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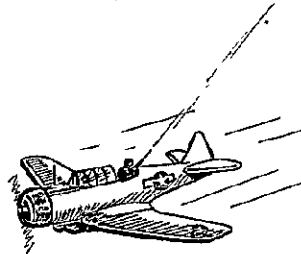
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Flexible **GUNNERY TRAINING**

IN THE

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FLEXIBLE GUNNERY TRAINING IN THE AAF

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See, Airman
Prepared by
Assistant Chief of Air Staff, Intelligence
Historical Division
March 1945

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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 380-5.

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Flexible Gunnery Training in the AAF

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INTRODUCTION

Although flexible gunnery schools are a product of the years since 1940, there is evidence of casual and continuing interest in that type of training during and since the period of World War I. It was not, however, until some time after the United States entered the war in 1917 that efforts to produce flexible gunners showed results. The process of providing facilities and equipment to prepare them was slow. The Lewis aircraft gun was modified to meet flexible needs, and though 30,000 of that type of gun had been produced by the time the Armistice¹ was signed, none had been delivered until late in May 1918. The Browning gun also was adapted to flexibility, but too near the end of² the war to be of much use.

Flexible gunnery training during the years 1917-1918 consisted of two kinds. First, there was ground instruction which comprised nomenclature, stripping and assembling of guns, range practice, and lectures on sights. Second, there was aerial instruction which included firing with machine guns and manipulation of the camera gun. The camera gun was a device which, instead of piercing another plane with bullets, took pictures showing where hits would have been made on the other airplane, had a gun been used. Further aids to accuracy in hitting the

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1. Division of Military Aeronautics News Letter, I (1918-1919), 14 Dec. 1918, 1, 9.
 2. The Signal Corps and Air Service: A Study of Their Expansion in the United States, 1917-1918, 98.

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target were the Norman Compensating Foresight and the Ring Sight, which were designed to gauge the speed, respectively, of the flyer's own airplane and that of the plane at which he was firing.³

While interest in flexible gunnery was not marked during the years 1919 to 1940, there is evidence of its continuity. Some attention was paid both to training and to provision of necessary equipment for combat gunnery. The Chief of the Air Corps stated in 1926 that during the preceding year all machine gun training was transferred from the Primary Flying School at Brooks Field, San Antonio, Tex. to the Advanced Flying School at Kelly Field, also at San Antonio. At the latter school gunnery training was included in a 6-month course in advanced flying for flying cadets and Regular Army officers.⁴ How limited the flying facilities were at Kelly Field is shown by the fact that early in 1926 only one JN-6H Curtiss airplane was available there for gunnery practice.⁵ At Wright Field in 1927 gunnery ranges, equipped with necessary targets, frames, and bullet-proof dugouts for observers, were being established for the purpose of flexible gunnery training,⁶ and at Langley Field, during the late 1920's, annual machine gun and bombing matches were held, at which one of the events was competition among flexible gunners.⁷ In commenting upon the fourth annual event of that character,

3. Ibid., 58, 97-98, 102.

4. Annual Report of the Chief of the Air Corps (1926), 128-130.

5. 1st ind. (Chief of Air Service, to CO, Kelly Field, 9 Feb. 1926), Kelly Field AFS to Chief of Air Service, 18 Feb. 1926, in AAG 452.1G, Curtiss Planes.

6. Annual Report of the Chief, Materiel Division, Air Corps (1928), 97.

7. Annual Report of the Chief of the Air Corps (1926), 153-159; ibid. (1928), 31-32.

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the Chief of the Air Corps declared that "gratifying improvement in the proficiency of Air Corps in aerial gunnery and bombing" had taken place. ⁸

Provisions for and discussions of flexible gunnery equipment represent additional evidence of the continuing interest in flexible gunnery during the 1920's and 1930's. In specifications to bidders for construction of a modified type of Martin bombardment plane, the Engineering Division of the Air Corps in 1919 included the following in respect to flexible equipment: 2 Lewis guns in front and rear cockpits, respectively, with Type B flexible gun mounts, 20 Lewis gun magazines, 3 Lewis gun sights, and 2 Lewis Wind Vane flexible gun sights, 120 m.p.h. ⁹

Flexible gun ring mounts were the subject of experimentation and discussion. Though the scarf mount had been standardized, there was considerable dissatisfaction with the operational difficulties which it presented. Successful experiments resulted in a recommendation of standardization on bombardment planes of another mount which was heavier and more complicated but easier to manipulate than the scarf type. ¹⁰

In 1933 the Chief of the Materiel Division expressed the opinion that in the mounting of flexible machine guns further improvement had been made in providing "greater protection for the gunner from the wind blast," an accomplishment made possible "by the application of a turret inclosure to the front cockpit and a semi-turret inclosure to the rear." ¹¹

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8. Ibid. (1928), 32.
 9. Engineering Div., Air Service, Specifications to Bidders for Bombardment Airplane, Martin Type, 12 April 1919, in AAG 452.1A, Martin Bombers.
 10. Annual Report of the Chief, Materiel Division, Air Corps (1928), 89, 90, 93; ibid. (1930), 141.
 11. Ibid. (1933), 27.

