65. History, Chanute Field, 3 July 1943 to 31 Dec. 1943, I, 81-82.

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7 students. All were to be 42 days in length.

Only one class of each had been entered under this arrangement when the latter two courses were ordered to be discontinued, and the enrollment of the first--"Radial Engine and Accessories Specialist (right)"--was reduced to 29. In March 1944 a new syllabus was adopted⁶⁶ for this lone remaining power plant course:

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|---|---------|
| I. Engine and Accessory Repair and Adjustment | 13 days |
| II. Engine Operation and Adjustment | 6 days |
| III. Engine Change and Inspection | 12 days |
| IV. Field Maintenance | 6 days |

This course too was ordered discontinued a few weeks after the adoption of this syllabus. Thereafter AAF units desiring training for their men in engine and accessory maintenance had to send them to one or more of the numerous short and highly specialized factory school⁶⁷ courses.

Hydraulics Specialists Course

A specialists' course which was begun relatively late in the AAF training program, which was never very large in enrollment but was of continuing importance, was that in Hydraulics. Instruction in elementary principles of aircraft hydraulic system maintenance had always been offered as part of the basic airplane mechanics course. Not until early 1943, however, was the need felt for a second and third echelon course for personnel already qualified as airplane mechanics.

66. History, Chanute Field, 1 Jan. 1944 to 29 Feb. 1944, I, 60-61.

67. Progress Report, Mar. 1944, Hq., AFPRC, 13.

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To fill this requirement a course was inaugurated at the factory of the Aircraft Accessories Corporation of Kansas City, Mo., manufacturers of hydraulics equipment. The first class of 25 men got under way on 25 February, and a month later the school had reached its maximum student strength of about 75.⁶³ The course lasted six weeks and was divided into three principal phases:

I. First Phase

12 days

Operating principles, replacement, maintenance repair, testing, and inspection of reservoirs, accumulators, relief valves, check valves, restrictors, seal coupling, tubing and flaring, hand pumps, pressure pumps, servo valves, master brake cylinder, wheel brakes, pressure governor, and hydraulic dump valve.

II. Second Phase

12 days

Operating principles, replacement, maintenance repair, testing, and inspection of sump pumps, pressure regulator, single brake valve, double brake valve, deboostor cylinder, hydraulic selector valve, and poppet type selector valve.

III. Third Phase

12 days

Operating principles, replacement, maintenance repair, testing, and inspection of hydraulic actuating cylinders, swivel joint, shimmy dampener, tail skid bumper jack, wing flap position indicator, wing flap hydraulic system, cowl flap hydraulic system, bomb door cylinder, gun turret cylinder, nose wheel cylinder, main landing gear cylinder, land-

68. History, AFTD Aircraft Accessories Corporation, Appendix D-14.

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ing gear lock, and towing mock-up.

With the levelling-off of training in the spring of 1943, space became available and personnel for a hydraulics course at Chanute Field. The Aircraft Accessories Corporation indicated that it could use its factory space and employees more profitably for manufacturing than for teaching. Accordingly, a course was started at Chanute during June, and instruction ceased at Aircraft Accessories with the graduation of the thirteenth class on 6 October.

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The course has been given continuously at Chanute to the present time (July 1944). Enrollment has soared and dipped, climbing to 145 in November 1943, to 257 in February 1944, then dropping to 36 in June.

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As given at Chanute, the course was more thorough and comprehensive, requiring seven weeks. Instruction on accessories was grouped into phases according to the type of plane on which they were used:

- I. Fundamentals and Repair of Hydraulic Units 14 days
- II. Hydraulic Systems of Pursuit and Attack Planes 14 days
- III. Hydraulic Systems of Bombardment and Cargo Planes 14 days

This arrangement made it possible for students from AAF fighter units to take only the first and second phases, students from AAF bombardment and transport units to take only the first and third phases, saving 14 days of instruction in either case.

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69. Ibid. Appendix D-23.

70. Ibid. Appendix D-14.

71. Monthly reports of Statistical Control.

72. History, Chanute Field, 1 Jan. 1944 to 29 Feb. 1944, I, 64-65.

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Training of Aircraft and Engine Depot Overhaul Mechanics

The inauguration by the Air Service Command, soon after Pearl Harbor, of an extensive program to train enlisted men for service in its depot and service groups led to the establishment of courses in fourth echelon aircraft and engine mechanics at 12 civilian schools. All this training was conducted between February 1942 and June 1943, inclusive.

At the start of the period, students sent to these two courses were men who had been recruited by the Air Service Command and who had been mechanics in civilian life, usually in garages. As the program progressed, graduates of the basic mechanics schools of the TTC were sent for this advanced training. AG/AS, 1-3, Headquarters, AAF protested that if a man were earmarked to become an aircraft depot overhaul specialist, it was not necessary that he study engines while taking the basic course. Or, if a man were to become an engine depot overhaul man, it was not necessary that he be given much instruction on aircraft while enrolled in the basic course. The TTC retorted that the AEC preferred that their men be trained in this way and no change in procedure was made.

Aircraft Mechanics. The fourth echelon aircraft mechanics course was designed to train enlisted men in depot overhaul of all parts of the airplane except the engine. It was given at seven schools, originally under the direction of the Air Service Command, but after June 1942 under

73. Memo for Col. Davasher by Capt. John E. Phipps, Technical Training Sec., AG/AS, 1-3, 3 Aug. 1942, in AG 352.11 F, Chanute Field, Course of Instruction.

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the supervision of the Technical Training Command. Five of these schools began giving the course on 2 February 1942: Aero Industries Technical Institute of Los Angeles, Calif.; Aviation Institute of Technology of Long Island City, N.Y.; Embry-Riddle School of Aviation of Miami, Fla.; Ohio Institute of Technology of Columbus, Ohio; and Parks Air College of East St. Louis, Ill. The Boeing School of Aeronautics of Oakland, Calif. started training on 4 April 1942.⁷⁴ On 27 April the Robertson Aviation School of St. Louis, Mo. became the seventh school to offer the training.⁷⁵ An average of 975 men monthly⁷⁶ took the following 15-week course:

I. Basic Mechanics

96 hours, 12 days

Air Corps maintenance and supply system, publications, etc.; electrical fundamentals; aircraft hardware; and Mechanics hand tools.

II. Airplane Structures

432 hours, 54 days

Construction, features, replacement of parts, maintenance repair, and inspection of fuselages, cockpits, and cabins; wings and control surfaces; flight control systems; landing gears, wheels, and brakes; shock struts; and cable splicing and wrap and solder splices. Also aircraft assembly and disassembly, including alignment.

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74. Training at Boeing may have actually started before this date. The History of AFTD Boeing School of Aeronautics, page 7, states, none too lucidly, that "On 4 April 1942 the Depot Overhaul branch of instruction, which had previously been supervised and sponsored on [sic] the airport in hangar 15 by the Air Service Command, was incorporated into the strength of the AFTTC detachment."
75. Summarized from Histories, AFTD Aero Industries Technical Institute; AFTD Aviation Institute of Technology, 23 Jan. 1942 to 7 July 1943; AFTD Boeing School of Aeronautics; AFTD Ohio Institute of Aeronautics, 9 Feb. 1942 to 31 Dec. 1942; ACD Parks Air College, 26 Mar. 1942 to 12 Oct. 1943; AFTD Robertson Aviation School, 17 Apr. 1942 to 20 Aug. 1943; ASCTD St. Louis School of Aeronautics, 17 Apr. 1942 to 19 Oct. 1943; AFTD St. Louis School of Aeronautics, 1 Jan. 1943 to 7 July 1943.
76. Monthly reports of Statistical Control.

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III. Engine Changes and Engine Change Inspection 192 hours, 24 days

Replacement of complete power plant units (air- and liquid-cooled), making all connections and adjustments of fuel and oil lines, electrical wires, engine controls, propeller controls, cowlings, instruments, auxiliary equipment, etc. Also replacement of accessories and instruments. ⁷⁷

Engine Mechanics. Depot overhaul of aircraft engines was taught at 11 civilian mechanics schools between February 1942 and June 1943, inclusive. As in the case of the aircraft mechanics course, arrangements were made originally by the Air Service Command, with responsibility assumed later by the Technical Training Command. Five of the schools began giving the course on 2 February: Aero Industries Technical Institute; Aviation Institute of Technology; Embry-Riddle School of Aviation; Ohio Institute of Technology; and Parks Air College. On 23 February the Stewart Technical School of New York City joined the program. The National School of Aeronautics of Kansas City, Mo. began its first classes on 5 March. During April there were two further additions: the Boeing School of Aeronautics on the fourth, and the St. Louis School of Aeronautics on the twenty-seventh. The Curtiss-Wright Technical Institute of Glendale, Calif. started the course on 4 May. No record is available as to when the Southwestern Institute of Technology of Weatherford, Okla. ⁷⁸ matriculated its first class, but presumably it was during the spring.

77. Syllabus of 17 Jan. 1943, in History, AFITD Aero Industries Technical Institute, Appendix.

78. Summarized from histories, AFITD Aero Industries Technical Institute; AFITD Aviation Institute of Technology, 23 Jan. 1942 to 7 July 1943; AFITD Boeing School of Aeronautics; AFITD Curtiss-Wright Technical Institute; AFITD National School of Aeronautics; AFITD Ohio Institute of Aeronautics, 9 Feb. 1942 to 31 Dec. 1942; AOD Parks Air College, 26 Mar. 1942 to 12 Oct. 1943; AFITD Stewart Technical School; ASOTD St. Louis School of Aeronautics, 17 Apr. 1942 to 19 Oct. 1943; AFITD St. Louis School of Aeronautics, 1 Jan. 1943 to 7 July 1943.

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The enrollment of the course was comparatively high, averaging about 3,000 students a month.⁷⁹ The curriculum was divided into six phases, requiring 15 weeks for completion:

I. Basic Mechanics

96 hours, 12 days

Similar in content to the Basic Mechanics phase of the Aircraft Mechanics Overhaul course.

II. Airplane Engines, Elementary

96 hours, 12 days

Principles of internal combustion engines; construction principles, adjustment, maintenance, repair, and inspection of standard types of air- and liquid-cooled airplane engines, excluding auxiliary engine equipment; and lubrication.

III. Engine Assembly, Disassembly and Inspection 144 hours, 18 days

Principles of induction systems; construction and operating principles, adjustment, maintenance, repair, and inspection of standard carburetors, fuel injection systems, superchargers, fuel systems, and oil systems.

IV. Engine Electrical Systems

96 hours, 12 days

Principles of airplane electrical systems; construction, operating principles, adjustment, maintenance, repair, and inspection of storage batteries, generators and control units, starters, magnetos, spark plugs, wiring assemblies and systems, miscellaneous electrical accessories and appliances, instruments, and soldering.

79. Monthly reports of Statistical Control.

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V. Engine Change and Engine Change Inspection 96 hours, 12 days

Replacement of complete power plant units (air and liquid-cooled), making all connections and adjustments of fuel and oil lines, electrical wires, engine controls, propeller controls, cowlings, instruments, and auxiliary equipment; replacement of accessories and instruments; complete maintenance inspection of complete airplane engine including ground run of power plant and check of all accessories, systems, and installations.

VI. Engine Operation and Test 96 hours, 12 days

Methods of starting, stopping, and operating the various types of standard air and liquid-cooled airplane engines; ground-testing procedure; demonstration of the effect of improper engine adjustments, ignition, carburetion, malfunctioning of parts, and instruction in the correct remedial action to be taken.

When the ITC cancelled the use of all civilian mechanics schools at the end of June 1943, the courses at all 12 of these schools automatically came to an end. Maj. Gen. W. H. Frank, Commanding General of the AEC, protested the step, declaring that his command still had need for the training, especially that for engine overhaul mechanics. It might be advisable to drop some of the less efficient schools and perhaps reduce the quotas of some of the others, he conceded, but a few should be retained. If the course were extended from 15 to 24 weeks, better qualified men would be turned out.

Although it did not follow General Frank's recommendations, the

80. History, AFIT National School of Aeronautics, I, 75-76.

81. Maj. Gen. W. H. Frank, CG, AFAC, to CG, IAF, 8 May 1943, in AAG 161, Contract Schools.

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Training Command made an abortive gesture towards satisfying, at least partially, the needs of the ASC. In October 1943 it directed Chanute Field to start training, "with the least possible delay," engine depot overhaul mechanics with an entrance rate of 27 students a month. Monthly enrollment would be 351 men. As students would be recruits direct from basic training centers, the first phases of the course would be general in nature, with the later phases concentrating on perhaps only one type of engine.⁸² But before the course got under way, the Training Command cancelled the project on the ground that there was too great a shortage of personnel and equipment to conduct fourth echelon maintenance at technical schools.⁸³

Training of Glider Mechanics

A type of specialized training which had a history fundamentally dissimilar to other types was the course for glider mechanics. The reasons for this are obvious. Gliders were a novel type of military weapon; in the United States Army there was a wide divergence of opinion as to their value. Because their use involved units of both air and ground forces, close coordination between several arms and services was necessary; this was not always forthcoming. The consequence was that the training of men to pilot the gliders and mechanics to maintain them followed an ever changing and frequently erratic course.⁸⁴

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- 82. CG, AFTRC to CG, AFOTTC, 22 Oct. 1943, with indorsements, in IAG 353, Mechanics Training.
 - 83. CG, AFTRC to CG, AAF, 19 Nov. 1943, in AG/AS, Training Files; Daily Diary, AFTRC, 23 Nov. 1943, in AFIRH files.
 - 84. The problems are well analyzed in AAF Historical Studies: No. 1, The Glider Pilot Training Program, 1941 to 1943.

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Two months before the delivery of the first CG-4A, the earliest combat type of glider used by the Army Air Forces, Headquarters, AAF began worrying about the problem of training men to maintain gliders. The Director of Ground-Air Support on 1 July proposed that arrangements be made with the Cessna Aircraft Company of Wichita, Kans., manufacturer of the glider, to train 25 airplane mechanics in the construction and assembly of the glider at its factory. ⁸⁵ The Cessna people begged that they be excused from this duty, pleading that they lacked the necessary equipment.

As an alternative, the Director of Individual Training proposed that a school to train glider mechanics be established near Amarillo, Tex., a district in which a number of glider pilot schools were located. The Cessna Company would send men from its factory to serve as instructors until the course was well under way; then enlisted men could take over. On the basis of the estimated need of one mechanic for each glider, to keep up with the production of gliders, the school would train 1,500 mechanics by the end of 1942 and 6,184 by the end of June 1943. ⁸⁶

As the Technical Training Command subsequently worked out the details, the course was opened, during September 1942, at Sheppard Field, Tex., home of a large airplane mechanics school. Seven hundred fourteen enlisted men were entered during the first month, and the enrollment rose constantly thereafter until a high of 1,312 was reached during the month

85. RAR, AFRGS to AFPM, 1 July 1942, in AG/13, Training files.

86. RAR, AFRT to AFRGS, 7 July 1942; Col. I. S. Smith, AFRT to CG, AFRT, 9 July 1942, in AG/13, Training files.

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of March.

Originally the course lasted 40 days, but during March 1943 it was increased to 47 days and two months later to 65 days. These extensions were important because they permitted the introduction of material on crating, uncrating, assembling, and rigging of the gliders. During the autumn of 1943, while the length of the course was 65 days, there were three principal phases, the main features of which were as follows:

I. Accessories

72 hours, 12 days

Six days: Nomenclature, care, and use of mechanics hand tools; repair of tubular structures; familiarization with AAF supply system; inspection and testing of aircraft batteries; electrical systems and radio; maintenance and repair of wheels, brakes, and shock struts; splicing and inspection of tow ropes and cordage.

Three days: Inspection, repair, and installation of instruments; compensation of compass; inspection and maintenance of auto-tow pilot.

Three days: Pre-stretching and inspection of control cables and swaging of terminals; cleaning, inspection, and servicing of control mechanisms and accessories.

II. Woodwork Branch

103 hours, 18 days

Six days: Nomenclature, care, and use of woodworking hand tools; identification, selection, and use of aircraft woods and glues; laminating and forming of wood members; and fabrication of wood glider parts.

27. Monthly reports of Statistical Control.

33. CG, TS, Sheppard Field to CG, 3d Dist., AFTC, 11 Mar. 1943; Lt. Col. Bruce V. G. Scott, Director of Training, TS, Sheppard Field, 3d Dist., to CG, AFTC, 21 May 1943, in AG/AS, Training files.

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Twelve days: Inspection, repair, and re-finishing of plywood skin, control surfaces, wing structures, and fuselages.

Twelve days: Nomenclature, care, and use of fabric covering and finishing tools and materials; repair and replacement of fabric covers; application of finishing materials; and cutting, forming, and repair of sheet plastic.

III. Assembly and Inspection

138 hours, 23 days

Six days: Uncrating and crating CG-4A glider; disassembling, assembling, and rigging CG-4A glider; handling and mooring; and structural alignment.

Two days: Application of weight and balance principles, determination of weight index and loading and securing cargo.

Two days: Performing preflight and periodic inspections and completing related forms.

Thirteen days: Disassembly, inspection, repair, reassembly, adjustment, and final inspection of CG-4A gliders.
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In February 1943 the IAF instituted a sudden and drastic reduction
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in glider pilot training. The Office of the Special Assistant for the Glider Program and AG/AS, Training in Headquarters, USA thereupon took steps to adjust the amount of glider mechanics training to correspond with the new pilot quotas. The first step was to reduce the enrollment at Sheppard by more than one-half between March and May--from 1,312
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students to 632. In June and September surveys were conducted to

89. Block outline of Glider Mechanics Course, Sheppard Field, 25 Oct. 1943, in AFHHS files.

90. The Glider Pilot Training Program, 88.

91. Monthly reports of Statistical Control.

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discover how many men had already been trained and what needs in the immediate future were likely to be. These suggested that there was still need for considerable additional training for both recruits and for practicing mechanics in need of refresher courses. Of the 4,547 mechanics graduated from Sheppard before 3 June 1943, it was estimated that only 1,443 had taken the course since the introduction of the important phases on crating, uncrating, assembling, and rigging of gliders. In addition, reports from overseas indicated that there were large numbers of mechanics who had received their training on types of gliders antedating the CG-4A--lamentable because the CG-4A was the only combat type of glider.

Before Headquarters, AAF could reach a decision as to exactly what type of refresher training Sheppard Field ought to provide these men, the Troop Carrier Command solved the problem by establishing "on-the-job" training for mechanics at Laurinburg-Maxton, N. C., Sedalia, Mo., Alliance, Neb., and Columbus, Ind. This was considered to be unusually effective because it was conducted under conditions simulating those in the field. 92 Indeed, it proved so generally satisfactory that the course was discontinued early in 1944, and all training of enlisted mechanics thereafter was done on the job by the TCC. 93

This did not mean the end of Sheppard Field as a glider maintenance

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92. R&R, AC/AS, Training to Special Assistant for the Glider Program, 15 June 1943, with indorsements, in AAG 221, Mechanics; R&R, Brig. Gen. R. W. Harper to Special Assistant for the Glider Program, 1 Sep. 1943, in AC/AS, Training files.
93. R&R, Col. E. S. Metzel, Chief, AFMP, to AC/AS, Training, 20 Jan. 1944, in AC/AS, Training files.

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school, however. In April 1943 Sheppard had begun giving instructions in glider mechanics to glider pilot candidates on detached service from the Flying Training Command. At the outset the course was substantially the same as that being given to enlisted men. On 1 August 1943, AG/AS Training ordered the course for embryonic pilots reduced from 65 to 30 days. The curriculum was redesigned to emphasize the rigging and assembly of the CG-4A and general supervision of glider maintenance. As such, it became an integral part of the training of all glider pilots.⁹⁴ Later the course was lengthened to 39 days but the scope of the instruction remained unchanged.

94. AG/AS, Training to CG, AFTRG, 1 Aug. 1943, in MAG 353, Glider Training, cited in The Glider Pilot Training Program, 71.

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Chapter V

FACTORY AND AIRLINE TRAINING

During World War II the AAF had large numbers of its maintenance men trained by employees of the airplane manufacturers either on the factory assembly line or in classrooms close to the factory. Small numbers were trained by employees of the commercial airlines on their maintenance lines. Such training provided crew chiefs and other highly experienced mechanics with advanced training and familiarization with the latest types of equipment. Moreover, during the period of rapid expansion of the AAF it reduced the load placed upon the already overtaxed AAF technical schools and civilian mechanics schools.

The use of this type of training was not an innovation in AAF practice. Considerable use of factory training was made during World War I. With the return of peace formal programs were dropped; but from time to time, especially when new types of planes and equipment were adopted, the factories making them would invite the Air Corps to send men for instruction in maintenance. Normally only about fifteen men were sent at a time, it being expected that they in turn would instruct others either at technical schools or through "on-the-job" training. Nominally the manufacturers made no charge for these services;¹ actually they were paid for in the purchase price of the equipment.

1. Lt. Col. M. F. Davis, Exec., OCAC to CG, GHQ AF, 3 Feb. 1937, in MAG 353.9, Factory Training, Airplane Training Crews.

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Sometimes this type of training served another purpose--men trained on a new plane could fly it from the factory to the base to which they and the plane were assigned. ² Established Air Corps policy was that factory ³ training should be used sparingly.

In July 1940--at the time the expansion program was getting well under way--Col. G. C. Brant, Commandant of Chanute Field, investigated the possibilities of setting up a regular and extensive training program for recruits to be conducted at the depots of commercial airlines. It appeared to him that the capacity of Chanute and the civilian mechanics schools would soon be reached; even if these schools were expanded, there would be a serious shortage of trained instructors. An apprentice system, similar to that which had long been used by the Navy and all the commercial airlines except United, might provide the solution. At any rate, it would be worth trying experimentally on a small scale. The vice-president of Braniff Airways of Dallas, Tex., indicated that his firm would be willing to give the scheme a trial, taking as many as 40 men at a time and assigning each to a line service mechanic. ⁴ There would be no charge to the government.

Colonel Brant's suggestion was vetoed by General Jacob E. Fickel on the grounds that it would not train men quickly enough and in large enough numbers. In civilian life apprenticeship as a mechanic normally

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2. Memo for Brig. Gen. H. H. Arnold, Asst. C/AC, by Col. H. J. Knerr, C/S, GHQ AF, 29 Jan. 1937, in ibid.
 3. Circular letter 39-32, Lt. Col. Ira C. Baker, Exec. OCAC, to CO's, all AC stations, 15 June 1939, in ibid.
 4. Robert J. Smith, Vice President, Braniff Airways, to Gen. [sic] G. C. Brant, Chanute Field, 5 July 1940; Col. G. C. Brant to C/AC, 15 July 1940; Col. G. C. Brant to Gen. J. E. Fickel, 16 July 1940, in MAG 353.9 C, Training, Mechanics.

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required four years, the general pointed out; it was not reasonable to expect that this could be reduced to less than two years. Two years was two-thirds of an enlistment period, which would mean the maintenance man would be useful to the Air Corps for only a short period after he was trained.⁵ For a few months this decision gave a quietus to proposals for training at factories and airlines.

Factory Training

During 1941 and early 1942 the Air Service Command, the Air Force Combat Command, and the Technical Training Command began to feel urgent need for advanced and specialized training for their assigned personnel. Individually they offered proposals for training to Headquarters, AAF: proposals which were usually approved by Training and Operations under a verbal authorization of General Arnold. Usually these classes were small, with an average of 15 men being trained for two-week periods. By March 1942 training of this type had grown to such an extent that General Oliver P. Echols, Commanding General of the Materiel Command, proposed that "to avoid duplication and confusion, the allocation and issuance of orders [for factory training] ought to be centralized." Inasmuch as the Materiel Command regularly dealt with the factories, it could fittingly assume this additional function. The suggestion was resisted by the Directorate of Individual Training, which held that although coordination of factory training was highly desirable,⁶ it was a function belonging properly to it.

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5. R&R, J. E. F., Chief, T&O Div., to [?], 19 July 1940, in *ibid.*
 6. R&R, O. P. E. [Echols], CG, AFAMC to AFRTT, 19 Mar. 1942; R&R, Col. L. S. S., [Smith] AFRTT, to AFAMC, 27 Mar. 1942, in AC/AS, Training files.

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Within a few weeks the decision in this argument was given to the Directorate of Individual Training and a command most closely allied to it--the Technical Training Command. The matter came to a head early in April 1942 when General Arnold suddenly reached the conclusion that far greater numbers of mechanics must be trained immediately than could be cared for by the AAF schools, and factory training was the only satisfactory solution. On the afternoon of Saturday, 11 April, he issued a verbal directive that beginning the following Monday the maximum number of AAF enlisted men "for which food, shelter and instruction" could be provided "without causing the men to be dependent on the communities" were to be trained at all factories producing combat airplanes, engines, propellers, and turrets for the AAF. The men were to be unassigned personnel and the Technical Training Command was to have charge of the program. The government was to pay the cost of instruction, housing, and messing. For the time being the course of instruction was to last six weeks.

Many of the details of this program were filled in during a telephone conversation late Saturday night between Brig. Gen. L. S. Kuter, Deputy Chief of Air Staff, and Maj. Gen. M. R. Leaver, Commanding General of the Technical Training Command. To make certain that the students arrived by Monday, the TTC was directed to "rout the men out of bed and put them aboard trains if necessary." Violations of minor rules would be permitted "in the interests of rapid and orderly procedures," although Headquarters, AAF was to be kept informed of them by telephone. TTC officers would accompany the men and be responsible for them during their training period. Courses of instruction were to

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be drawn up by the TTC. Instructors would be provided by the factories. General Kuter authorized the TTC to divert one combat type plane at each factory for instructional use.

In the course of the midnight conversation a number of long-term objectives for the factory training program were developed also. Once the program was well under way it would become a sort of "post-graduate" course, preparing men for service in tactical units and depots--roughly comparable to the advanced courses at Chanute and the third and fourth echelon courses given at a number of civilian mechanics schools. The number of men ultimately to be so trained was not specified in figures, but it was to equal the number of replacements expected to be necessary for both combat and depot establishments. It was hoped that the practice of having crew chiefs, following their graduation from a factory course, to fly with new planes to the bases to which they and the planes were to be assigned, might be revived and extended.⁷

To get the program under way by the date specified by General Arnold, AAF officials had to work hastily. It was estimated that the maximum number of students which the factories could accommodate was 5,000. It was impossible for the TTC to find, on such short notice, 5,000 unassigned technical school graduates. As the next best thing, 5,000 men who were approaching the end of the basic mechanics course at a number of Air Corps technical schools were ordered to entrain for the factories. Administratively they were considered as graduates of the basic course.⁸

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7. Memo for AFRIT by Brig. Gen. L. S. Kuter., DC/AS, 12 Apr. 1942, in AG/AS, Training files.
 8. R&R, W. H. Mitchell to John S. Canterbury, 17 Apr. 1942, in Bureau of the Budget, Administrative Management files.

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The next problem was to find housing and mess facilities for the men. Most of the twenty-odd factories engaged in the program had only small barracks and limited cafeteria facilities, if any at all. A great many were on the West Coast, where the communities were congested with war workers. How the problem was handled is well illustrated by the case of the Los Angeles area, to which more than 2,000 men were assigned for factory training. The staff of Col. C. W. Steinmetz of the Western Procurement Office made arrangements for this torrent of men to be housed temporarily at the Grand Hotel and the Edgewater Hotel in Santa Monica. The living conditions here, according to Capt. John C. Kelly of Headquarters, AAF who inspected them on 18 April, were far from ideal. At this time the Los Angeles area had 2,125 men on its hands.

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Approximately 1800 men had spent the night in the Grand Hotel [Captain Kelly reported] sleeping in the lobby, swimming pool, locker rooms, kitchens and corridors. Seven cases of yellow jaundice existed within the hotel. . . . While the morale of the men was still reasonably good, there was insufficient officer personnel to regulate them, to have assemblies or any type of physical recreation. The hotel is located on the beach and many soldiers with no previous association with the ocean, were going into the water. One, and possibly two soldiers had drowned Saturday morning. By Monday night, when I left Santa Monica, the bodies had not been recovered nor had their identity been determined.

Obtaining airplanes upon which to instruct the students was equally difficult. The directive setting up the program authorized the diversion
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of one combat type plane at each factory. But as Captain Kelly pointed

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9. Report on Factory Training Program, Technical Training Command (Western Division), 22 Apr. 1942, in AAG 353.9 C, Factory Training.
 10. CG, AAF (AFRIT) to CG, AFTTC, 29 Apr. 1942, in Bureau of Budget, Administrative Management file.

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out following his inspection trip, this number was far from adequate."

"One plane must be made available for each 60 men," he declared. This would mean 12 to 15 planes at the Douglas plant alone. "The War Department must allocate sufficient planes for these men to train on," he wrote.
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Although difficult, the task of setting up administrative units to supervise training in the factories was handled with more success. Maj. Gen. John F. Curry, Commanding General of the Fourth District of the TTC, gave orders that a detachment consisting of two officers, two noncommissioned officers, and some civilian typists be established at each factory. For the time being medical facilities were contracted for locally; in most cases this meant that students were cared for in the plant hospital. Meanwhile plans were drawn up to establish a small
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medical detachment at each of the larger plants.

The problem of teaching the thousands of students who had suddenly been turned over to them was solved by the factories more or less by trial and error. General Arnold's original directive had ordered that the course last six weeks; subsequently this was reduced to 28 days. The factories were to provide instructors; this they did expeditiously and without a great deal of difficulty. More trouble was met in deciding what the course of instruction was to be and how it was to be given. As one of the AAF factory representatives informed General Arnold a little later, "they had no idea what they were supposed to teach to the

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11. Report on Factory Training Program, TTC (Western Division), 22 Apr. 1942, in AAG 353.9 C, Factory Training.
 12. Memo for [?] by Lt. R. H. Glissmeyer, Technical Training Sec., AFRTT, 20 Apr. 1942, in ibid.

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enlisted men . . . sent to the factories for training."¹³

Apparently Headquarters, AAF originally had the notion that some, if not all, of the men ought to be taught by actually working on the assembly lines of the factories. This suggestion most of the factories resisted stoutly, insisting that such a practice would seriously interfere with their production schedules. They added that they believed the type of information which could be picked up on an assembly line was not very vital to the work of AAF maintenance men; at any rate, what was important was a thorough understanding of the operation and maintenance of various features of the plane. Accordingly, they resorted to classroom lectures and demonstrations on mock-ups and actual airplanes.¹⁴

After training had been going on in the factories for about a fortnight, Headquarters, AAF and the TTC authorities took steps to place it upon a more orderly and uniform basis. The number of enlisted men to be trained at factory schools was set at a constant enrollment of 6,750. Thereafter all graduates of basic mechanics courses would be sent to a factory school for advanced study. The proportions sent to each school would in general correspond with the numbers and types of aircraft and accessories produced by that factory. The schools would give the men a 24-day course designed to make them good assistant crew chiefs. Approximately the top third of each class would be held at the school for a second 24-day course which would qualify them to perform

13. R&R, L. S. K[uter], DJ/AS, to AFRTT, 4 May 1942, in AAG 353.9 Factory Training.

14. Report on Factory Training Program, TTC (Western Division), 22 Apr. 1942, in AAG 353.9 C, Factory Training.

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the duties of a crew chief. Some of the graduates of the first 24-day course would be sent to engine factories so that they might be able to perform third and fourth echelon engine maintenance.¹⁵

About the same time the ITC worked out the various courses in more detail, General Weaver held a conference with the manufacturers of pursuit aircraft and accessories at Chicago on 25 April and another with producers of bombardment aircraft and accessories in the same city on 2 May. Out of these emerged definitions of the objectives, scope of instructions, and syllabi for each course.¹⁶ These changed the length of the courses once again, raising the aircraft factory courses to 32 instructional days, reducing those in the engine factories and accessory factories to 21 instructional days.¹⁷

Meanwhile, vigorous steps were being taken to solve the problem of providing more permanent classroom and housing accommodations. Headquarters, AAF arranged with the Corps of Engineers to construct by early June classrooms and barracks adequate for 6,750 students plus the necessary administrative overhead. Classrooms were to be built adjoining the factories and the barracks were to be as close as possible to the classrooms.¹⁸

In its haste to get the factory training program into operation, Headquarters, AAF had rather lost sight of the numerous factory schools

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15. Memo for Gen. Arnold by Brig. Gen. L. S. Kuter, 30 Apr. 1942, in AAG 353.9 D, Factory Training.
 16. EER, L. S. Kuter] 03/13, to AFRTT, 4 May 1942, in AAG 353.9, Factory Training.
 17. Report of Gen. [Junius M.] Jones, 5 May 1942, in *ibid.*
 18. CG, AAF (AFRTT) to CG, AFMTC, 29 Apr. 1942, in Bureau of the Budget, Administrative Management Files.

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which the Air Service Command and the Ferrying Command had long been conducting for the edification of their assigned personnel. To centralize all AAF factory training, late in May orders were issued that administrative responsibility for all factory schools would be assumed by the TTC effective 1 June. Headquarters, AAF directed the two commands to submit to it estimates as to how many of their personnel would need factory training in the future. A similar invitation was extended to the commanding generals of the various air forces. When these requested had been correlated, Headquarters, AAF turned them over to the TTC which thereupon trained the assigned personnel along side of its own unassigned personnel.

Some attempt to take stock of the factory training program, to find out what it was accomplishing and to make suggestions as to how its shortcomings might be overcome, was made in the course of discussions of a board of officers which met at Knollwood Field, N. C., 17 to 28 August 1942. By this time the program had been in operation on an extensive scale for four and a half months; schools were being conducted at 30 airframe, engine, and accessory factories from New York to California; 5,097 enlisted men and 231 officers were under instruction; and it was expected that this number would be increased to 9,760 as soon as housing then under construction was completed. In addition, small numbers of men were receiving factory training in armament,

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19. CG, AAF, AFITC, CG, AFASC, CG, Ferrying Command, 20 May 1942, in ibid.; CG, AAF to CG, AFASC, CG, ASC, Ferrying Command, 25 May 1942, in AAG 353.9, Factory Training; CG, AAF to CO's, all continental U.S. AAF stations, 25 June 1942, in AFTHI files.
20. Technical Training Report -- Factory Training Program, issued by AFRT, 31 Aug. 1942, in ibid.

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photography, radio, etc. By this time the chaos that had accompanied the inauguration of the program was over, adequate classroom and housing facilities had been provided for students, the courses of instruction had been standardized, and selection and assignment of students were being conducted in an orderly fashion. It was not too soon for a fair appraisal of the program.

The testimony of the officers and noncommissioned officers at the conference ranged from commendation to strong condemnation. The harshest judgment came from Brig. Gen. Junius W. Jones of the Technical Training Command, who declared: "It is my opinion that factory training so far is a washout."²¹ The greatest shortcoming of the program, it was generally agreed, was the inadequate number of aircraft and accessories assigned for training. Although recommendations had been made that a greater number of planes be made available, the directive ordering one combat plane for each factory school still remained unchanged. General Jones reported the situation he found at the Glenn L. Martin factory at Baltimore where an attempt was being made to teach 525 men on one plane. In an eight-hour school day each man had an opportunity actually to operate the engine for only seven minutes. The rest of the day was spent in "hot, crowded classrooms, listening to lectures by instructors . . . [who] seem to have been recruited from high schools." General Weaver had recommended that the school be put on a 24-hour day basis to make the equipment go farther, "but nothing has been done

21. Brig. Gen. Junius W. Jones during general discussion, 17 Aug. 1942, in "Proceedings of the Board of Officers Appointed to Review and Reorganize the Technical Training Program, Knollwood Field, 17 August to 28 August 1942," in ibid.

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about it."

Quite similar conditions obtained at the Boeing factory in Seattle, Lt. Col. C. P. Gilger of the 42d Bombardment Group told the conference. Although he approved in general of the instruction offered at the school, Colonel Gilger pointed out that one instructor could teach maintenance on a plane to a maximum of about five students at a time. The school had 300 students; therefore its quota of planes ought to be increased from one to five.²³ An officer and a noncommissioned officer who had visited the Consolidated factory at San Diego agreed that the equipment available for teaching, though excellent in quality,²⁴ ought to be doubled in quantity.

Despite the asperity of the remarks General Jones had made about the quality of the instructors at the Martin factory, the testimony of other officers suggested that this problem had been fairly well handled. For example, the instructors at Boeing, according to Colonel Gilger, were "well qualified," each a specialist in his line, with factory experience in what they had been teaching. Capt. C. D. Fields suggested that the effectiveness of their teaching might be increased if they were sent to tactical units for short periods to learn Air Corps practices.

There was general agreement that the proportion of "practical" to "theoretical" instruction ought to be increased considerably. Estimates

22. Ibid.

23. Testimony of Lt. Col. C. P. Gilger, 42d Bombardment Group, before Board of Officers, Knollwood Field, 22 Aug. 1942, in ibid.

24. Testimony of Capt. Clarence D. Fields and M/Sgt. Lyle C. Cochran, 34th Bombardment Group, before Board of Officers, Knollwood Field, 22 Aug. 1942, in ibid.

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varied as to what it was and what it should be. Colonel Gilger judged that at Boeing two-thirds of the student's time was spent on theory, one-third on practical problems, while ideally it ought to be the other way around. W/Sgt. Lyle H. Cochran of the 34th Bombardment Group, who had visited the Consolidated factory, thought the ratio of practical to theoretical instruction at that school was 50-50, while it ought to be 80 to 20. It was generally recognized that the reason for the undue stress on theoretical instruction was the shortage of teaching equipment and that this condition could not be corrected until more equipment was made available.

Both the Training Command and AC/AS, Training made earnest efforts to obtain increased allocations of airplanes for the factory schools. In September 1943, for example, the Training Command proposed to the Commanding General of the AAF that a sliding scale for the assignment of planes be established:

<u>Type</u>	<u>Engines</u>	<u>No. of planes per 100 students in a class</u>
Fighter	Single	5
Fighter	Twin	4
Bombardment (light)	Single	4
Bombardment (medium)	Twin	3
Bombardment (heavy)	Four	2
Cargo	Twin	3
Cargo	Four	2

A group of eastern aircraft manufacturers even went so far as to suggest that one complete airplane of a new type be assigned to the Training Command for factory school use before deliveries were begun to AAF tactical units.

25. CG, AFTRC to CG, AAF, 16 Sep. 1943, in AC/AS, Training files.

26. R&R, Col. O. P. Weyland, Allocations and Progress Div. OC&R, to AC/AS, Training, and Requirements, Div., OC&R, 17 Aug. 1943 in ibid.

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But the Materiel Command and AC/AS, Materiel, Maintenance, and Distribution steadfastly resisted such requests on the ground that if they were granted, operations in the combat theaters would be seriously jeopardized. Sometimes LM&D evaded the issue entirely by suggesting that responsibility for allocations was a problem of AC/AS, Operations, Commitments, and Requirements and ought to be taken up with it.

About all that the Training Command and AC/AS, Training were able to obtain was a directive ordering AAF resident representatives at the factories, once deliveries had been made to units with high priorities, to withhold one airplane of the latest type for each school on the understanding that it would be released as soon as a later production model became available. This was some gain, for previously the factory schools had not always been able to obtain the use of the latest models. In occasional instances, too, O&R was willing to grant one or two additional planes, and in a few cases the AAF factory representative was able to obtain at least temporary use of newly produced planes for the schools. But the problem of obtaining adequate teaching equipment was a continuing one and was never solved satisfactorily.²⁷

A complaint frequently made against the factory training program was that the courses were too short to give a thorough understanding of the maintenance problems of the more complex types of aircraft. This particularly true in the case of heavy bombers. Capt. John H. Phipps of the Technical Training Section of A-3, in August 1942

27. R&R, Col. J. M. Sessions, Jr., Chief, Production Br., Materiel Div., LM&D, to AC/AS, Training (Technical Training Div.) 26 Aug. 1943; Col. Alden R. Crawford, C/S, AFAMC, to AC/AS, LM&D, 2 Sep. 1943, in ibid.

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developed a plan to make the instruction more thorough without increasing the length of the course. This was postulated on the fact that the normal heavy bomber squadron included 64 airplane mechanics. Each 64 men, Captain Phipps proposed, would be divided into four groups of 16 men each. One group would spend its entire time at a factory school studying airframe and controls inspection and maintenance. A second group would concentrate on engine change, inspection, and the supercharger. The third group would specialize on hydraulics inspection and maintenance, while the fourth would be concerned with electrical inspection and maintenance. Through such training, Captain Phipps declared, a team of four mechanics, each man trained in one specialty, would be able to service a bomber completely and capably. In time, close association with the three other types of specialists would equip a man to perform all the maintenance work on the bomber. ²⁸ There is no record of any action having been taken on Captain Phipps' suggestion. The problem of assignment of men to training and duty under such a plan would have been great--perhaps so great as to make the scheme impracticable.

A year later, in August 1943, the question of lengthening the course was again brought to the fore, this time by a meeting of the aircraft plant service managers conducted under the auspices of the Aircraft War Production Council, East Coast, Inc. The service managers advanced four reasons for lengthening factory school courses:

1. In recent classes, the caliber of students had fallen considerably,

28. Memo for Col. Davasher by Capt. John H. Phipps, 3 Aug. 1942, in AAG 353.9 G, Factory Training.

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making it necessary for more time to be spent on elementary material. Repeated requests had been made that all theory be eliminated from the course, but, the service managers pointed out, "experience indicates that additional time is necessary for this type of material at the start of the course."

2. The accelerated development of new models had created the need for new phases of instruction to point out the differences between the various models and the idiosyncrasies of each.

3. Experience had shown that certain maintenance problems previously not considered very important required more extensive explanation. Three examples of such requirements were cited: a "thorough understanding of the importance of the center of gravity--its determination and importance in being maintained in narrow specified limits; a more thorough understanding of complex electrical installations not previously encountered in military aircraft; and a nicer concept of the kind of interchangeability that can be effected by well-equipped personnel in theatres of combat."²⁹

The suggestion was frowned upon by Headquarters, AAF which by the autumn of 1943 was making a general practice of rejecting requests for extension of courses. Headquarters insisted that the present factory courses gave sufficient elementary material for men who were graduates of the basic mechanics course. The inference was that if more care were taken in assigning men to factory courses, one of the arguments for

29. Donald K. Tasker, Secretary, Service Committee, Aircraft War Production Council, East Coast, Inc., 1st. Dist., to CG, AFTC, 7 Aug. 1943, in AAG 353.9, Factory Training, Miscellaneous.

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extending them would no longer exist.

The notion was not easily downed, however. Requests for extension of the courses kept pouring in in such volume that barely two months after Headquarters' refusal, the Training Command suggested that conditions governing the training program had changed sufficiently to make it desirable that the decision be reversed. Factory airframe courses on single-engine planes should be increased to 6 weeks, on twin-engine planes to 7 weeks, and on four-engine planes to 8 weeks, the Training Command urged. To carry out such a program, additional funds would of course be required. Again AC/AS, Training refused the request on the ground that established AAF policies did not permit it, although it was granted that the plan itself was "meritorious."³¹

The concentration of control of the factory training program in the hands of the TTC and its successor the Training Command inevitably led to several administrative difficulties. During the autumn of 1943 the Air Transport Command, successor to the Ferrying Command, began laying plans for the establishment of detachments of its own at aircraft factories to train its flight chiefs, crew chiefs, and line chiefs. This was stopped by a conference between officials of the command and AC/AS, Training. The ATC representatives agreed they would thereafter arrange with the Training Command for factory training for their more skilled maintenance men and develop an operational training unit program

30. 1st ind., Hq., AAF to CG, AFTRC, 20 Sep. 1943, in ibid.

31. CG, AFTRC to AC/AS, Training, 26 Nov. 1943; 1st ind., Brig. Gen. R. W. Harper to CG, AFTRC, undated, in AC/AS, Training files.

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for the advanced training of their run-of-the-mill mechanics.³²

This matter had barely been threshed out before the ATC became alarmed by a report that the Training Command was planning to discontinue factory training on cargo aircraft and accessories. Col. Harold R. Harris, Assistant Chief of Staff, Operations of the ATC, pointed out that during the calendar year 1944 his command expected to need 20,140 men with advanced training on four principal types of cargo aircraft. This burden could not be shifted to the command's OTU program because of the great shortage of Class 26 aircraft³³ and qualified instructors. Accordingly, arrangements were made to continue training on three of the types, although the quotas granted were not as large as those requested by the ATC.³⁴

To make the responsibility for factory training clear to all commands, AC/AS, Training informed the Air Adjutant General in November 1943 that only two commands beside the Training Command would ever be permitted to conduct factory training, and these only in particular instances. The Materiel Command was authorized to assign its personnel to special instruction at the factories during the development and early production stages of new materiel, and the Air Service Command might have its civilian employees trained at the factories if it did not interfere with regular Training Command courses.³⁵

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- 32. Memo for Col. Ryan by Maj. R. H. Glismeyer, 17 Sep. 1943, in ibid.
 - 33. Class 26 aircraft are in an unflyable condition and cannot be put in a flyable condition with any reasonable amount of repairs.
 - 34. Col. Harold R. Harris, AC/S, Operations, ATC, to AC/AS, Training, 5 Oct. 1943, in AC/AS, Training files.
 - 35. P&R, Brig. Gen. R. L. Harper to AAG, 20 Nov. 1943, in ibid.

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Unquestionably the most difficult and persistent administrative problem in the factory training program was that of the selection of students and their assignment to schools in a steady, even flow. Although the practice of "shanghaiing" groups of men unprepared for such advanced training to meet hazily defined quotas was dropped a few months after the start of mass factory training in the spring of 1942, complaints about abuses kept pouring into the various command headquarters. In September 1942 the manager of the Packard Motor Car Company's Aircraft Engine School complained that students kept straggling in at all times; he and his assistants had no notion from day to day how many men they were supposed to be teaching nor at what level they were supposed to be trained.³⁶

Slightly more than a year later pretty much the same complaint was made by the field service manager of North American Aviation, Inc., of Inglewood, Calif. "Apparently," he asserted, in a letter to the Commanding General of the AAF in October 1943, "no judgment is being used in the assignment of men." Since the preceding June his school had received unassigned students from every airplane mechanics school in the country and assigned men from tactical units. In many cases the men did not have the previous training and experience necessary for them to obtain the maximum benefit from his school's instruction on the E-25 and P-51. Moreover, the flow of students to the school had been so erratic as to be detrimental to the instruction. To correct

36. G. W. Rapin, Manager, Packard Motor Car Co. Aircraft Engine School, to Col. W. T. Myers, District Commander, AFHIC, 29 Sep. 1942, in MAG 353.9 I, Factory Training.

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these conditions, he made four recommendations: (1) A steady and regular flow of students ought to be provided. (2) Students should be sent only from two basic mechanics schools--Sheppard Field, which specialized in the B-25, and Lincoln Army Air Field, which specialized in fighter planes. (3) Assignment of students should be made by the nearest echelon of command--the Western Technical Training Command at Denver. (4) No assigned men should be sent to factory schools because these schools found it necessary to follow definite syllabi--a practice not always of maximum benefit to men from tactical units.³⁷

In response, Brig. Gen. R. W. Harper, the AC/AS Training, declared that his office appreciated the justice of the criticisms, but was unable to do very much about them, although it was trying. He blamed the unevenness of the flow of students on the "exigencies of war."³⁸

This resignation to the "inevitable" led to serious consequences toward the end of 1943. As the number of recruits assigned to the AAF by the Army became smaller, and increasing numbers of men were sent overseas on special projects, the numbers of unassigned men available to the Training Command for factory training became proportionately smaller. The factory school population fell to 5,254 at the end of October and to 4,682 at the end of November.³⁹ The situation was especially acute in the case of the airframe schools, the administrators of which had

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37. Frank H. Lyons, Field Service Manager, North American Aviation, Inc., to CG, AAF, 9 Oct. 1943, in AAG 353.9, Factory Training, Miscellaneous.
38. Brig. Gen. R. W. Harper to Frank H. Lyons, 22 Oct. 1943, in AC/AS, Training files.
39. Memo for CG, AAF by Brig. Gen. R. W. Harper, 19 Jan. 1944, in ibid.; RER, Technical Training Div., AC/AS, Training to Budget and Fiscal Officer, 8 Mar. 1944, in AAG 353.9, Factory Training, Miscellaneous.

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been led, earlier in the year, to expect an average student population of 6,000.

The matter came to a head at Headquarters, AAF on 15 January 1944. To bring up the airframe factory school student population immediately to more than 6,000, Brig. Gen. L. S. Kuter, Acting Chief of Air Staff, issued a directive that 3,000 "properly qualified" enlisted men were to be moved to the schools by noon of 19 January. AC/AS, Training was to make certain that from that time forward the number of students at these schools did not fall below 6,000.⁴⁰ On 17 January, two days before the deadline, AC/AS, Training had 6,769 enlisted men under in-⁴¹struction in 24 airframe factory schools.

To facilitate the task of maintaining training at this pace, the Training Command asked that all commanding officers of establishments in the continental United States be notified that they must fill their factory training quotas for assigned personnel scrupulously. If for some reason they were unable to do so, the Training Command was to be advised of the fact at least two weeks in advance. Hereafter, too, commanding officers must guard against using the schools as a "dumping ground" for inferior personnel or as a means of permitting high-ranking noncommissioned officers to be stationed temporarily near their homes.⁴²

By the middle of 1944 the enrollment of the factory schools had settled down to a constant level of 6,000, with no immediate prospect

40. R&R, Brig. Gen. L. S. Kuter to AC/AS, Training, 15 Jan. 1944, in ibid.

41. Memo for CG, AAF by Brig. Gen. E. J. Harper, 19 Jan. 1944, in AC/AS, Training files.

42. R&R, Brig. Gen. E. J. Harper to AFME, 20 Jan. 1944, in ibid.

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43 of change. Since early spring there had been no student flow from AAF technical schools; now the chief source had become mechanics with experience in the combat theaters who had been returned to commands in the United States. The practice was for the command to select the men it considered most worthy and send them in an assigned status to the Training Command for factory training on a specific type of plane.⁴⁴ Twelve factories were offering 17 courses in the second echelon maintenance of 19 different models of planes; most of these courses lasted 5 weeks, although one on the B-29 lasted 10 weeks. Six engine factories were giving 7 courses in second echelon maintenance of 8 different types of engines, 4 and 5 weeks in length. Three propeller manufacturers were teaching 4 third echelon maintenance courses on as many types of propellers; these lasted 2 and 6 weeks. In addition, a turbosupercharger factory and a carburetor plant were giving short courses in the maintenance of these two accessories.⁴⁵ There appeared to be every likelihood that the factory schools, satisfactorily filling a real need, would remain a part of the AAF airplane maintenance training program indefinitely.

Airline Training

Far less satisfactory than the training conducted in factories was that done for the AAF by 14 major airlines over a period of several months in 1942. The program was inaugurated at a time when there was

43. Monthly Reports of Statistical Control.

44. R2R, Brig. Gen. R. T. Harper to DG/AS, 7 Mar. 1944, in AAG 353.9, Factory Training, Miscellaneous.

45. Hq., AFTRC, Prospectus of Courses under Training Command (Technical), 1 May 1944.

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wide discussion about using every possible facility for training AAF maintenance men. Not to be outdone by the aircraft manufacturers, who were already cooperating with the AAF in this respect, the organized airlines of the United States, through E. S. Gorrell and F. M. Barker of the Air Transport Association, in March offered their hangars, equipment, and personnel for training purposes.⁴⁶ The suggestion was greeted warmly by General Arnold on the grounds that "any load we can take off of our schools will make it possible to graduate just that many more individuals."⁴⁷ Headquarters, AAF, the Technical Training Command, and the Air Service Command collaborated with the Air Transport Association in surveying the possibilities. The responses to informal inquiries and a formal questionnaire circulated by the AAF were not encouraging. As it turned out, only 14 airlines were in a position to sign contracts with the AAF to train a maximum of 942 enlisted men at the rate of 38-1/2¢ an hour.

As it was ultimately determined, two programs were to be conducted. A second echelon course known as "Airline Inspection and Maintenance" was to be given by eight airlines--Eastern Airlines, Pan American Airways, Transcontinental-Western Airlines, American Airlines, United Airlines, Northwestern Airlines, Mid Continental Airlines, and Colonial Airlines. Some of the schools were to start 19 July, the others 31 July. Every 12 days 130 graduates of the basic Airplane Mechanics course, assigned men of the Flying Training Command or unassigned men

46. R&R, Donald H. Connolly, Military Director of Civil Aviation, to AFTTC, 12 Mar. 1942, in AC/AS, Training files.

47. R&R, H. H. A[Arnold] to AFMT, 18 Mar. 1942, in ibid.

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furnished by the TIO, were to be entered. The maximum capacity of the
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 course was to be 390 men. The length of the course was to be 34 days.
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 The curriculum was to be as follows:

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|---|----------|
| I. Airplane Structures | 48 hours |
| II. Airplane Hydraulic Systems and
Miscellaneous Equipment | 48 hours |
| III. Engine Operation, Test, Change and
Change Inspection | 48 hours |
| IV. Airplane Inspection and Maintenance
Inspection of Complete Serviceable Airplanes | 96 hours |

Another course, to be known as "Airline Depot Overhaul," was to be given on the fourth echelon level by 11 airlines--Braniff Airways, Chicago and Southern Airways, Delta Air Corporation, Eastern Airlines, Mid Continental Airlines, National Airlines, Northeastern Airlines, Northwestern Airlines, Pan American Airlines, Transcontinental-Western Airlines, and Western Airlines. Classes at these schools were to start 6 July and every 12 days thereafter until a maximum of 552 men were in training. The structure of the course was to be similar to that of the "Airline Inspection and Maintenance" course although instruction was to be conducted on a more advanced level. Students were to be men on detached service from the Air Service Command who had been graduated from the ASC depot overhaul course given at civilian mechanics schools. Like the second echelon schools, these were to be administered by

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48. Col. L. S. Smith, AFRT, to CG, AFMTC, 16 July 1942, in ibid.
 49. Syllabus for Airplane Mechanics Airline Schools--Inspection and Maintenance, undated (about 15 July 1942), in AAG 353.9 C, Training Mechanics.

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the TTC.

Almost as soon as the first classes started reporting to the schools, the airlines began to beg to be relieved of the training responsibility on the ground that their equipment and personnel were already being overtaxed by their work for the Air Transport Command. The second echelon course was particularly hard hit in this respect. Contracts with all airlines giving this course were cancelled by Headquarters, AAF late in July; only the classes at Eastern and Northwestern Airlines continued until graduation.⁵¹

The depot overhaul course was longer-lived. By early September six of the schools had discontinued giving this training, but five-- Braniff, Chicago and Southern, Delta, National and Pan-American--survived until the end of the year. Headquarters, AAF and the TTC were anxious to drop these as well on the grounds that the training was not up to "standards necessary" and the student capacity of each was not great enough to warrant the cost of maintaining administrative detachments at them; but the ASC was satisfied with the program, and it was continued a few months longer than would otherwise have been the case.⁵²

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50. CG, AFTTC to AFRIT, 19 May 1942; Col. James D. Givens to Fowler M. Barker, Secretary, Air Transport Association of America, 22 May 1942, in AG/AS, Training files; Chief of Field Services, Wright Field to CG, ASC, 18 June 1942, in AAG 353.9 C, Training Mechanics.
51. R&R, Col. L. S. Smith, AFRIT to AFALC (Attn: Capt. Bitner), 30 July 1942; Col. L. S. Smith to CG, AFTTC, 30 July 1942; R&R Brig. Gen. L. S. Smith to AFILP, 14 Dec. 1942, in AG/AS, Training files.
52. CG, AFTTC to AFRIT, 9 Aug. 1942, in AAG 353.9C, Training, Miscellaneous; 4th ind., CG, AFTTC to AFRIT, 4 Sep. 1942; Capt. John H. Phipps to Lt. Col. D. M. Speer, Chief, Field Services, ASC, 4 Sep. 1942; R&R, Brig. Gen. L. S. Smith to AFALC, 14 Nov. 1942, in AG/AS, Training files.

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Looking back on the program, Brig. Gen. L. S. Smith observed that "training by airlines [is] considered of little value for men who go to combat organizations. . . . [It] is only applicable to the needs of the Air Service Command, the Air Transport Command and the Troop Carrier Command."⁵³ These needs could easily have been met by other AAF training facilities. But as one Headquarters, AAF official remarked, it was a case of everyone--the airline officials and AAF officials--"thinking they were doing something nice for the other," with the secretary of⁵⁴ the Air Transport Association in the middle trying to keep his job.

53. R&R, Brig. Gen. L. S. Smith to AFMFP, 14 Dec, 1942, in ibid.

54. Capt. John H. Phipps, Technical Training Sec., to Lt. Col. Dallas M. Speer, Field Services Sec., ASC, 31 July 1942, in ibid.

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Chapter VI

TRAINING OF ENGINEERING OFFICERS AND CADETS

Although the Air Service assigned officers to devote their full time to the supervision of the work of enlisted mechanics during World War I, the practice was dropped after 1918. With the passage of time, the myth grew up that "Air Corps officer pilots have always performed¹ these duties in addition to their duties as members of combat crews." By 1940, when training under the expansion programs had gotten well under way, the demand for pilots had become so great that it was found necessary to shift administrative and supervisory duties to a ground officer known as the squadron engineering officer. Provision for this new type of officer was made in squadron tables of organization.²

As subsequently defined, the duty of a squadron engineering officer was to supervise the operations of an aircraft maintenance and repair unit at an air field or an air base. In the course of doing this, he (1) supervised and instructed personnel in disassembly, assembly, repair, and testing of aircraft and such aircraft equipment as airplane engines, landing gear, and fuselages; (2) planned and assigned the work of repair crews; (3) inspected and tested all work done to make certain that equipment was adequately repaired and ready for service;

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1. R&R, B. K. Y. [Brig. Gen. Barton K. Yount], Plans Div., to T&O, 3 Sep. [1940], in AC/AS, Training files.
 2. R&R, J. E. F. [Maj. Gen. Jacob E. Fickel], T&O Div., to Exec., thru Plans Div. 9 Sep. 1940, in ibid.

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(4) supervised the issue of all tools, supplies, and materials and was accountable for them; and (5) supervised the preparation of reports and records.³

Early in September 1940 Maj. Gen. Jacob E. Fickel, Chief of the Training and Operations Division, gave consideration as to what type of men should be selected to fill the openings and how they should be trained. College men with degrees in engineering were the type desired. Short courses at factories and air base depots would not provide the quality of training required; only a thorough, well-developed course at an Air Corps technical school would serve the purpose.⁴

General Fickel's point of view found favor with Air Corps officials, and during the next several months a good deal of discussion went on between them and the authorities at Chanute as to what form the course should take. At the instance of Brig. Gen. Rush B. Lincoln of the Technical Training Command, representatives of leading engineering schools and the United States Office of Education attended a conference at Chanute at which the question was explored thoroughly. Proposals for extensive training at a number of universities to supplement a course at Chanute were drawn up, but the Office of the Chief of the Air Corps later reduced these to a fairly modest scale.⁵ For the time being, it

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3. Memo for C/AS by Brig. Gen. R. W. Harper, 17 Feb. 1944, in AAG 353, Engineering Training.
 4. R&R, J. E. F. [Maj. Gen. Jacob E. Fickel], T&O Div., to Exec. thru Plans Div., 9 Sep. 1940, in AC/AS, Training files.
 5. Lt. Col. L. W. Brock, Jr., Exec., TS, Chanute Field, to C/AC, 15 Nov. 1940, in AAG 352.11 F, Chanute Field Course of Instruction; Brig. Gen. Davenport Johnson to Brig. Gen. Rush B. Lincoln, 20 Nov. 1940, in AAG 353.9, Engineering; Lt. Col. A. W. Brock, Jr. to Professor John D. Akerman, University of Minnesota, 12 Dec. 1940, in ibid.

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was decided, 100 eliminated flying cadets and men who had had three years of study in engineering schools would be enlisted as aviation cadets and trained 12 weeks at a university and 23 weeks at Chanute, after which they would be commissioned second lieutenants and normally assigned to squadrons as maintenance engineering officers.⁶

Two universities were engaged to give the first part of the course, New York University and Purdue University. Cost of the training at New York University was paid by the Air Corps from its own funds, that at Purdue by the United States Office of Education.⁷ Training under this program began on 6 January 1941 when classes of 50 men were entered at each school.⁸

The instruction at the universities was designed to give an understanding of the theoretical aspects of aircraft maintenance. Classes were held seven hours a day Monday through Friday and four hours on Saturday. Of the 465 hours of this part of the course, 285 were devoted to lectures and 180 to laboratory work. The principal features were as follows:⁹

	Class Hours	Laboratory Hours
I. <u>Fundamentals of Aerodynamics and Airplane Design</u>	45	

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6. Memo for AG by Maj. R. E. Nugent, Asst. Chief, Personnel Div., in ibid. For a general discussion of the selection of men for this course, see AAF Historical Studies: No. 21, The Aviation Cadet Ground Duty Program, in AFHFI files.
 7. Brig. Gen. Davenport Johnson to Brig. Gen. Rush B. Lincoln, 20 Nov. 1940, in AAG 353.9, Engineering.
 8. Brig. Gen. Davenport Johnson to Comdt., ACTS, Chanute Field, 20 Nov. 1940, in ibid.
 9. Syllabus for Course at New York University, inclosed with letter from James H. Coburn, New York University, to Brig. Gen. Jacob E. Pickel, 5 Oct. 1940, in AAG 352.11 F, Chanute Field Course of Instruction.

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	Class Hours	Laboratory Hours
II. <u>Airplane Design</u> Principles of airplane design, followed by complete design of one type of airplane	15	90
III. <u>Airplane Engines and Installation</u> Airplane engines and their in- stallation, construction details, valve timing, firing orders, ignition items, carburetion, fuel and oil systems, controls and ac- cessories, test procedure and performance calculations	45	
IV. <u>Airplane-Engines Laboratory</u> Engine testing on large dynamometer, fuel-pump lubrication, engine and magneto timing, carburetor ad- justment and jet testing, engine installations, fuel tests for de- tonation and octane rating		30
V. <u>Airplane Stress Analysis</u> Procedure, study of load factors, application of air loads to air- craft components, A.C. Designers handbook, special problems such as Three-Moment Equation and determination of elastic axis	30	
VI. <u>Structure and Aerodynamics of Military Airplanes</u> Structural and aerodynamic theory of the military airplane	30	
VII. <u>Aircraft Instruments</u> Theory and practice	30	
VIII. <u>Materials and Methods of Aircraft Construction</u> Metallurgy of ferrous and non- ferrous metals with special appli- cation to aircraft construction; shop methods	30	
IX. <u>Propeller Design</u> Aerodynamic theory, stress analysis, design	15	30

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Class Hours Laboratory Hours

X. <u>Airplane Stress Analysis</u>	30	
Continuation of work in phase V; analysis of metal-covered structures, wing and fuselage; control systems and surfaces; landing gear		
XI. <u>Airplane Detail Design</u>	15	30
Welded, riveted, bolted and pinned connections; common types of welded, cast and drop-forged fittings in aircraft; design of fuel tank, tank supports, bulkheads, riveting of sheet metal seams, etc.		

Totals 285 180

Grand Total 465

Upon completion of the university phase, students proceeded to Chanute for the more practical aspects of the course. The first class¹⁰ reached the field in time to start classes on 1 April 1941. In the main, the course resembled the basic airplane mechanics course for enlisted men given at the field; but there were significant differences. To prepare the aviation cadets for their future duties as squadron engineering officers, particular emphasis was placed on the supervisory and inspection phases. Instruction on machine practices, sheet metal work, welding, parachutes and aircraft clothing, not given to the enlisted men, were also included. Lectures on military customs, military law, infantry drill, ceremonies and inspection, and interior guard duty also were given. Classes were held seven hours a day Monday through Friday and three hours on Saturday. Approximately 40 per cent of the course time was spent in lectures, and 60 per cent on practical work.

10. History, Chanute Field, 1 Jan. 1939 to 7 Dec. 1941, 63.

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The chief features of the course were:

I. Air Corps Maintenance System	35 hours
II. Shop Fundamentals	35 hours
III. Airplane Structures	70 hours
IV. Airplane Hydraulic Systems and Miscellaneous Equipment	70 hours
V. Aircraft Propellers	70 hours
VI. Aircraft Instruments	70 hours
VII. Aircraft Engines	70 hours
VIII. Aircraft Electrical Systems	70 hours
IX. Engine Induction, Fuel and Oil Systems	70 hours
X. Engine Operation and Test	70 hours
XI. Airplane Inspection (Single Engine)	70 hours
XII. Airplane Inspection (Multi-engine)	70 hours
XIII. Machine Shop Lathes, milling machines and shapers, grinders, heat-treating	14 hours
XIV. Sheet Metal Work	14 hours
XV. Welding	14 hours
XVI. Parachutes and Aircraft Clothing	14 hours

Other subjects:

I. Military customs and administrative practices	81 hours
II. Inspection of Wright Field, Fairfield Air Depot, and Allison Engine Plant	35 hours

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11. Lt. Col. A. J. Brock, Jr. to C/AC, 15 Feb. 1941, with inclosures, in MG 352.11 F, Chanute Field Course of Instruction.

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Obviously there was a good deal of duplication between the theoretical and practical phases of the course. To eliminate this and reduce by more than one-third the amount of time required to turn out a maintenance engineering officer, the theoretical phase was discontinued after the first class of 100 men had completed it. No important changes were made in the course for the next 18 months. During this period, to meet the ever-surging need for squadron engineering officers, the enrollment was increased constantly--to 393 in October 1941, to 395 in December 1942. A small number of qualified officers was admitted regularly to the course after early 1942; by December of that year 26 such officers¹² were in training.

In the latter part of 1942 an important new source for squadron engineering officers was tapped: enlisted graduates of the basic airplane mechanics course. The initiative for this step came from the Technical Training Command which urged that training these men would greatly improve the morale of students taking the basic course and would produce officers "equal, if not superior, to those now produced from the Aviation Cadets."¹³ In granting the request, Headquarters, USAF specified that not more than 20 per cent of the graduates of any class were to be given the officer training.¹⁴

A separate course for these men, known as the Maintenance Engineering Course (Sp), was set up at Chanute on 31 October 1942. The men

12. Monthly reports of Statistical Control.

13. Col. C. H. Howard to CG, AFMTC to CG, USAF, 15 Aug. 1942, in Aviation Cadet Pr. Files.

14. Memo for AG by Aviation Cadet Sec., AFMTC, 2 Dec. 1942, in I/C Pr. Files.

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had first undergone a course in officer indoctrination at another school.¹⁵ The Maintenance Engineering Course (Sp) was 36 days in length, devoted completely to the administrative aspects of aircraft maintenance. Upon graduation the men were commissioned second lieutenants and sent to an officers training school for indoctrination in the purely military aspects of an officer's duties.¹⁶

In early January 1943, at the time all aviation cadet and officer technical training was being centralized at Yale University, both the Maintenance Engineering Course and the Maintenance Engineering Course (Sp) were moved there from Chanute.¹⁷ About this same time, although it had no connection with the transfer of the training, an important change was made in the curriculum of both courses. This was the introduction of a phase known as Weight and Balance Control, which dealt with the arrangement of cargo and personnel in aircraft so as to obtain the maximum safe load. Beginning 18 December 1942 the Maintenance Engineering Course (Sp) was extended from 36 to 48 days to provide two weeks of instruction on weight and balance control. At the same time six to ten days of instruction on this new subject was introduced into the Maintenance Engineering Course; the addition was made at the expense of other phases of that course so that its over-all length was not increased.¹⁸

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- 15. CG, AFMTC to AFMTC, 25 Nov. 1942, in LAG 352.11, Technical Schools, Miscellaneous.
 - 16. History, Chanute Field, 7 Dec. 1941 to 1 Jan. 1943, 315-316.
 - 17. Ibid., 316.
 - 18. Discussion of the instruction on weight and balance control will be given later in this chapter.

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Great as were the numbers of squadron engineering officers under training during 1942, they were more than doubled during the first half of 1943, reaching a high of 1,873 cadets under instruction during the month of June.¹⁹ By the end of February 1943 the IAF was finding it increasingly difficult to find civilians with three years of college engineering training to meet the quotas, and the educational qualification had to be reduced to two years of engineering "or its equivalent."²⁰ Subsequently this was modified so that especially well qualified crew chiefs with at least one year's experience on the line were acceptable. The practice of accepting 20 per cent of the top graduates of the enlisted men's basic mechanics course was continued. Especially selected officers were still trained in grade, although "ordinarily officers holding flying ratings or better qualified by reason of experience and knowledge of other duties"²¹ were not admitted.

The levelling-off of Air Corps expansion in 1943 affected the Maintenance Engineering Course in several fundamental ways. For one, it greatly reduced the quantity of training. A survey conducted by AC/AS, Training in February 1944 indicated that between 15 September 1941 and 25 February 1944, 5,542 aviation cadets had been graduated from the course. According to AC/AS, Personnel there was "no further requirement" for maintenance engineers. The 1,138 cadets then in training, it was decided

19. Monthly reports of Statistical Control.

20. R&R, Col. E. S. Wright, AFHQP, to AC/AS, 1-1, 30 Jan. 1943, in AC/AS, Training Files.

21. Memo for Lt. Col. Hutchins by Maj. R. H. Glissmeyer, 12 July 1943, in ibid.; memo for C/AS by Brig. Gen. R. W. Harper, 17 Feb. 1942, in MAG 353, Engineering Training.

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should be given additional training, if qualified for it, in one of two fields for which there was considerable demand for officers at the moment--aeronautical engineering and weight and balance control.²² Furthermore, no more applications were to be accepted for the Maintenance Engineering Course. No additional quotas were to be granted for enlisted graduates of the basic airplane mechanics course, and the Maintenance Engineering Course (Sp)²³ was to be discontinued. Even before this, however, the AAF had taken steps to reduce quotas for the course, so that in December 1943 only 1,126 cadets were in training. The survey of February 1944 led to an acceleration of the trend; in May 1944 but 322 cadets were taking the course. The number of officers being trained in grade,²⁴ however, remained fairly constant.

With civilians and enlisted men no longer an active source of students for maintenance engineering training, the AAF found a new group upon which to rely in filling its reduced quotas in this course. These were pilots recently returned to the United States from combat theaters. This was, of course, a reversal of the policy stated in the middle of the previous year that officers with flying ratings should not be given such training. There were reasons for this change. First, training of pilots had by this time reached such an accelerated pace and losses in combat were so far below expectations that a surplus of pilots was actually beginning to accumulate. Second, the employment of pilots,

22. Memo for Col. T. J. DuFose by Col. L. O. Ryan, 25 Feb. 1944, in AG/AS, Training files.

23. "Proposed Plan for Adjusting 1944 Production of Officers" circa Mar. 1944, in *ibid.*

24. Monthly reports of Statistical Control.

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it was felt, "will serve to give the Engineering Officer more prestige and thus result in closer supervision of operation. In other words, the Engineering Officer will [be able to] 'tell off' a pilot who abuses his equipment."²⁵

When the emphasis in maintenance engineering officer training was changed from quantity to quality, proposals were made that a period devoted to practical "on-the-job" training with tactical units be given following graduation from the course at Yale. Beginning in October 1943 graduates were sent to air force stations in the United States for one month of such training. Wherever possible, the station to which a man was detailed was of the same type as that to which he was later permanently assigned.²⁶ In March 1944 the Training Command recommended that the period for "on-the-job" training be extended to two months,²⁷ but approval for this was not granted by AG/AS Training.

Only one important modification was made to the content of the course during the levelling-off period. This was the introduction in June 1944 of instruction on the administrative problems of "Production Line Maintenance," a system which was coming into wide use in tactical and training units. This system was designed to obtain, among other things, maximum efficiency from the relatively inexperienced mechanics who now comprised the bulk ofAAF maintenance personnel by assigning

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25. Memo for Brig. Gen. R. W. Harper by Col. L. O. Ryan, 17 Feb. 1944; "Proposed Plan for Adjusting 1944 Production of Officers," circa Mar. 1944, in AG/AS, Training files.
 26. FSR, Brig. Gen. R. W. Harper to AFMFP, 11 Sep. 1943, in ibid.
 27. CG, AFTRC to AG/AS, Training, 22 Mar. 1944, in ibid.

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them to specialized tasks. Instructors and supervisory personnel of Yale course were sent to three Texas fields to study the operation of
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 the system in preparation.

Weight and Balance Control

As has been indicated, a ten-day course in weight and balance control for officers training in grade was started at Chavute in December 1942. At the same time six to ten days of instruction on the subject was introduced into the Maintenance Engineering Courses for aviation
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 cadets. The dissemination of such information was especially useful to the Air Transport Command, the Troop Carrier Command, and the various bombardment units, all of which were encountering weight and balance control problems in their routine operations. The Air Transport Command had been conducting classes for its officers at a number of airports throughout the country during the autumn of 1942; but complaints reached Headquarters, AAF that a wide variation existed in the information presented at these various centers.
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 Moreover, the Director of Individual Training felt that the need for such information was so widespread that it ought to be given to all cadets in training as
 31
 maintenance engineers.

During the period the courses were being set up, a qualified weight and balance control officer of the Air Transport Command and the chief

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28. Headquarters Progress Report, Hq., AFTRC, May 1944, in AFTHI files.
 29. In January 1943 both courses were transferred to Yale University.
 30. R&R, Col. S. R. Harris, Director of Flying Safety, to AFDM, 5 Nov. 1942, in AG/AS, Training files.
 31. R&R, Brig. Gen. L. S. Smith to AFDPB, 14 Nov. 1942, in ibid.

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weight and balance control engineer of the Boeing Aircraft Company were sent to Chanute for a period to give advice. In addition, one each of the following airplanes was made available to the school for use only³² in the course: B-17, B-24, B-25, B-26, C-53, and C-60.

The following outline of the officers course, as given in February 1944, gives some notion of the subject matter presented:³³

- | | | |
|------|---|-------------|
| I. | Introduction | 7 hours |
| II. | Engineering Problems of Weight and Balance,
Principles of airplane balance | 7 hours |
| III. | Weighing and Measuring | 7 hours |
| | Weighing and CG [center of gravity]
calculations | 2 hours |
| | Weighing a model airplane | 1-1/2 hours |
| | Use of handbook of weight
and balance data | 3-1/2 hours |
| IV. | Field Weighing and Checking of Basic
Airplanes | 7 hours |
| | Weighing nose wheel air-
planes | 3-1/2 hours |
| | Weighing tail wheel air-
planes | 3-1/2 hours |
| V. | Cargo Airplane Weight and Balance Records | 7 hours |
| | Basic records for cargo air-
planes | 3-1/2 hours |
| | Loading by graph, chart B | 3-1/2 hours |
| VI. | Weight and Balance for Medium Bombers,
Loading medium bombers | 7 hours |
| VII. | Weight and Balance for Heavy Bombers,
Loading and limit calculation for heavy
bombers | 7 hours |

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32. Col. L. S. Smith to CG, AFMTC, 3 Nov. 1942, in AAG 352.11, Technical Schools, Miscellaneous; CG, AFMTC to CG, 2d Dist., AFMTC, 13 Nov. 1942, in AG/AS, Training files.
33. TS, AFMTC, Yale University syllabus ME-B-117 officers, 25 Feb. 1944.

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- VIII. Weight and Balance Control of Class I Air-
planes, Loading Cargo Airplanes, Loading
and Lashing of Cargo 7 hours
- Weight and balance control of Class
I airplanes 1-1/2 hours
- Cargo airplane loading cal-
culations 2-1/2 hours
- Loading and lashing cargo 3 hours
- IX. Charts A, B and C, Form F and the Load Adjuster 7 hours
- Use of forms and the A-23 and A-29
Load Adjuster 3 hours
- Loading and use of the load
adjuster 4 hours
- X. Administrative Functions 7 hours
- AAF Regulation 55-3 and loading direc-
tive

When the course was begun, it was estimated that there were 50
officers in the AAF who had particular need of the training and that
all could be trained within three and a half months.³⁴ Soon it be-
came evident that the instruction was so valuable that large numbers
of AAF officers could profit from it. The ATC, for example, requested
training for 200 of its officers.³⁵ A survey conducted by the Air
Service Command disclosed that many of the officers in its depots and
supply divisions were in need of the training.³⁶ The Bombardment
Branch of CGAR maintained that no man ought to be assigned as an
engineering officer with a bombardment squadron unless he had suc-
cessfully passed the course.³⁷ Such testimony as this led Headquarters,

34. CG, AFHIC to CG, 2d Dist., AFHIC, 13 Nov. 1942, in AC/AS, Train-
ing files.

35. RAR, Maj. Gen. H. L. George to AC/AS, Training, 26 Apr. 1943, in
ibid.

36. CG, AFHIC to CG, AAF, 11 June 1943, in ibid.

37. RAR, Col. W. E. Gross to AC/AS, Training, 14 Sep. 1943, in ibid.

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AAF to put the officers course on a continuing basis, with classes of 25 officers entering each Monday.

Because they dealt with a new field, considerable difficulty was encountered in administering the weight and balance control courses, especially that for officers. In April 1943 the Operations Division of the ATC protested to AG/AS, Training that the 150 officer graduates it had been furnished up to that time had had "little or no practical experience in weighing aircraft or in the proper method of loading." It suggested that 30 days of "practical" training be added to the course. AG/AS, Training retorted that the school at Yale, where the course was now being given, did not have the facilities to give such "practical" training. Inasmuch as the ATC did a great deal of loading in its own operations, the officers could easily acquire this type of experience on the job.³⁸

A complaint unusual in technical training arose from the fact that the instructors of the course were noncommissioned officers. "It was noted," an officer of the Bombardment Branch of CGAR, who visited Yale reported, "that many of the officers attending the school felt it somewhat beneath their dignity to observe ordinary military courtesy. There were also cases of resentment where an officer of field grade would take class room orders from a noncommissioned officer."³⁹

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38. R&R, Maj. Gen. H. L. George to AG/AS, Training, 26 Apr. 1943; R&R, No. 2, Brig. Gen. R. W. Harper to ATC Operations Division, 4 May 1943, in ibid.
 39. R&R, Col. W. E. Gross to AG/AS, Training, 14 Sep. 1943, in ibid.

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Another problem arose from the type of officers sent to attend the course. A representative of the Air Inspector's office who investigated the course in the autumn of 1943 made three recommendations in this respect. First, a more careful selection of students should be made by the commands and air forces granted quotas for students. Too many officers were being sent simply because their homes were near New Haven and they desired temporary duty at Yale. Second, only men who were graduates of the maintenance engineering course should be detailed to the weight and balance control course. Because the training was so much in demand, all graduates of the course should be assigned weight and balance control as their primary duty. The third recommendation applied to both the officers course and the phase given aviation cadets as part of the maintenance engineering courses. This was that all training in weight and balance control should be lengthened to 15 days, so that more time might be devoted to a review of arithmetic and other mathematics. The inspector had noticed, he said, that while students who were recent college graduates mastered the mathematical aspects of the course readily enough, older officers and enlisted men were experiencing a great deal of difficulty.

That these suggestions were well taken, on the whole, was acknowledged by Col. Raymond J. Reeves, commanding officer of the school at Yale. He agreed that students for the officers course ought to be

40. Capt. Andrew F. Brooks, Field Air Inspector, Morris Field, Charlotte, N. C., to The Air Inspector, 17 Nov. 1943, in AC/13, Training files.

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chosen more carefully and that all graduates ought to be assigned weight and balance control as their primary duty. He did not feel, however, that it was essential that students be graduates of the maintenance engineering course; two years of high school algebra, one year of elementary physics, and a fundamental knowledge of airplane mechanics were sufficient. However, as a result of discussion at a recent conference of the Working Committee of the Aeronautical Board in Washington, the authorities at his school were drawing up plans to incorporate more loading problems into the course. This might necessitate the extension of the course by two days.⁴¹

Upon the basis of this discussion, Brig. Gen. R. W. Harper, AG/AS Training, decided that the length of the course was to remain 10 days, but that the training hereafter would be limited to three types of men presumably most likely to benefit from it: (1) commissioned officers holding a rating of pilot; (2) qualified aircraft engineering officers; and (3) aviation cadets in training to become engineering officers.⁴² The course continued unchanged in any fundamental respect during the first half of 1944, Headquarters, AAF granting quotas for classes starting every Thursday.

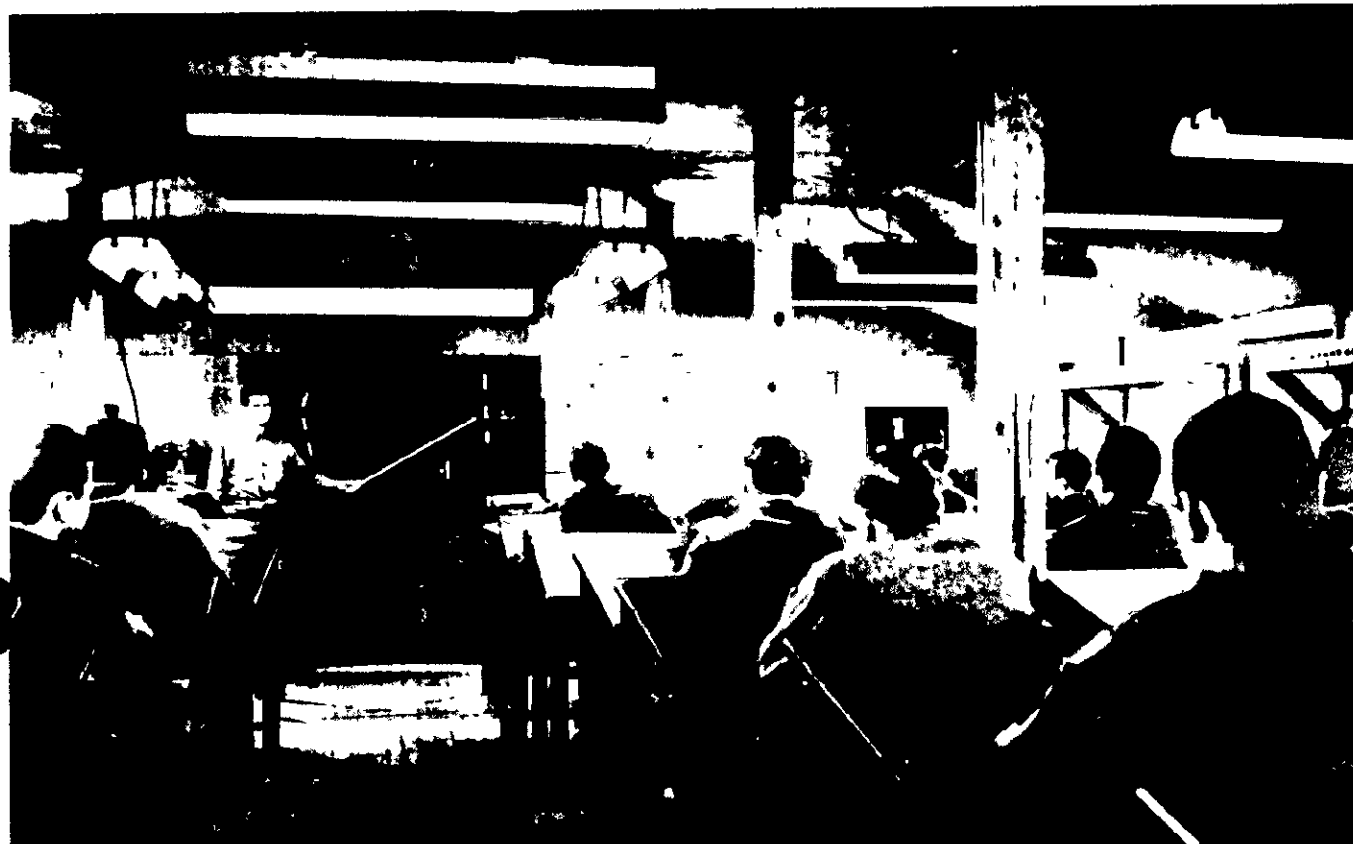
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41. 14th ind., Col. Raymond J. Reeves to CG, AFMTC, 4 Feb. 1944, in AG/AS, Training files.
42. 7th ind., Brig. Gen. R. W. Harper to CG, AFMTC, 29 Feb. 1944, in AG/AS, Training files.

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● USING A SYNTHETIC TRAINING DEVICE TO EXPLAIN THE PRINCIPLES OF WEIGHT AND BALANCE CONTROL

AIRCRAFT MAINTENANCE COURSE BEING TAUGHT BY MEANS OF THE NOW DISCARDED ALL-LECTURE METHOD.



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Chapter VII
MOBILE TRAINING UNITS

World War II produced only one general method of training airplane mechanics which had not been used in World War I and the ensuing interval of peace. This was the mobile training unit. Like many another highly successful invention, it was fathered by necessity. During the spring of 1942 the Fourth Air Force, which used the P-38 airplane on a large scale, complained to the Lockheed Vega Aircraft Corporation, manufacturers of the P-38 airframe, that it was having a good deal of trouble operating and maintaining that type of aircraft. The Lockheed people admitted that some of the difficulties grew out of mechanical faults, but contended that the bulk of the trouble was caused by lack of knowledge of proper maintenance procedure in the air forces.

They expounded this point of view at a breakfast conference in Los Angeles on 17 June 1942 which was attended by Maj. Gen. Walter R. Weaver, Commanding General of the Technical Training Command, Maj. Gen. John F. Curry, Commanding General of the Fourth District of the TTC, and representatives of the Allison Company, makers of the P-38 engine. Out of these discussions was evolved a plan whereby a small group of technical instructors would tour tactical units of the Fourth Air Force to disseminate knowledge of correct maintenance methods. General Weaver delegated responsibility for development of the project to General Curry. General Curry in turn named Maj. Thomas E. O'Connell, Assistant G-3, Headquarters, Fourth District, TTC, as Project

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Officer of Mobile Training Units, with Maj. Franklin Rose, District Supervisor of the Los Angeles Area of the Fourth District, as his assistant.

The first step taken by Majors O'Connell and Rose was to interview the Commanding General and group commanders of the Fourth Air Force to ascertain precisely what maintenance difficulties were being encountered. Discussions with representatives of Lockheed and Allison followed. On the basis of these talks an outline of a course of instruction was drawn up. It was decided further that each mobile training unit would carry with it appropriate charts and diagrams, textbooks, technical orders, film strips, and a few sectionalized parts. The staff was to be composed of two Allison and two Lockheed civilian instructors and an enlisted crew chief.

When the first mobile training unit began its tour of Fourth Air Force bases on 2 July, it ran into a difficulty that had not been anticipated. It was equipped with only the barest minimum of instructional equipment on the supposition that at each tactical unit a plane could be borrowed to demonstrate the points covered in the course of instruction. However, planes were not available, for the training program in use at the tactical units counted on the use of every plane 24 hours a day. Although the reception given to the first mobile unit by group commanders was universally favorable even with the little equipment it carried, the officers in charge of the project grew anxious to increase the effectiveness of the instruction through the use of a variety of operating mock-ups and cutaways. As General Curry has put it,

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"Advanced maintenance procedure could not be taught by dry lectures.

The student must see and feel what he is working on."

The use of parts of Class 26 airplanes for conversion into mock-ups and cutaways was out of the question, for the Technical Training Command had not been able to obtain enough Class 26 planes even for its own school purposes. Therefore, on 21 July Headquarters of the Fourth District, TTC, recommended that an open purchase money order be assigned the project for the purchase of instructional equipment and facilities to transport the units more readily. Ultimately a sum of \$165,000 was allotted the Fourth District. The money was spent on practical instructional equipment and 11 Fruehauf trucks and trailers. The Fourth District did not wait for these funds to expand its mobile unit program, however. During the summer of 1942 inadequately equipped units for B-25 and B-17 airplanes were made available to the second and third air forces.¹

The mobile training unit was well under way before any recognition of it was taken at Headquarters, AAF. On 1 July 1942--one day before the first unit actually went into the field--the Technical Training Command requested Headquarters, AAF officially to authorize its conduct of such a program. At the same time it asked that transport planes be assigned it to carry instructors and their equipment from

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1. This account of the origin of mobile training units is based largely on "History of the Development of Mobile Training Units in the Fourth District AAF/TTC," undated, included in a booklet on the P-38 MTU in the files of AC/AS, Training; and G. E. Nistal, "Mobile Training Units," in Air Tech, Apr. 1944.

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post to post. Headquarters, AAF promptly indicated its general approval of the project, but pointed out that there were not enough planes available to the AAF to grant the second request.² Meanwhile the Directorate of Individual Training conducted an informal investigation of its own as to the extent of the need for such a type of training. By 21 July the Directorates of Bombardment, Air Defense, and Ground-Air Support all had indicated that at least a dozen such units would be highly useful in the air forces and commands whose activities they supervised. A number felt that units equipped to teach armament, radio, bombsight,³ and turret as well as general maintenance were desirable.

Encouraged by this response, on 17 August 1942 Headquarters, AAF formally charged the Technical Training Command with the administrative⁴ supervision of all mobile training units in the United States. The following day the Technical Training Command notified the commanding generals of each of the four districts of the TTC that they should establish a unit for "each type of plane assigned to an appreciable⁵ number of operating units" in their district.

Under this plan, between August and November 1942 the four districts of the TTC equipped 24 units, representing 19 different models of planes, and put them in operation in the continental United States. Funds totalling \$360,000 were made available by Headquarters, AAF for

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2. CG, AFTTC to CG AAF, 1 July 1942, in AG/AS, Training files.
 3. Memo for Col. L. S. Smith by Capt. H. B. Hinson, 21 July 1942, in *ibid.*
 4. CG AAF to all AF's and CO's, all continental U. S. stations, 17 Aug. 1942, in *ibid.*
 5. CG AFTTC to CG's, all Dists., AFTTC, 18 Aug. 1942, in AAG 353.9, G Factory Training.

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this purpose. The number and type of these units were as follows:

- 6 Heavy Bombardment units to tour the Second Air Force
- 4 Medium Bombardment units to tour the Third Air Force
- 1 Dive Bombardment unit to tour the Third Air Force
- 1 Light Bombardment unit to tour the Third Air Force
- 2 Fighter (P-47) units to tour the Eastern Defense Command
- 1 Fighter (P-40F) unit to tour the Eastern Defense Command
- 2 Fighter (P-38) units to tour the Western Defense Command
- 1 Fighter (P-39) unit to tour the Western Defense Command
- 1 Fighter (P-40) unit to tour the Third Air Force
- 1 Fighter (P-39) unit to tour the Third Air Force
- 2 Transport units to tour the Troop Carrier Command
- 1 Tow Target unit to tour Tow Target stations
- 1 Observation unit to tour Observation squadrons

In equipping and operating the new units, the various districts of the Technical Training Command drew upon the experience of the Fourth District of the TTC, modifying the pattern it had developed, whenever it seemed advisable. As a rule, the staff of a unit consisted of the following:

- 1 commissioned officer in charge
- 1 enlisted crew chief instructor
- 1 civilian instructor representing the airframe company
- 1 civilian instructor representing the engine company
- 1 enlisted instrument instructor
- 1 enlisted hydraulic system instructor
- 1 enlisted supercharger instructor
- 1 enlisted electrical system instructor
- 2 or more airplane mechanic instructors who also could act as chauffeurs

All these men were especially trained to cope with the particular teaching conditions they were likely to encounter on their tours. Periodically they were sent back to factory schools conducted by the manufacturers of their specialty to refresh their knowledge and to acquaint

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6. Col. L. S. Smith to CG, AETTC, 7 Sep. 1942; 1st ind., CG, AETTC to AFRT, 12 Dec. 1942, in AC/AS, Training files.

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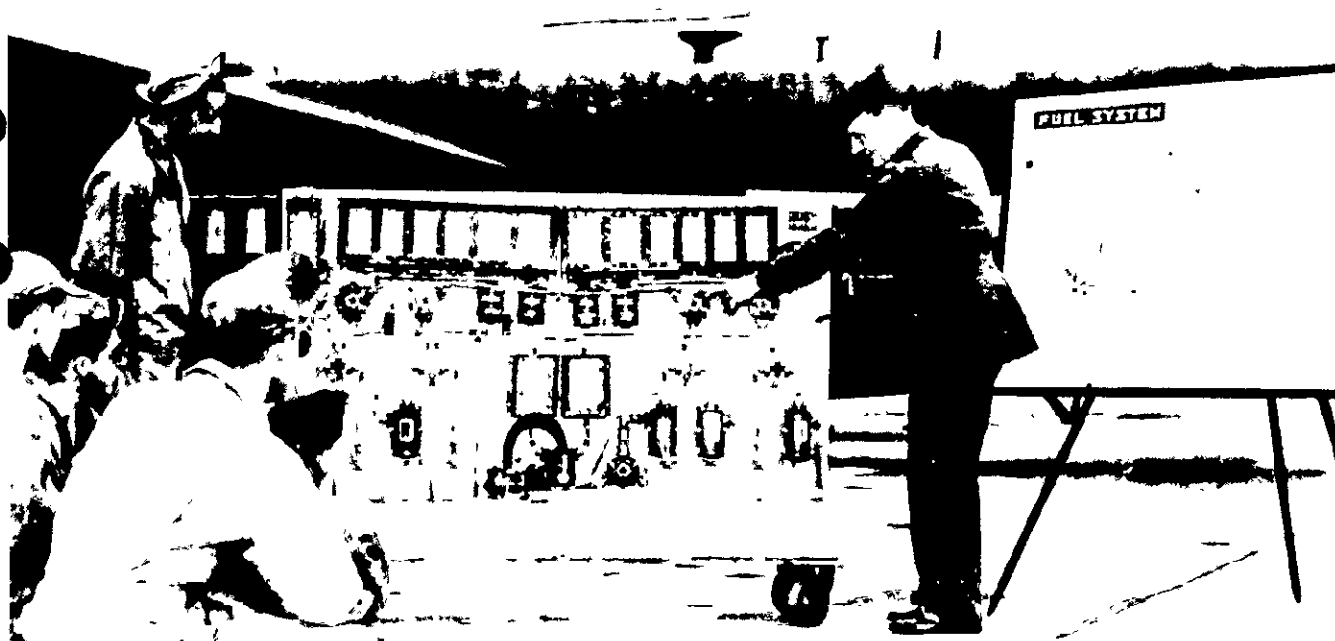
themselves with the latest developments in their field.

A typical unit consisted of a big, van-like Fruehauf trailer drawn by an Autocar tractor. In the trailer there were mock-ups, cutaways, and other devices to demonstrate the operation of all the mechanism of a particular type of combat plane. In a B-17 unit, for example, was a complete cockpit assembly, with controls and instruments that could actually be operated and observed in any operation. There was a cutaway B-17 engine, revealing every part to close scrutiny. Other devices carried included: a cross-sectioned propeller; mock-up panels disclosing the operation of the hydraulic and cooling systems; a panel showing the fire control apparatus, designed to prevent the spread of fire set by enemy shells; yet another panel illustrating the entire wiring system of the plane so that a mechanic could follow every tiny wire; and a cutaway revealing the construction of the aircraft supercharger and other engine accessories. The latest B-17 training films were carried in the trailer along with a projector with which to exhibit them.

One reason for the effectiveness of the mobile unit program was the fact that a good deal of the initiative in the drawing up of the itineraries came from the air bases. It is true that the district headquarters of the TTC--especially that of the Fourth District--were

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7. "Development and Use of Mobile Training Units," undated and unsigned paper, in ibid.
 8. This description of equipment is paraphrased from S/Sgt. Jack Angell, "Mechanical Training by Trailers," in Air Force, Sep. 1943, 26.

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WITH THE AID OF A PORTABLE MOCKUP, AN MTU INSTRUCTOR EXPLAINS LATEST TYPE FUEL SYSTEM



THE INSTRUCTIONAL & ADMINISTRATIVE STAFF OF A TYPICAL MTU, LINED UP BESIDE ITS EQUIPMENT

REMOVING A B-24 ENGINE FROM AN MTU VAN PREPARATORY TO GIVING INSTRUCTION TO THE GROUND & AIR CREWS AT AN AIRFIELD IN THE CONTINENTAL U.S.



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tireless in their efforts to "sell" the program to the various air forces and their station commanders. But the merest rumor of the availability of such units usually aroused enthusiasm among station commanders. The customary practice was for a station desiring the visit of a unit to submit a request to the commanding general of the air force or command to which it was assigned. The commanding general consolidated these requests, and from his knowledge of the number of units available prepared a tentative itinerary which he then sent to the nearest headquarters of the Technical Training Command. Upon the basis of this the district commanders of the TTC ordered the movement of their units.⁹ The normal period for the visit of a unit to a field was 10 to 15 days, never longer than a month.

A writer for the Technical Training Command has given a vivid description of what occurred on a typical visit to an air station by a mobile unit. "Let's follow a B-17 unit as the heavy semi-trailer pulls to a stop before station headquarters," he wrote. "The young lieutenant in charge strides smartly into the Adjutant's office, reports, and arranges accommodations for messing and housing his enlisted crew. He determines where to spot the trailer and coordinates his daily schedule. He arranges for station passes for the civilian instructors representing the airframe and engine factories who will arrive by private car.

"With these preliminaries attended to, he directs the mobile training unit to the designated spot, in this case a roomy corner of a quiet hangar. While the men unload the equipment, the lieutenant consults the engineering officers of the units attached to the base to determine

9. "Development and Use of Mobile Training Units," undated and unsigned paper, in AC/AS, Training files.

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what particular maintenance problems have been encountered and need to be emphasized. He also checks on the probable size of the groups to be accommodated and the schedule to be followed.

"He finds a squadron has been having trouble with hydraulic systems and has two airplanes grounded as a result of valve trouble and would he mind if the crew chiefs concerned each brought a mechanic over after supper so they can work over the airplanes again and try to get them ready for an early morning flight! So the lieutenant returns to the hangar. He checks the layout of the various mock-ups and has the instructor crew test each one for operating condition. . . .

"The lieutenant then advises his men where to report for supper and for their bunks. He asks the crew chief and the hydraulics specialist to return to the hangar for about an hour after supper and excuses the propeller, electrical, instrument, and supercharger specialists.

"Early in the evening a small group gathers about the main landing gear mock-up. The crew chief and the hydraulics specialist demonstrate the operation in detail. Hydraulic flow is illustrated by means of wall charts. Technical orders are withdrawn from the trailer for reference. The squadron crew chiefs and their mechanics scratch their heads and carefully examine the cutaway valves and the technical orders. The disassembly, cleaning and reassembly of the main landing gear control valve is demonstrated for them. The men practise it a time or two and return to their airplanes, while the mobile training unit crew chief and hydraulics specialist get things ready for the morning class. Just as they are about to leave, one of the mechanics of the grounded planes dashes back to announce that they have found the

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trouble,- that one of the valves had been improperly assembled after a recent cleaning and now they could get the fortresses back in the air. The mechanic borrows the cutaway valve to use as a check pattern and arranges to return it the next morning.

"The following day the instruction began in earnest. Mechanics clustered around the various mock-ups and display panels, each after his own specialty. The instructor crew pointed, operated, and explained, while their audience refreshed in their minds the things learned in their technical schools and asked questions as to the troubles they had found in line maintenance. The engineering officers practically monopolized the time of the civilian representatives, really going into the ways and wherefores of the B-17 and its engines.

"One squadron engineer cornered the lieutenant in charge of the unit and asked if he could borrow the instrument specialist to look over an airspeed indicator. The lieutenant firmly refused, explaining that the mission of the unit was to instruct squadron mechanics how to do their work and not to act as a mobile repair shop. . . .

"After the unit had been on the road about three months, it returned to the factory where the mock-ups were brought up to date by factory engineers and the instructors taught the latest service information. The unit, thus refreshed, was soon ready for the road again."¹⁰

This is a picture of a mobile training unit operating under ideal conditions. However, one A-20 unit, visiting Will Rogers, Mitchel, and

10. "Development and Use of Mobile Training Units."

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Langley fields in November and December 1942, found interest in the instruction it offered very meager. At Will Rogers only a threat of restrictions induced the enlisted personnel to visit the unit during the last days of its stay, and when the men came they gave little evidence of a desire for more knowledge. Only a few officers dropped by, and from their conversation, gave the crew of the unit the impression that as long as their planes flew they were content. At Mitchel and Langley calisthenics and routine field operations were given precedence over the unit's classes. Lt. L. H. Johnson, in charge of the unit, darkly reported the condition of planes at both fields to be "very poor" and their mechanics' need for specialized instruction "very great."¹¹

Such comments are notable because they were made shortly after the inception of the program. Indeed, after the project had gotten under way, letters of commendation began pouring into headquarters of the higher echelons in volume and were written with enthusiasm rare in Army history. Maj. Gen. Barney M. Giles, Commanding General of the Fourth Air Force, wrote of the "highly effective" results obtained in his command. The "thoroughly trained and proficient" instructors accompanying the units had solved many of the problems that had arisen in conducting OTU and RTU projects with comparatively inexperienced personnel. Pilots¹² had benefitted from the instruction as much as the maintenance men. Brig. Gen. E. L. Eubank, Director of Bombardment, declared that the Technical Training Command should be commended on this important phase

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11. Lt. L. H. Johnson, in charge of A-20 MTU, Will Rogers Field, Okla., to CG, 1st Dist., AFMTC, 11 and 21 Dec. 1942, in AG/AS, Training files.
 12. Maj. Gen. Barney M. Giles, CG, 4th AF to CG AAF, 29 Jan. 1943, in ibid.

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of training."¹³ The commanding officer of a typical base, that at Columbia, S. C., wrote warmly to express his thanks "for your energy, efforts and accomplishments" during the recent visit of a B-25 unit.¹⁴

Another characteristic experience was reported by Lt. Howard G. Mealey, Jr. of the 481st Bombardment Squadron, Avon Park, Fla. Lt. Mealey gave members of his flight the choice of attending the lectures and demonstrations of a visiting unit any one of three nights; several crews enjoyed the instruction so much that they attended all three nights. "With the exception of actual experience in the air," he declared, "it gives new crews a better knowledge of the B-26 airplane than any other type of instruction that I have encountered." The lectures were "excellent"; the cutaways and mock-ups "even better." He thought even more attention might profitably be given to the latter. The use of hypothetical "crisis" to demonstrate what procedures should be followed "helped immeasurably."¹⁵

Still more striking testimony to the value of the mobile training unit was offered by two other branches of the armed service, the Navy and the Marine Corps. In November 1943 the Navy Bureau of Aeronautics asked the AAF to sell it a B-31 unit. The request was granted, the AAF delivering the unit and giving Navy personnel instruction in its use at the naval air station at Boca Chica, Fla., late the next

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- 13. 1st Wrapper Ind., Brig. Gen. E. L. Eubank to AFRAS, 23 Jan. 1943, in ibid.
 - 14. Maj. Robert L. Webb, Adjutant, Columbia AAB, to CO, 1st MTU, 3d AF, 3 Dec. 1942, in ibid.
 - 15. Lt. Howard G. Mealey, Jr., 481st Bombardment Sq., Avon Park, Fla., to Lt. W. A. Compton, CO, MTU, 19 Feb. 1943, in ibid.

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16 month. Use of a B-25 unit was furnished the Marine Corps' air sta-
 17 tion at Cherry Point, N. C., in February 1944.

Within the AAF itself increasing use of the units was made as time went on. By the early spring of 1943, when the Air Service Command stations were added to the itinerary, posts of every command and air force in the continental United States were receiving regular visits from units operated by the Technical Training Command. Installations as widely divergent in character as airplane mechanics schools, antisubmarine bases, advanced flying schools, transition training
 18 schools, and troop carrier centers were included. By June ferrying group, base squadron, and even Russian mechanics were being taught
 19 P-39 maintenance at Ladd Field, Fairbanks, Alaska.

Use of mobile units was extended beyond the continental United States by the Air Transport Command, which in April 1943 obtained permission from Headquarters, AAF to assign 12 of them to its wing commanders in overseas theaters. These units were built, equipped, and manned by personnel of the Technical Training Command; once overseas, their administration and assignment was charged to the ATC. Many of these units were constructed so as to be moved by plane rather than by truck and trailer, a concession to the lack of highway facilities

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16. Lt. Comdr. E. M. Howell, Bureau of Aeronautics, Navy Dept., to CG AAF, 3 Nov. 1943, in ibid.
 17. Brig. Gen. R. W. Harper to CG, AFTRC, 28 Jan. 1944, in ibid.
 18. CG, 3d Dist., AFTRC, to CG, AFTRC, 1 Feb. and 1 Mar. 1943, in ibid.
 19. Lt. William F. Love, Liaison Officer, P-39 MTU #9, Ladd Field, Fairbanks, Alaska, to CG, 4th Dist., AFTRC, 23 June 1943, in ibid.

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in many remote theaters. This development appealed strongly to AG/AS, Training because it was felt inadvisable to return personnel from distant stations to attend technical schools. Through the use of the units,
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the schools were brought to the men.

By mid-September 1943, 53 units had been authorized, 37 of them for the United States, 15 for overseas. Types and assignment were
21
as follows:

<u>Type</u>	<u>Training Command</u> (for continental U. S.)	<u>Air Transport Command</u> (for overseas)
B-17	6	1
B-24	9	1
B-25	3	1
B-26	3	1
A-20	1	1
A-24, 25, 36, Dive Bomber	1	-
P-38	2	1
P-39	2	1
P-40	2	1
P-47	2	1
C-47	2	1
C-46	-	2
C-54	1	1
C-60	1	1
B-34	2	1
Totals	37	15

In the autumn of 1943, following the creation of the Training Command, control of all mobile training units was concentrated in the hands of the Western Technical Training Command, successor to the Fourth District, TTC. This step was taken to avoid duplication of effort in administering the program. The W TTC was charged with the

20. Col. L. G. Fritz, AG/S, Operations, ATC, to CG, AFTEC, 24 Mar. 1943; 2d ind., Brig. Gen. R. W. Harper to CG, AFTEC, 15 Apr. 1943, in ibid.

21. Memo for AG/AS, Training by R. H. G. [Capt. Robert H. Glissneyer], 16 Sep. 1943, in AG/AS, Training files.

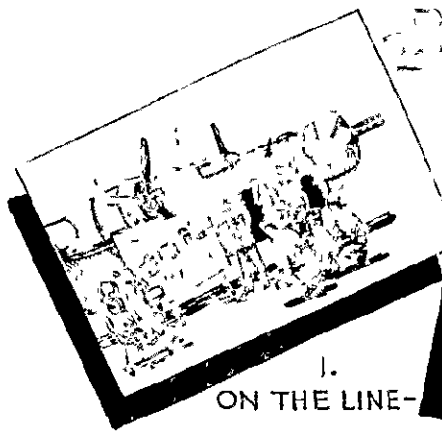
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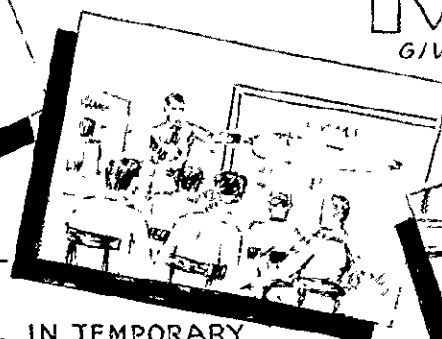
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MTU

MOBILE TRAINING UNIT
GIVES INSTRUCTION —



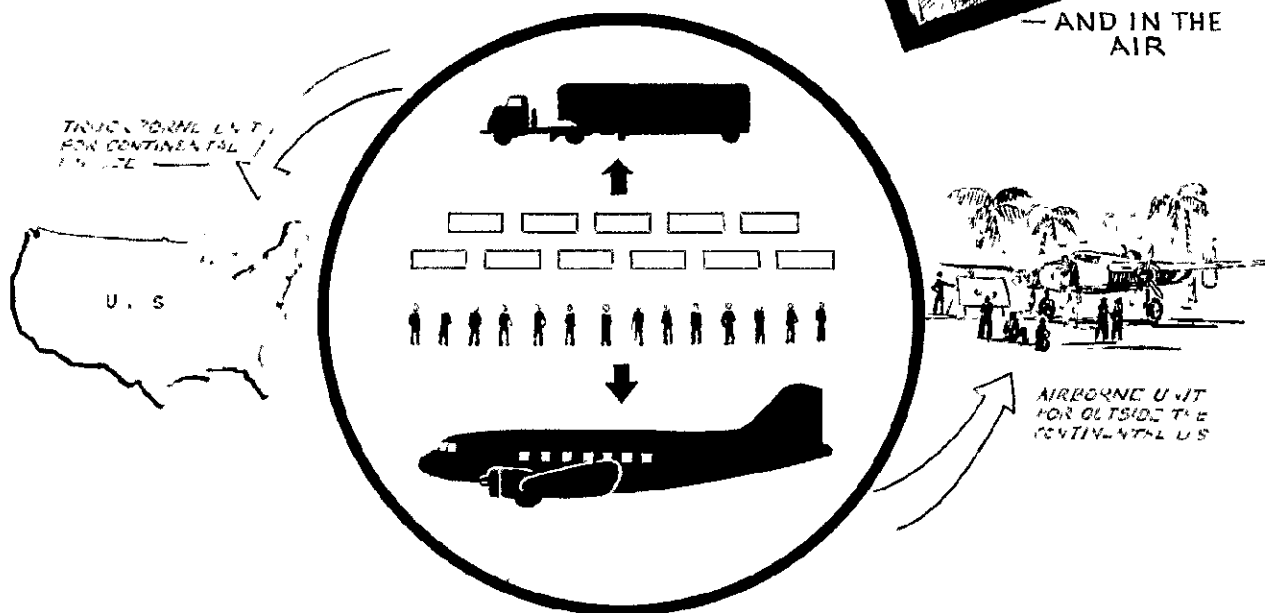
1. ON THE LINE—



2. IN TEMPORARY CLASSROOMS —

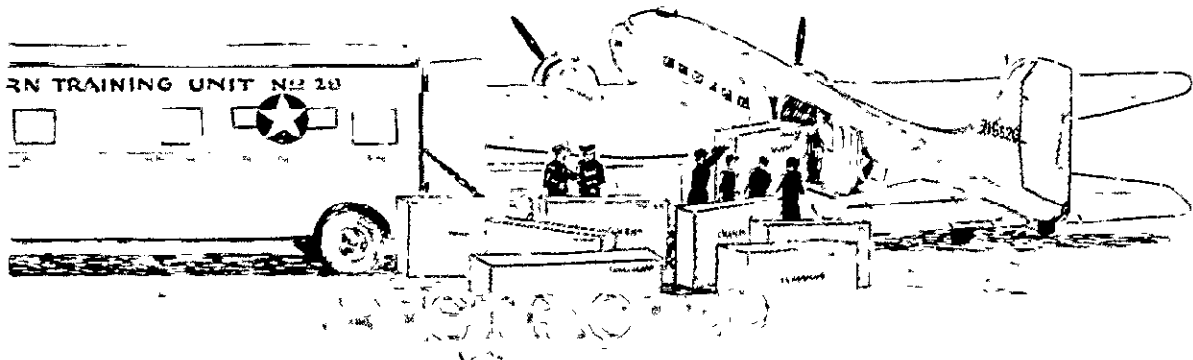


3. — AND IN THE AIR



Instructional Equipment in these units include.
HEAVY BOMBERS - MEDIUM BOMBERS - FIGHTERS - CARGO
AND SPECIAL UNITS

(UNIT IN CIRCLE IS THE AIRBORNE UNIT IN CIRCLE SHOWN IN CIRCLE)



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responsibility of building, equipping, furnishing trained personnel, and arranging for the itineraries of all units in the United States and overseas. In the case of overseas units, however, the arrangement of itineraries was merely nominal, the actual scheduling of unit movements within the theater being taken care of by the headquarters of the overseas air force.

The WTTC promoted the use of mobile training units aggressively. Characteristic of its efforts along this line was an elaborate illustrated brochure which was circulated in the spring of 1944. It described the types of units available and their methods of operation. Also the brochure advised station commanders ^{in the United States} to "phone, telegraph or write your immediate headquarters" stating the type of unit desired, the length of the instruction period required, and the urgency of the need. These headquarters in turn would forward them to the WTTC. In making assignments, the WTTC stated, the following factors would be taken into consideration:

- . . . every effort is made to eliminate excessive travel, and also to visit AAB needing similar MTU training. Should your base require a special priority, due to an influx of inexperienced personnel, new planes, or a last minute check before departing to a combat zone, it is advised that such information be contained in your request. If this need for an emergency training period is concurred in by your immediate Hq., then the verified request when received by the Western Technical Training Command will get immediate action.

If the station commander were outside the United States, the brochure continued, he should forward the necessary information to his theater

22. Interview with Capt. H. C. Freeman, AC/AS, Training, 14 Aug. 1944.

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commander. The latter might then forward the request, together with necessary travel priority and clearance, to Headquarters, AAF. The request would in turn be forwarded to the WFTC.

In administering the mobile training unit program, it was the stated policy of the WFTC wherever possible, to return instructors to factories for refresher courses after they had been on the road for six months. This rule was honored more in the breach than in the observance, particularly in the case of units overseas. The shortage of skilled instructors and the difficulties involved in transporting men and equipment across the oceans discouraged strict adherence to the policy. However, whenever important new devices were developed, men who had been trained in their operation by the factories were sent out to supplement instructional staffs in the field.

Under the direction of the WFTC, during the first three months of 1944, 30 mobile training units, staffed by 315 enlisted instructors and 30 liaison officers gave instruction to 37,313 officers, enlisted men, and civilians at bases in the Zone of the Interior. During the same period, 27 MTU's were operating outside the continental United States. Most of the units overseas were on duty with the Eighth Air Force or touring the China-Burma-India Theater for the Air Transport Command. Units also were committed for the first overseas combat air force to seek the use of them.

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23. Brochure, "Mobile Training Units," AFWFTC, in AFIFI files.
 24. Interview with Capt. Freeman.
 25. Brochure, "Mobile Training Units."
 26. Brig. Gen. Julian E. Haddon, Hq., C-B-I AF Training Command (Prov.), to CG, AAF, I-3 Sector, C-B-I Theater, 7 Dec. 1943, in AC/AS, Training files.

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By January 1944 a number of officials at Headquarters, AAF had come to believe that, because of the difficulties being encountered in procuring equipment for the construction of units and properly trained factory representatives and enlisted instructors to man them, the expansion of the mobile training unit program ought to be curtailed for the time being.²⁷ This feeling was prevented from being translated into an established policy by a deluge of requests for new units from commanders in overseas theaters that began pouring into Headquarters, AAF.

At this time thousands of men who had been rapidly trained as mechanics in the AAF's technical schools during the great expansion period but who had not yet acquired much practical experience were beginning to reach the overseas units. The MTU's appealed to the commanders as a way of repairing the inadequacies of the "green-horn" mechanics' knowledge. But the commanders were concerned not only about their ground crew men. With the acceleration of the pace of aircrew training, many pilots, bombardiers, aerial engineers, radio operators, and gunners had been graduated who lacked an adequate appreciation of the problems of airplane maintenance. The MTU's might help these men, too, so the commanders thought.

As a consequence, many new units were built and many which had been touring the continental United States were converted for overseas service. By June 1944 a total of 100 units had been authorized. Of these, 37 were touring the United States or were under construction. The 63 overseas

27. 1st ind., Brig. Gen. R. W. Harper to CG, AFTRC, 22 Jan. 1944, in ibid.

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units were distributed as follows:

8th and 9th Air Forces	35
15th Air Force	7
Pacific and China-Burma-India	15
Air Transport Command	6

There appeared every likelihood that the number of units and the scope of their activities would increase as the war continued and new types of airplanes and new devices were developed.

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28. Interview with Capt. Freeman.

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Chapter VIII

ADMINISTRATIVE PROBLEMS

In carrying out its airplane mechanics training program between June 1939 and June 1944, the AAF was faced with four major problems: (1) the procurement and administration of suitable school facilities; (2) the procurement, training, and employment of capable instructors; (3) the creation of suitable syllabi and the development of satisfactory teaching methods; and (4) the provision of adequate teaching equipment.

As has been brought out in the preceding chapters, the AAF used six types of training in this program: (1) AAF technical schools, (2) civilian mechanics schools, (3) factory schools, (4) commercial airline depots and modification centers, (5) mobile training units, and (6) on-the-job training in tactical and operational training units. Frequently the two latter types were combined.

The most successful type of training appears, beyond question, to have been that done by mobile training units. Conceived by necessity, the MTU program was born so quietly that the first unit was on the road before Headquarters, AAF became aware of its existence. Through the promotional enterprise of the Western Technical Training Command and the merits of the units themselves, their use spread rapidly through every command in the continental United States and through most of the air forces abroad. The number of letters which they have

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evoked from commanding officers is without precedent in recent AAF training history. They were particularly useful in "rounding out" the knowledge of thousands of recruits who were given rapid training in AAF schools at the height of the expansion period. Yet the MTU was at best only a valuable accessory to other forms of maintenance training, a supplement to training in regular schools or in operational units.¹

Another highly satisfactory form of training was that accomplished in operational training units. In the OTU it was possible for a command to teach raw recruits the maintenance procedures fundamental to its own type of operations. To work successfully, additional advanced training had to be available at technical or factory schools for men who appeared to be potential crew and line chiefs. Moreover, best results could be obtained from an OTU program only when the command offering it had reached the approximate limit of its expansion---when it possessed a large, solid corps of experienced mechanics, and new personnel² were added only to serve as replacements and reserves.

The AAF found technical schools useful for training under three conditions: in peacetime, to give a thorough grounding in maintenance fundamentals to men who intended to make a career of the Air Corps; during the rapid expansion period of wartime, to acquaint large numbers of recruits with the essentials of aircraft maintenance; and in both peacetime and wartime, to give advanced and specialized instruc-

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1. For a fuller discussion of mobile training units, see chap. VII.
 2. A study of operational training units will be made in the near future by the AAF Historical Division.

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tion to men who already had experience in Air Corps mechanical work. A school possessed one great advantage over operational units—it could teach men more quickly and more thoroughly, explaining the "why" as well as the "how" of maintenance practices. On the other hand, it tends to become somewhat removed from the reality of the flying line, stressing the theoretical rather than the practical.

Because the AAF could exert close administrative supervision over its own technical schools, it preferred them to other types of schools. In them the manner in which the syllabi were presented and the work of the teachers could be most easily controlled. Normally, too, it was easier to give military and physical instruction and to supervise the life of the students outside the classroom at such a school.³

During the period of rapid Air Corps expansion, extensive use was made of civilian mechanics schools. Although only the best CAA-approved schools were selected, their performance was not very satisfactory. A board of officers meeting in August 1942 declared that although the number of students trained at these schools was less than 20 per cent of all mechanics training, they evoked more complaints than all other mechanics schools combined. The instruction they offered tended to be even more theoretical than that in the AAF's schools; their teaching equipment was more inadequate, and the living conditions of the students at them remained a constant problem. Naturally enough, as soon as the limit of Air Corps expansion was reached, the services of these

3. "Proceedings, Board of Officers, Knollwood Field, 17 to 28 August 1942," in AFHFI files.

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schools were dropped.

More satisfactory in the long run were the factory schools. The AAF first made use of schools of this type in April 1942. The program was inaugurated so hastily and without adequate preparation that one general declared four months later that it was a "complete washout." Once syllabi had been carefully drawn up, adequate classroom and housing facilities obtained, and a steady flow of well-selected students provided, the factory schools became one of the most satisfactory forms of AAF training. The hope that a completely practical type of instruction might be achieved by having the students learn by working on the assembly line was never realized; the manufacturers protested that such a practice would interfere with production. However, the physical proximity of the factory school classrooms to the plants, the familiarity of the civilian instructors with production methods, and the comparative ease with which the latest types of equipment could be obtained made this kind of school extremely valuable to the AAF, especially for advanced and specialized training.

Least satisfactory of all types of schools used were those conducted at airline depots and modification centers. Neither the AAF nor the airlines were anxious to conduct schools of this type in the first place: the AAF felt that the number of men who could be accommodated at them was too small to make the plan economically sound; the airlines were afraid that the instruction would interfere with their

4. Ibid. Also, see chapter III.

5. See chapter V.

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routine operations. But an overzealous trade association secretary promoted the plan vigorously at the time the Air Corps was expanding. The AAF, anxious not to offend the industry, and the airlines, fearful of being considered unpatriotic, acceded. After a few months of trial the mutual dissatisfaction with the project became apparent, and it was discontinued.

In meeting its second large administrative problem, the procurement and employment of capable instructors, the AAF was fortunate in that it had developed, over a period of many years, a corps of enlisted and civilian instructors at Chanute Field. As the school at Chanute was expanded, and one after another gigantic AAF technical school was opened, this corps was spread ever more thinly. Two sources were tapped to meet the demand for new instructors: enlisted men who did well while taking the course were selected to be instructors upon their graduation; and former grade and high school teachers, civilian technical school teachers, and experienced mechanics were recruited through civil service. Before entering service these men were given brief courses in approved AAF teaching methods as well as further training in the subject they were to teach. Usually new instructors began their teaching careers in a long-established school. When a new school was opened, a corps of experienced teachers and supervisors from an older school were sent to staff it.

6. See chap. V.

7. Col. R. E. O'Neill, CO, Chanute Field, to CG, GHQ AF, 13 Mar. 1941, in AAG 353.9 E, Training, Miscellaneous.

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Following the entrance of the United States into the war, the need⁸ for instructors became even more acute. For a time it was the stated AAF policy to release all general service instructors for overseas duty and replace them with civilian and limited service instructors. But this came at a period when the schools were expanding rapidly and the need for experienced instructors was acute. The authorities of many schools simply refused to release an instructor under any circumstance. Good civilian instructors were often caught in the net of selective service or lured away by offers of Navy ratings or by the high wages prevailing in war industries. Some school authorities attempted to obtain deferments or Army commissions for their better instructors or to arrange for their assignment to the school as enlisted men after they had been inducted into the Army. This, however, required tremendous exertion and was^{only} occasionally successful. All too often when school authorities did not have enough instructors to handle a huge incoming class, they made up their shortage from the class then graduating, regardless of whether or not the men had shown particular potentialities as instructors or mechanics. Sometimes the instructor shortage was so acute that the instructors course was allowed to lapse, and an enlisted man might graduate one day only to find himself detailed to teaching a class the very next day, often with unhappy results. Still another undesirable consequence of this shortage of teachers was

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8. The following discussion of procurement and employment of instruction personnel during the expansion period is based upon the histories of Chanute, Amarillo, Gulfport, Lincoln, Seymour Johnson, Keesler, and Sheppard fields. See also RAR, AFRIT-3 to AFFMP, 18 Dec. 1942, in AAG 220.63, Technical Schools, Miscellaneous.

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that it discouraged school authorities from weeding out unsatisfactory instructors.

In desperation, the AAF technical schools experimented with all types of instructors. As a group, enlisted men were probably the most satisfactory source. This was true more in the early period of AAF training than it was later when large numbers of new and less carefully selected men had to be added to the staff. There was a widespread belief that the efficiency of these new instructors could be greatly increased if they could be detailed to a tactical unit for practical maintenance experience or to a factory school for "refresher" work on new types of equipment. But usually the schools were so hard pressed for instructors, and arrangements for detached service were so difficult to make that the new men were only rarely sent to tactical units. Considerable use was made of factory "refresher" courses, particularly after the training program had begun to level off.

One type of enlisted instructor deserves special mention--the "limited service" men. Considerable numbers of this type of man were selected as instructors as soon as the Army began inducting them in the late spring of 1942. They proved to be most useful in satisfying the great need for instructors created by the rapid growth in the number of AAF technical schools at this time. Ordinarily they were older men whose presence in the classroom had a salutary effect on the students, most of whom were in their early twenties. Several school authorities reported them to be intelligent and eager, although a few were aggrieved because they were not given a more active assignment. Their greatest shortcoming, compared with the instructors they were chosen to replace

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or supplement, was their lack of experience with airplane maintenance problems and teaching. However, as this same objection could be made against any other type of enlisted man available to the Technical Training Command at the time, the use of the limited service instructor appears to have been a highly satisfactory expedient.

Another type of instructor with which the AAF attempted to replace its general service men was the civilian. The experience of the AAF schools with civilian instructors had always been quite happy. But by 1942 the booming war industries were offering far higher wages than the schools could offer. In the circumstances, the schools found it difficult not only to obtain able new civilian instructors, but to hold the ones they already had. The operation of the draft created several additional problems in this respect. Occasionally a school reported that students were branding civilian instructors "draft dodgers," although difficulties of this sort were not as frequent as might have been feared. More common were instances of resentment by enlisted men over the nominally higher salaries being paid to civilians for performing the same teaching duties. School authorities carefully explained the advantages the enlisted men enjoyed in the form of extra services and allowances, but the soldiers were not always convinced.

As the draft and war industry wages cut into the ranks of men civilian instructors, many of the AAF schools undertook to replace their losses with women civilians. The number of women employed as instructors was never large; at one representative school, Gulfport Field, it was about 4 per cent, approximately the male civilian instructor loss. Women instructors were generally used in the more theo-

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retical introductory phases of the course--for example, Maintenance Fundamentals. Apparently their work was satisfactory, although not outstanding enough to cause the school authorities to increase their numbers.

What has just been said about instructors applies primarily to the AAF technical schools. In the civilian mechanics schools and the factory schools, which operated under contract, all instructors were civilians hired by the contractor. Like the AAF schools, the contract schools had trouble recruiting and retaining good instructors after the war boom had started. The teaching abilities of many factory school teachers were improved by previous practical experience in the plants of the aircraft makers. There is, however, little reason to believe that the instructors at the civilian/mechanics schools were any better than the civilian instructors at the AAF schools--which was about equal or perhaps a little inferior to the enlisted instructors.

Most of the syllabi used in the airplane mechanics schools were lineal descendants of ones which had been developed at Chanute Field during the pre-expansion period. Exceptions to this generalization were the depot overhaul courses arranged by the Air Service Command in 16 civilian contract schools and the factory school courses drawn up jointly by the Technical Training Command and the manufacturers. In these two cases the experience of Chanute was heavily drawn upon.⁹

As the demands for technicians soared, the length of the courses

9. See chaps. IV, V.

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was sharply reduced--in some instances too sharply, with the result that subsequently they had to be extended a bit. Very often when instruction on new types of equipment was introduced, the over-all length of the course was not increased. As a consequence many phases were reduced to the level of superficiality so that all the material might be covered in the time allotted. This may be condoned for the period when men had to be trained quickly. But once the limit of AAF expansion had been reached, it would seem to have been advisable to reconsider the length of all courses. Yet when school authorities and equipment manufacturers protested that not enough time was permitted to teach the intricacies of the new equipment properly, Headquarters, AAF replied merely that it was against current policy to authorize the lengthening of courses.

In a few notable instances, however, Headquarters, AAF was willing to permit courses to be extended. Complaints were received from a number of tactical units that under the quickened pace of training the schools were unable to give their students any conception of the conditions under which they would have to work in the field. To correct this, training for future maintenance engineering officers was lengthened to include a month of practical experience with tactical units

before permanent assignment.¹¹ For enlisted men, phases were added to a number of courses which gave a week or two of training under simu-

10. See chap. IV.

11. See chap. VI.

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lated field conditions. These phases have met with general approval.

To make maximum use of classroom facilities and training equipment during the expansion period, the schools switched from a five- to a six-instructional-day week, and from one to two and even three shifts. Apparently the use of the six-day week and two shifts had no serious effect on the quality of training. However, the introduction of a third shift covering the night-time hours, appears to have been ill-advised. The health and morale of both students and instructors were seriously affected, with a consequent slump in the quality of instruction. As soon as the training program began to level off, the third shift was

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abandoned.

Important modifications in the curriculum and teaching methods used in airplane mechanics training were introduced at the height of the expansion program as a result of a visit which Lt. Gen. H. H. Arnold, Commanding General of the AAF, paid to a Chicago civilian mechanics school in August 1942. What General Arnold saw in Chicago convinced him that a thorough revision of the training program must be undertaken to make the instruction more specialized and more practical. He directed that a board of officers representing Headquarters, AAF and every air force in the continental United States meet at Knollwood field, N. C., within the next few days to make recommendations as to

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how these ends should be achieved.

12. See chap. III.

13. Brig. Gen. L. S. Smith to CG, AFMTC, 25 Nov. 1942, in AAG 000.8, Contract Schools.

14. Lt. Gen. H. H. Arnold, CG, AAF to Maj. Gen. W. R. Weaver, CG, AFMTC, 13 Aug. 1942, in AAG 413.4 E2, Radio Equipment.

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Most of the officers present at Knollwood approved the specialization suggestion on the ground that it would raise the quality of the instruction without increasing the length of the courses. Specifically, each airplane mechanics school would henceforth concentrate on one particular model of aircraft in the case of bombardment planes or on one particular type of aircraft in the case of pursuit planes.

In theory this was an excellent idea; in practice, it led to several pitfalls. One was the danger that men trained on one type of aircraft would be assigned later to maintenance work on another type. This did not mean that all their training was lost, but it did mean the loss of part of it. Moreover, a serious morale problem sometimes resulted among men who were malassigned. Another pitfall was the result of the shortage of teaching equipment. Too often a school would have to teach maintenance on one type of aircraft through demonstrations on another type of aircraft. Fortunately this was only a temporary condition and was¹⁵ corrected, or at least alleviated, as time went on.

The gradual levelling-off of training raised the question whether this specialization should become a permanent feature of AAF technical training. The program put into effect in the spring of 1944, providing that the bulk of ground crew training be conducted in operational units and factory schools, continued this emphasis upon specialization. But in planning for a peacetime AAF, it would seem that the possibility of again training "all-around" maintenance men should be seriously considered.

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15. "Proceedings of Board of Officers Appointed to Review and Reorientate the Technical Training Program, Knollwood Field, N. C., 17 to 28 August 1942," in AFTHI files.

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The recommendation that the instruction be made more "practical" --with students taught the "how" if not the "why" of aircraft maintenance--had farther reaching and more dubious consequences. As the number of men under training as airplane mechanics increased during the first part of the expansion period, undesirable teaching practices appeared and existing ones were aggravated. Finding themselves unable to obtain enough instructors and teaching equipment, the schools resorted to larger and larger class sections. At Sheppard Field the student-instructor ratio was 10 to 1; at Casey Jones it was about 15 to 1; at the Consolidated factory school it varied from 17 to 1 to 34 to 1. Every school complained that the amount of equipment furnished to it was highly inadequate. At the Glenn L. Martin factory school, for example, only one plane was available to instruct 525 students.

The natural consequence of such conditions was that instruction was given more and more by the lecture method and became more and more theoretical in character. Estimates made at the time General Arnold issued his recommendations indicated that at Sheppard Field instruction was 80 per cent theoretical, at Casey Jones 70 per cent, and at the Consolidated factory 50 per cent. To overcome some of the handicaps created by such conditions, instructors were making increasing use of blackboards, students, of notebooks. Unfortunately in many cases both instructors and students carried these practices too far, spending hours drawing and embellishing diagrams and charts.

Impelled by General Arnold's recommendation, the Technical Train-

16. "Proceedings of Board of Officers," passim.

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ing Command, in October 1942, issued a directive designed to correct the undesirable conditions. Thereafter the ratio of instructors to students was to be increased sharply, with 1 to 5 considered ideal and 1 to 3 considered an absolute minimum. Civilian schools were to be encouraged to increase their instructor-student ratio through the negotiation of new contracts increasing their rate of payment.¹⁷ Blackboards were to be removed from classrooms, and students were forbidden to keep notebooks. To discourage the tendency toward lectures, all chairs were to be removed from classrooms, and instructors were forbidden to speak to more than one student at a time. So that the students could "learn by doing," an effort was to be made to increase the amount of teaching equipment. Greater use was to be made of mock-ups and synthetic training devices. Written examinations were to be discontinued; thenceforth students were to be graded according to their performance of a number of problems on the equipment and mock-ups. Cleanliness and neatness were to be stressed¹⁸ in all instruction.

As this directive was forwarded to the various schools during the autumn of 1942, it arouses a loud storm of protest. Most vociferous were the contract schools, where the instructional staff was completely civilian. The reaction of the staff at the St. Louis School of Aeronautics was typical. Here the instructors insisted that to provide an adequate check on the progress of students, periodic examinations and supervised study hours in the students' free time were necessary. There-

17. CG, AFTRC to AFTRIT, 24 Oct. 1942, in AAG 161, Contract Schools.

18. Capt. W. L. Klum, Asst. AG, 2d Dist., AFTRC, to various training schools, 23 Oct. 1942, reproduced in History, AFTRD, St. Louis School of Aeronautics, 1 Jan. 1943 to 7 July 1943, 36-38.

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fore they proceeded to ignore the sections of the directive which forbade these measures. At the same time the commanding officer of the detachment called this fact to the attention of higher authorities. Not for more than six months was anything done about it. On 1 May 1943 Headquarters, Second District, TFO issued a directive reaffirming the earlier order, and specifying that no examinations, written, oral, or implied, were to be given at any school; the progress of students, it was reported, was to be determined by a practical demonstration of their ability to perform technical operations. This time the directive was followed scrupulously at the St. Louis school, but the instructors declared they saw an immediate drop in the interest of the students and in the quality of the work done. "Good aeronautic mechanics in the making reverted to the careless habits of the garage and the machine shop," it was said.

There is considerable evidence to suggest that these directives were as keenly resented by the staffs of the AAF technical schools. Many of their instructors asserted that it was impossible successfully to teach the "how" of aircraft maintenance without giving some information about the "why" behind it. Some pointed out that unanticipated problems inevitably would appear in theaters of operation and that these could be solved only by men having a grasp of the theoretical aspects of the subject. Nevertheless, the school authorities did their best to put the provisions of the directive into effect. Two things followed: there was a sharp drop in instructor morale and gradually

19. History, AFID., St. Louis School of Aeronautics, 12-14.

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more and more winking at the extreme provisions of the directive.

Relaxation of the provisions was authorized following the absorption of the TTC by the new Training Command in July 1943. How this relaxation was accomplished is well illustrated by the case of Keesler Field. In August 1943 the commanding officer of Keesler requested permission to restore the use of written examinations at the end of each phase; multiple-choice questions stressing the practical would be employed. Such a step, it was urged, would increase the accuracy of the grading of students and over a period of time would provide data as to the best arrangement of course subject matter, the adequacy of the instruction, and the efficiency of the instructors. Permission was

²¹ granted. Later a one-hour study period was made a part of every ²² basic airplane mechanics school day.

In retrospect it would appear that while the motive behind the directive was a worthy one, the directive itself went too far in prescribing precise procedures to be followed in making the instruction "practical." The result was that for a time the quality of airplane mechanics training was impaired rather than improved. The permission subsequently granted by the Training Command to modify the directive appears to have struck a more happy mean in this respect.

Like all forms of AAF training, that in airplane mechanics was at all times seriously handicapped by the shortage of equipment for

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20. For an excellent discussion of this experiment at an AAF school, see History, Gulfport Field, Section II, 441-445. See also Brig. Gen. R. W. Harper to CG, AFERC, 21 July 1943, in AG/AS, Training files.
21. History, Keesler Field, 8 July 1943 to 31 Dec. 1943, II, 336-337.
22. T. C. Memo No. 50-32-1, 15 July 1944.

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teaching purposes. In the AAF's own schools this condition had existed even in peacetime; it became badly aggravated by the conditions of war-
²³time expansion. The true extent of the shortages was seldom accurately indicated on routine property reports because much of the equipment listed on them was either outmoded or in poor condition. At one factory school visited by General Weaver in May 1942 "a pile of junk" lying outside a classroom, useless for any purpose, was charged to the
²⁴school as aircraft for training purposes.

During the expansion period the TTC waged an unceasing struggle to obtain more and better equipment for instructional use. The Knollwood Board of Officers meeting in August 1942 worked out a table to show the
²⁵minimum requirements for mechanics classes. In September 1942 the Training Command hopefully submitted to the Commanding General of the
²⁶AAF another sliding scale for the assignment of planes. About the same time an order was issued that one airplane of the latest type be
²⁷allocated to each factory school. But operational and tactical units continued to have priority for equipment over the schools, and until their needs were satisfied the schools had to go without.

A sensible basis for solving the equipment problem was established in May 1944 under the terms of an agreement between AC/AS, Training and

23. A-3 Diary for 9 Jan. 1942, in AFHFI files.

24. Maj. Gen. W. R. Weaver to CG AAF, 27 May 1942, in AAG 353.9 F, Factory Training.

25. "Proceedings, Board of Officers."

26. CG, AFTRC to CG AAF, 16 Sep. 1943, in AC/AS, Training files.

27. Col. Alden R. Crawford, C/S, AFAMC, to AC/AS, NMED, 2 Sep. 1943, in ibid.

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AC/AS, OC&R. This provided that

as an item is approved for standardization and procurement, it will be brought to the attention of AC/AS Training, with a request to state quantitative requirements for training purposes. Based on statement of quantitative requirements, 10% of monthly production of such desired operation equipment will be allocated until the total training requirements are met. Exception to above would be critical items which are an integral part of a special project. This method will establish a basis of needs for planning and will become an automatic procedure in that it will be a routine operation.

To make up for the shortage of adequate training equipment and to provide a better method of instruction, the AAF schools made extensive use of mock-ups, cutaways, charts, films, and synthetic training devices. Many of these were made by the staffs of the AAF schools from salvage materials; a few were furnished by manufacturers of the equipment; and from 1943 on much was supplied by the Training Aids Division of AC/AS, Training. Here again the needs were rarely filled because of shortage of salvage materials and labor. Visitors to airplane mechanics schools generally agreed, however, that the training aids in use were varied and effective pedagogical devices. The success they have attained promises continued and more widespread use in AAF training.

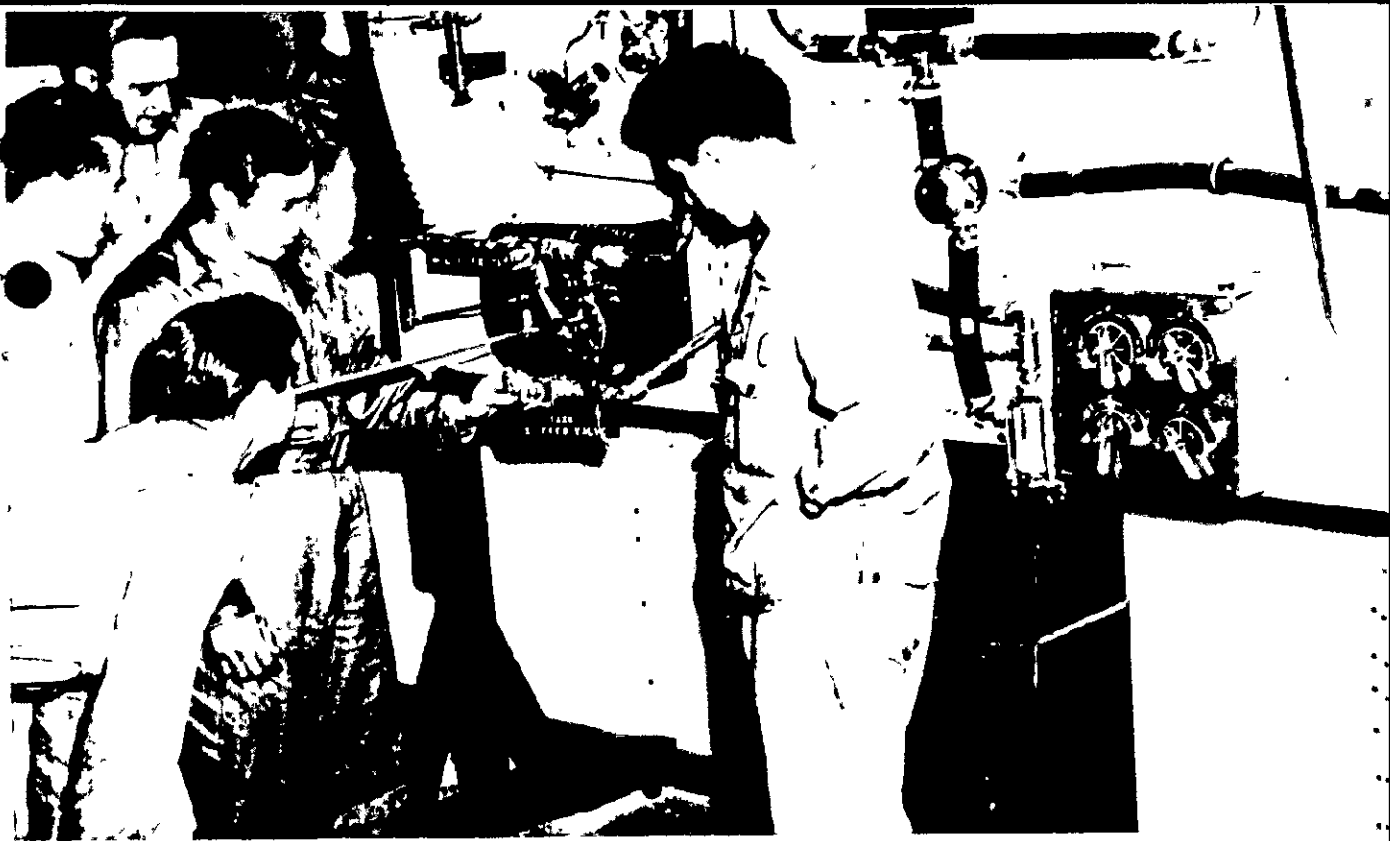
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A problem particularly pressing during the period of rapid AAF expansion was that of obtaining students of the type who would make good mechanics. On the basis of the experience of a typical school, Gulfport Field, it appears that through the autumn of 1942 the standard of men was quite high--men of a median age of 22 $\frac{1}{2}$, high school gradu-

28. Daily Diary, Requirements Div., OC&R, 11 May 1944, in AFHI files.

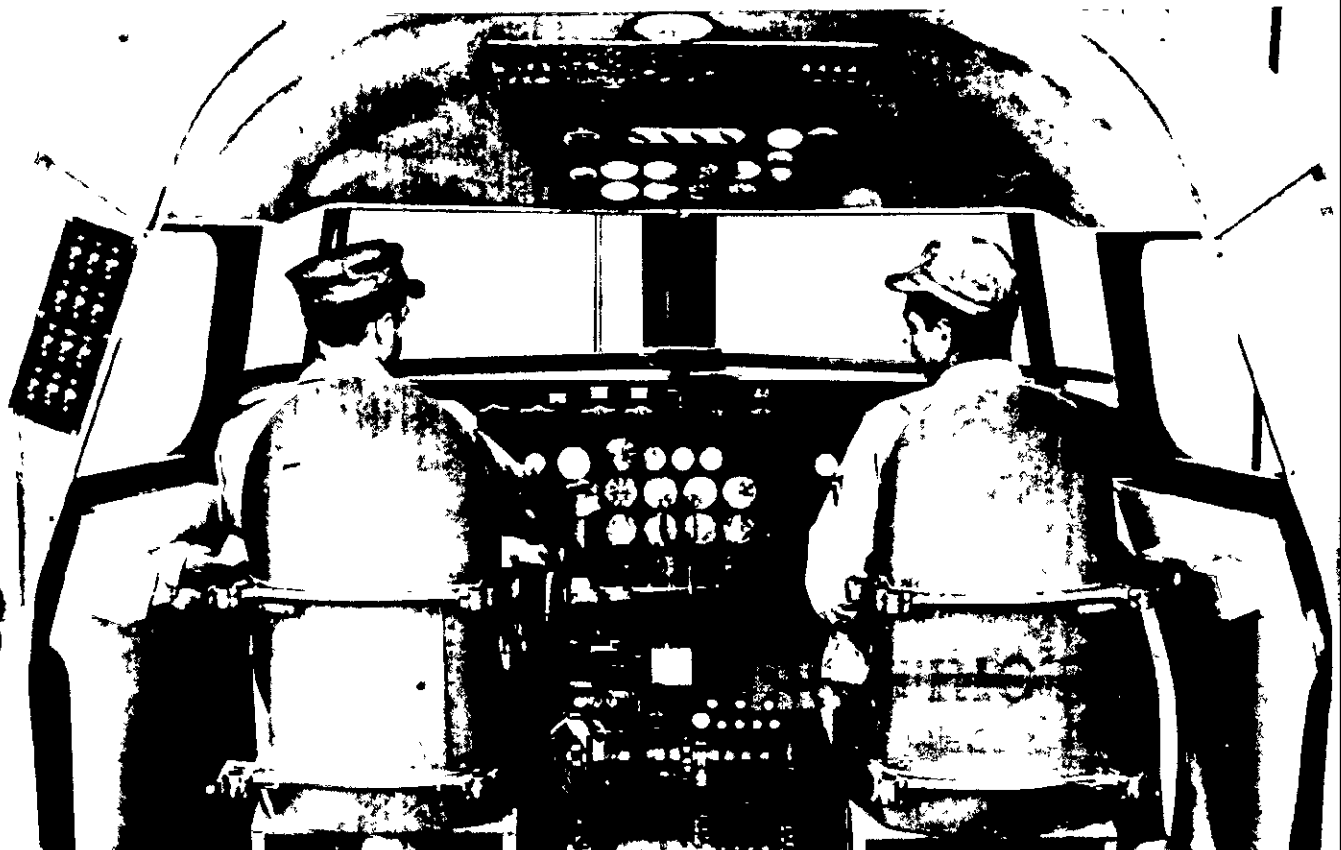
29. "Proceedings, Board of Officers," passim.

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AN AAF INSTRUCTOR ELUCIDATES HIS EXPLANATION OF THE A-20 FUEL SYSTEM BY MEANS OF A MOCKUP

A MOCKUP OF THE COCKPIT OF A FOUR-ENGINE PLANE BEING USED TO TEACH AIRCRAFT MAINTENANCE



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ates with a median General Classification Test score of 112.9. By the fall of 1943 it had fallen considerably: the median age was 19.7, almost half lacked a high school diploma, and the median G. C. T. score was 106.8. Instructors reported the students more difficult to train as time went on. Yet all through the expansion period an arbitrary elimination rate was maintained. Normally this quota was filled completely by incorrigible "bad boys" and those^{who} dropped out for reasons of health. It is obvious that more and more men were graduated from the course who were not really deserving.³⁰ Luckily before this decline in standards had reached dangerous depths, AAF training had levelled off and the schools were able to devote their efforts almost exclusively to men who already had proved their worth in tactical units or in theaters of operation.

Yet another problem with which the schools had to cope was the unevenness of the flow of students to them. All too often the size of a class was much larger or much smaller than the one which had preceded it, creating administrative problems as to instructors, equipment, and housing facilities. This was particularly true in the case of the factory training program, at the time of its start in April 1942 and again in the latter part of 1943. Some, although not all, of these fluctuations were caused by conditions outside the province of AC/AS, Training and the Training Command. But their frequency and seriousness suggest that close coordination with Selective Service,

30. History, Gulfport Field, 1942, Sec. II, 2L2-50. See also R&R, AFAAP to AFRIT, 9 Sep. 1942, in AAG 353.9 0, Mechanics; 2d ind., CG, AFTRC to CG AAF, 6 Jan. 1943, in AC/AS, Training files.

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the Plans Division, Personnel, and other agencies is imperative during a period of rapid expansion.

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Almost equally deleterious to the success of the mechanics training program was the all too frequent malassignment of men after their graduation from school. Cases of graduate mechanics being assigned to guard duty, and of men trained to maintain bombers being assigned to fighter units suggest not only a woeful waste of manpower but created serious morale problems when news of them got back to the mechanics schools. Here again closer coordination between the various agencies of the AAF might have avoided many mistakes.

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31. See chap. V; CG, 1st Dist., AFTTC, to CG, AFTTC, 29 July 1942, in AAG 353.9 C, Training, Mechanics; G. W. Rapier, Packard Motor Car Co., to Col. W. T. Myers, 29 Sep. 1942, in AAG 353.9 I, Factory Training; Frank H. Lyons, Field Service Mgr., North American Aviation, Inc., to CG AAF, 9 Oct. 1943, in AAG 353.9, Factory Training, Miscellaneous.
32. R&R, Gen. Arnold to Gen. Weaver, 30 Jan. 1943, in AC/AS, Training files; Sgt Adam F. Illik, 411th Bombardment Sq., Gowen Field, Boise, Idaho, to Lt., 30 June 1943, in AAG 353.9, Factory Training, Miscellaneous; Lt. Col. H. M. Burke, Acting Chief, Control Div., AFTAI, to CG, ASC, 4 Aug. 1943, in AC/AS, Training files; Brig. Gen. B. E. Myers, Deputy AC/AS, MEAD, to Henry T. Rowland, Glenn L. Martin Co., 20 Aug. 1943, in AAG 353.9, Factory Training, Miscellaneous.

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Chapter IX

SUMMARY: THE LESSONS LEARNED

In the five years from 1 July 1939 to 30 June 1944 the AAF airplane maintenance courses conducted in the United States had well over half a million (530,853) graduates.¹ In the preceding pages are recorded the experience of the AAF in training this host of men, the problems encountered, and the manner in which they were solved. A close examination of this record discloses certain lessons learned in the course of the five years, which may profitably be acted upon in the future--many of them during peacetime, all of them in the event that the United States is again involved in war. Among these are:

In conducting maintenance training in schools, for basic mechanics courses the most satisfactory results are obtained from the AAF's own technical schools. For training on an advanced or highly specialized level, factory schools are most useful. Civilian contract schools involve many administrative problems and seem advisable only in a period of great emergency. Invaluable instruction to supplement the work of the schools is provided by "on-the-job" instruction in operational units and by mobile training units. The tremendous possibilities of MTU's as an aid in training have barely begun to be realized. (Chapter VIII.)

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1. Report of AAF Technical Training Program as of 30 June 1944, prepared by Statistical Control Div., Office of Management Control, in AFTHI files.

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In the selection of civilian schools of any type, only contractors who are anxious and able to provide the type of training desired by the AAF should be called upon. The experience with contractors who operated courses only out of a sense of patriotic duty or whose financial and technical capacities were limited was an unhappy one. (Chapters IV, V.)

Headquarters, AAF should at all times exert close supervision over all AAF maintenance training to prevent the duplication of effort and the confusion which result when the various commands set up their own training programs. Planning, supervision, and coordination should be conducted with particular vigilance at the start of an expansion program. (Chapters IV, V.)

"The unevenness of student flow" which troubled school administrators during much of the expansion period might have been avoided or at least alleviated by more careful planning and closer coordination between AC/AS, Training, AC/AS, Personnel, the planning agencies within Headquarters, AAF, and the Training Command. (Chapters V, VIII.)

Even if the need for mechanics is acute, it is unwise to order the inauguration of an extensive training program without allowing adequate time for the careful preparation of curricula and provisions for housing and mess facilities. (Chapter V.)

When accelerating the pace of training during an expansion period the temptation to reduce the length of courses too drastically should be resisted lest the quality of the training be impaired. (Chapter III.)

When great numbers of men without previous experience in mechanical work are being trained, a good deal of instruction on shop practices and elementary mechanical procedures must be retained in the

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curriculum. (Chapter III.)

In the preparation and revision of curricula, allotment of the same amount of time to all phases, irrespective of the amount and difficulty of material presented in each, is ill-advised. (Chapter III.)

Once the AAF has reached the limits of its expansion, the wisdom of Headquarters, AAF in refusing earnest requests from school authorities to lengthen certain courses on the ground that it is against "established practice" to grant extensions, although admitting the justice of the individual requests, is highly debatable. (Chapter V.)

The specialization of instruction on a particular type of aircraft or accessory is easier to achieve at AAF schools than at civilian mechanics schools. (Chapter III.)

With the levelling-off of training and preparation for training on a peacetime basis, the question of the retention of specialization as a feature of mechanics training has become moot. Much evidence suggests that it ought to be abandoned as soon as practicable. (Chapter VIII.)

Lack of planning and coordination by Headquarters, AAF and the Training Command is evident in the cross-purposes and contradictory orders which characterized the transition of the advanced specialists courses from an expansion to a "levelled-off" basis. Such a situation should be avoided in planning for a peacetime AAF. (Chapter IV.)

Records of experience, syllabi, and if possible, some of the personnel of discontinued courses ought to be held in readiness in case they are needed in the future. (Chapters V, VI.)

In time of war, when the manpower situation is stringent, enlisted

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personnel, especially limited-service men, appear to provide the most satisfactory source for instructors. These men should be thoroughly trained before being detailed to actual teaching duties. This can be done, of course, only if higher echelons provide the schools with an even flow of students and apprise them well in advance of the anticipated need for instructors. (Chapter VIII.)

It is folly to order completely "practical" training until enough equipment and instructors are available to make it possible to put such a policy into effect. (Chapter VIII.)

The retention of some "theory" seems not only desirable but necessary for effective teaching, as does a moderate use of such time-honored pedagogical devices as quizzes, study periods, etc. (Chapter VIII.)

Inasmuch as the machine is only as good as the knowledge of the men assigned to operate and maintain it, it is imperative that requirements and materiel agencies cooperate to the utmost in providing the training authorities with up-to-date equipment in adequate quantities. (Chapter VIII.)

But, by and large, the lessons learned and yet to be learned, are matters of detail. From the scattered reports which have to date reached the United States from combat theaters, the conclusion is irresistible that AAF authorities have done a fine job of training airplane maintenance men. Illuminating in this respect is a memorandum which Albert I. Lodwick, Special Consultant to the War Department, wrote in February 1944 upon his return from a visit to China, India, the Middle East, Africa, Sicily, Sardinia, Italy, and the United Kingdom. Lodwick

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reported that he had talked with a large number of maintenance managers, maintenance sergeants, and crew chiefs to determine whether the mechanics courses ought to be changed to improve the usefulness of their products. "The general slogan," he wrote, "seemed to be 'Don't change the course of instruction--just send us more mechanics.'" This, he concluded, was a real tribute to the training program laid out by Maj. Gen. W. R. Weaver and today administered by Maj. Gen. R. W. Harper² and Brig. Gen. B. K. Yount.

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2. Memo. for Gen. H. H. Arnold by Albert I. Lodwick, Special Consultant, War Department, undated but about 27 Feb. 1944, in AAG 353, Mechanics Training.

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G L O S S A R Y

AAB	Army Air Base.
AAF	Army Air Forces
AAG	Air Adjutant General
AC	Air Corps
AC/AS	Assistant Chief of Air Staff
ACD	Air Corps Detachment
AC/S	Assistant Chief of Staff
ACTS	Air Corps Technical School
AGTTC	Air Corps Technical Training Command
AF	Air Force
AFAMC	AAF Materiel Command
AFOPTC	AAF Central Technical Training Command
AFDFS	Directorate of Flying Safety
AFDMR	Directorate of Military Requirements
AFDTS	Directorate of Technical Services
AFETTC	AAF Eastern Technical Training Command
AFIHI	Historical Division
AFILP	Directorate of Legislative Planning
AFMP	Military Personnel Division
AFRGS	Directorate of Ground-Air Support
AFRIT	Directorate of Individual Training
AFTD	AAF Training Detachment
AETRC	AAF Training Command
AETTC	AAF Technical Training Command
AFWTTTC	AAF Western Technical Training Command
AG	(The) Adjutant General
ASO	Air Service Command
ASCTD	Air Service Command Training Detachment
ATC	Air Transport Command
CAA	Civil Aeronautics Administration
C/AC	Chief of the Air Corps
C-B-I AF	China-Burma-India Air Force
CG	Commanding General
CO	Commanding Officer
Comdg.	Commanding
Comdt.	Commandant
C/S	Chief of Staff
DC/AS	Deputy Chief of Air Staff
GHQ AF	General Headquarters Air Force

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Hq.	Headquarters
I-B	India-Burma
Ind.	Indorsement
M. C.	Member of Congress
MM&D	Material, Maintenance, and Distribution
MTU	Mobile Training Unit
OC	Officer in Charge
OCAC	Office, Chief of the Air Corps
OC&R	Operations, Commitments, and Requirements
OTU	Operational Training Unit
R&R	Routing and Record Sheet
T. C.	Training Command
TS	Training School
TTC	Technical Training Command
T&O	Training and Operations
WTFCTC	Western Technical Training Command

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B I B L I O G R A P H Y

Official Publications

AAF Library, Pentagon Bldg.

War Department. Office of the Director of Air Service: July 1, 1918 to June 30, 1919.

Headquarters, Army Air Forces

Annual Reports of the Director of Air Service.

Valuable for early years of maintenance training.

Air Corps News Letter.

In lieu of original documents, this has been used occasionally as secondary material.

Headquarters, Training Command

Training Command Memoranda

Monthly Progress Report, Training Command

Daily Diary, Training Command

Prospectus of Courses under Training Command (Technical Training)

Headquarters, Western Technical Training Command

Brochure on "Mobile Training Units."

Bureau of the Budget Files

The files of the Administrative Management Division contain some valuable information on the planning and execution of the maintenance mechanics training program during the expansion period.

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AAF Central Files / cited AAG/

Files marked * contain a good amount of material; those marked ** are invaluable.

000.8	Contract Schools
*161	Contract Schools
220.63	Technical Schools, Miscellaneous
220.66 A1	Detail of Students to Factory Training, Misc.
*221 B	Mechanics
*221 C	Mechanics
*221 D	Mechanics
352.11	Technical Schools, Misc.
353	Engineering Training
353	Mechanics Training
*353.9	Engineering
*353.9	Factory Training
*353.9	Factory Training, Misc.
353.9	Mechanics Training
**353.9 A	Training, General
353.9 C	Factory Training
353.9 C	Mechanics
*353.9 C	Training, Mechanics
353.9 C2	Training General
353.9 D	Factory Training
353.9 D	Training, Misc.
353.9 D2	Training, General
353.9 E	Training, Misc.
353.9 G	Factory Training
353.9 G1	Miscellaneous Training
353.9 I	Factory Training
370.5	Post Field
413.4 E2	Radio Equipment

These files contain official correspondence consisting of letters, memoranda, routing and record sheets, telegrams, reports, and charts. They have been used, along with the files of AC/AS, Training, as the chief source of Headquarters and lower echelon action.

Headquarters Staff and Training Command Files

AC/AS, Training

Individual Training Division:

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Miscellaneous Mechanics Correspondence

This material, most of it invaluable because of its importance and because most of it is not obtainable elsewhere, has been used extensively in the writing of this study. It covers every branch of maintenance training, although it is particularly voluminous for factory training and mobile training units.

AC/AS, Personnel, Military Personnel Division

Aviation Cadet Branch:

Miscellaneous Correspondence

Contains information on standards, and on recruitment and assignment of personnel to maintenance engineering courses.

AC/AS, Intelligence, Historical Division

Administrative History Branch:

Daily Diaries of AC/AS, Personnel; AC/AS, A-3; AC/AS, Training; AC/AS, OC&R; AETTC

Reports

Report, Board of Officers Appointed to Review and Reorientate the Technical Training Program, Hq., AETTC, 17 to 28 August 1942.

Contains information on training developments and recommendations for changes. Invaluable.

Monthly reports on students undergoing technical training, prepared by Statistical Control Division, Office of Management Control.

Interview: Capt. H. C. Freeman, AC/AS, Training, Individual Training.

Sources and Editorial Branch (Archives):

Unit Histories

Chanute Field, 1 Jan. 1939 to 7 Dec. 1941
 Chanute Field, 7 Dec. 1941 to 1 Jan. 1943
 Chanute Field, 8 July 1943 to 31 Dec. 1943
 Chanute Field, 1 Jan. 1944 to 29 Feb. 1944
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Keesler Field, to 7 Dec. 1941
 Keesler Field, 7 Dec. 1941 to 31 Dec. 1942
 Keesler Field, 1 Jan. 1943 to 7 Dec. 1943
 Scott Field, 1 Jan. 1939 to 7 Dec. 1941
 Sheppard Field, to Dec. 1941
 AFTD Academy of Aeronautics
 AFTD Aero Industries Technical Institute
 AFTD Aircraft Accessories Corporation
 AFTD Aviation Institute of Technology, 23 Jan. 1942 to 7 July 1943
 AFTD Boeing School of Aeronautics
 AFTD Casey Jones School of Aeronautics
 AFTD Connecticut State Vocational Trade School, Hartford,
 21 July 1942 to 13 Mar. 1943
 AFTD Connecticut State Vocational Trade School, New Britain,
 21 July 1942 to 13 Mar. 1943
 AFTD Curtiss-Wright Technical Institute
 AFTD Embry-Riddle School of Aviation, 7 Dec. 1941 to 7 July 1943
 AFTD Lincoln Aeronautical Institute, 7 Oct. 1940 to 15 Nov 1943
 AFTD National School of Aeronautics
 AFTD Ohio Institute of Aeronautics, 9 Feb. 1942 to 31 Dec. 1942
 AFTD Ohio State University, 27 July 1942 to 10 Mar. 1943
 ACD Parks Air College, 26 May 1942 to 12 Oct. 1943
 AFTD Paterson Vocational Trade School, 12 Sep. 1942 to 13 Mar. 1943
 ASOTD St. Louis School of Aeronautics, 17 Apr. 1942 to 7 July 1943
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 AFTD Thomas A. Edison, Inc., 17 Aug. 1942 to 22 Dec. 1942
 AFTD University of Wisconsin, 18 July 1942 to Apr. 1943
 AFTD Williamson Free Trade School, 2 June 1942 to 13 Mar. 1943

These consist of narratives and supporting documents. They are invaluable for their discussions of problems encountered and procedures developed in the lower echelons while carrying out the directives of higher authority. Supporting documents are cited. In some instances course syllabi are included in the appendices.

Other Histories and Studies

AAF Historical Studies: No. 1, The Glider Pilot Training Program, 1941 to 1943.

AAF Historical Studies: No. 21, The Aviation Cadet Ground Duty Program: Policy, Procurement, and Assignment.

Historical Sketch of the U. S. Army Mechanics School, St. Paul, Minn., 1918, prepared by the Historical Division (Technical Training), AFTRC.

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Miscellaneous

Angell, S/Sgt. Jack, "Mechanical Training by Trailers, " in Air Force,
Sep. 1943.

New York Times, 6 Aug. 1939.

Nistal, G. E., "Mobile Training Units," in Air Tech, Apr. 1944.

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Appendix

WAR DEPARTMENT
Office of the Chief of the Air Corps
Washington

April 21, 1939.

SYLLABUS OF INSTRUCTION FOR AIRPLANE AND ENGINE MECHANICS IN
CIVILIAN MECHANICS SCHOOLS

1. Scope:- To train individuals in the general construction principles, maintenance repair and replacement, minor repair, and inspection of the complete airplane, engine and airplane equipment, except radio and armament equipment; also in the care and use of materials, tools and equipment used in the hangar.

2. Duration:- 960 academic hours of instruction, over a period of not less than 24 weeks and not more than 28 weeks.

3. Outline of Instruction:- The course to consist of the following instruction:

	<u>Hours</u>
a. Shop Mathematics	35
(1) Addition, subtraction, multiplication and division.	
(2) Fractions and decimals.	
(3) Denominate numbers and mensuration.	
(4) Formulas and tables.	
(5) Shop trigonometry.	
(6) Applied problems.	
b. Mechanical Drafting and Blue Print Reading	35
(1) Fundamental principles of mechanical drafting.	
(2) Exercise in orthographic projections.	
(3) Development of surfaces.	
(4) Blue print reading.	
(5) Exercises in blue print reading.	
c. Aviation Fundamentals	10
(1) Airplane nomenclature.	
(2) Fire regulations and the care and use of fire extinguishers.	
(3) Safety rules for shops and hangars.	
(4) General instructions relative to handling airplanes in and around the hangar.	
(5) Parachute instructions (general).	

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	<u>Hours</u>
<u>d.</u> Elements of Metal Work	40
(1) Properties and use of the common metals.	
(2) Care and use of the common tools needed in the repair and manufacture of small parts.	
(3) Metal work - Projects in drilling, filing, thread cutting, reaming, etc.	
(4) Soldering - Soft and hard soldering.	
(5) Brazing.	
<u>e.</u> Elements of Electricity	40
(1) Fundamental principles of electricity.	
(2) Electrical circuits.	
(3) Application of Ohm's Law.	
(4) Batteries.	
(5) Magnetism.	
(6) Electro-magnetism.	
(7) Induction.	
<u>f.</u> Airplane Structures	80
(1) Construction features, maintenance repair and replacement, inspection of fuselages, wings and control surfaces, flight control systems, landing gears and brakes.	
<u>g.</u> Airplane Hydraulic Systems and Miscellaneous Equipment	80
(1) Operating principles, maintenance repair and replacement, inspection of hydraulic systems and equipment, de-icer systems and equipment, fire extinguisher systems and equipment, oxygen systems and equipment, flotation systems and equipment.	
(2) Loading, unloading, inspection, and maintenance of flare racks and flare rack equipment.	
<u>h.</u> Airplane Propellers	80
(1) Construction and operation features, maintenance repair and replacement, and inspection of airplane propellers and airplane propeller installations.	
<u>i.</u> Airplane Instruments	80
(1) Construction features, operation principles, maintenance repair and replacement, and inspection of standard airplane instruments and airplane instrument installations.	

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	<u>Hours</u>
j. Airplane Engines	80
(1) Internal combustion engine principles, including ignition, induction, cooling and lubrication.	
(2) Maintenance repair of standard engine units.	
(3) Construction principles, adjustment, maintenance repair and inspection of the standard types of airplane engines.	
k. Airplane Electrical Systems	80
(1) Principles of airplane electrical systems.	
(2) Construction principles, maintenance repair, adjustment and inspection of storage batteries, generators, voltage control units, starters, spark electrical systems, except radio.	
l. Engine Induction, Fuel and Oil Systems	80
(1) Principles of induction systems.	
(2) Construction principles, maintenance repair, adjustment and inspection of standard carburetors, fuel chargers, superchargers, fuel systems and oil systems.	
(3) Properties of fuels and oils.	
m. Engine Operation and Tests	80
(1) Methods of starting, stopping and operating the various types of standard airplane engines.	
(2) Ground testing procedure.	
(3) Demonstrations of the effect of improper engine adjustments and malfunction of parts on performance, and the instructions in the correct remedial action to be taken.	
n. Engine Change and Engine Change Inspection	80
(1) Replacement of complete power plant units, both air and liquid cooled, making all connections and adjustments of fuel and oil lines, electrical wires, engine controls, propeller controls, cowlings, instruments, and auxiliary equipment.	
(2) Replacement of instruments and accessories.	
(3) Engine change inspection of the complete airplane, all accessories, systems, and installations.	
o. Airplane Inspection and Maintenance on Complete Serviceable Airplane	80
(1) Applications of the following inspections on various types of serviceable airplanes: Daily inspection, 20-hour inspection, 40-hour inspection and special inspections.	
(2) Performance of the necessary maintenance in connection with the foregoing inspections.	

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