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There were significant changes in respect to the type and caliber of flexible guns. For some years there had existed a feeling that the Browning was superior to the Lewis gun, and before the end of the 1920's action had been taken to install the single flexibly mounted former type in place of the double Lewis type.¹² The .30-caliber gun had been in general use, but before the end of the 1930's the .50-caliber one was also used to some extent. The adoption of the latter type necessitated the development of new accessory equipment and required the strengthening of the airplane structure in the vicinity of the gun position.¹³

It is thus apparent that flexible gunnery activities were by no means absent before the advent of World War II. The training was apparently somewhat superficial and not highly specialized, and, in the words of the Chief of the Air Corps in 1935, decisions were yet to be made in respect "to almost every phase of armament equipment" that had to do with flexible gunnery training. He did, however, add that during the preceding fiscal year "the number of flexible guns employed was increased and distributed about the airplane to provide greater defensive ability."¹⁴

12. Ibid. (1927), 75-76; ibid. (1929), 201.

13. Ibid. (1928), 93; Annual Report of the Chief of the Air Corps (1936), 46.

14. Annual Report of the Chief of the Air Corps (1935), 35.

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Chapter I

ESTABLISHMENT OF SCHOOLS AND SECURING OF STUDENTS

Prior to 1941 there were no specialized flexible gunnery schools. Such rudiments of that type of training as were given were made possible through some of the six Air Corps schools that existed during the 1920's and 1930's.¹ The military appropriations act of 1939 provided for the expansion of the old fields and the creation of new ones.² The first active steps in the direction of specialized flexible gunnery schools were taken in 1940 and 1941. In September 1940 the Chief of the Air Corps in Washington revealed to the newly activated Southeast Air Corps Training Center at Maxwell Field, Ala., plans for the establishment of two aerial gunnery schools and asked for recommendations which would further that end. The Southeast Training Center Headquarters responded with a proposed program of instruction in October 1940 which, after several revisions, was adopted officially by the Chief of the Air Corps on 4 March 1941. A five-week course was contemplated in which emphasis the first week would be on orientation;

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1. Those six were the Air Corps Primary Flying School, Brooks Field, San Antonio, Tex.; Air Corps Advanced Flying School, Kelly Field, San Antonio, Tex.; Air Corps Balloon and Airship School, Scott Field, Belleville, Ill., which was inactivated during the 1930's; Air Corps Tactical School, Langley Field, Hampton, Va.; Air Corps Engineering School, McCook Field, Dayton, Ohio; Air Corps Technical School, Chanute Field, Rantoul, Ill. Before 1938 the Primary School had been removed to Randolph Field and the Tactical School to Maxwell Field. Annual Report of the Chief of the Air Corps, (1926), 129; ibid. (1936), 28-30; ibid. (1938) Chart opposite 29.
 2. Ibid. (1939), 1-3.

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the second, on sighting and lectures on such matters as range estimates, repairing of guns and aircraft recognition; the third, on ground range exercises; the fourth, on preliminary air exercises; and the fifth, on air range instruction.

To facilitate the establishment of schools and the working out of an efficient training program, officers were sent to England in the summer of 1941 to study the RAF gunnery system. In October one of them, Maj. W. L. Kennedy, who was attached to the Office of the Chief of the Air Corps (OCAC), made a report which was something of a landmark because of the basic information it contained, serving to clarify the subject then being so much discussed. Some of his suggestions were as follows: (1) As many officers as possible should go to England, get first-hand information on training requirements for actual combat flying, and return after six months to study changes in the course. (2) Gunners should practice actual aerial firing at a target. Synthetic devices were valuable in preparing the gunner for air-to-air practice but should not be a substitute for air firing. (3) There should be assigned to flexible gunnery schools "fighter type aircraft for making attacks against cinema guns and for teaching proper methods of gunnery control and tactics." (4) Well-trained instructors "should be considered the backbone of the gunnery schools." They should have a good understanding of armament and classroom technique. (5) A distinctive badge or emblem should be authorized for the uniform of graduate air gunners. (6) A percentage of gunners in tactical units should

3. History of Buckingham Army Air Field, Installment I, II, 11-13.

4. Ibid., 14-15.

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be commissioned.

In the meantime definite steps had been taken to organize at Las Vegas, Nev., the first flexible gunnery school. Military authorities, inspecting the site near that town during the late months of 1940 and the early months of 1941, were impressed with its possibilities as the location of a gunnery school. Its strategic advantages were excellent, the flying weather there was good, and more than 90 per cent of the area contemplated was uninhabited public wasteland. Despite unsatisfactory moral conditions in Las Vegas, there was a feeling that the advantages outweighed the disadvantages. Final arrangements between the city and the Army in the form of a lease were completed 25 January 1941. Troops to staff and man the post arrived from Brooks Field on 17 June 1941, though there was no actual firing training before 7 December 1941. By that time three classes of instructors, totaling slightly more than 100 men, had graduated, and on 9 December 1941 the Chief of the Air Corps ordered immediate aerial training for gunners.⁶ Before the end of 1941 the West Coast Training Center had asked approval of a plan to enlarge the Las Vegas School so that it might have 320 students enter each week.⁷ Some idea of the expansion of this first flexible gunnery school may be gained by comparing the number of students connected with it in 1942 and 1943. In the former year 10,562 enrolled and 9,117 graduated; in the latter, 18,974 enrolled and 18,071

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5. Maj. W. L. Kennedy to C/AC (through Chief, T&O Div.), 8 Oct. 1941, in AAG 353.901, Training, General.
 6. History of Las Vegas FGS, 1 Jan. 1939-7 Dec. 1941, 1-3, 5, 33, 84-86; ibid., 8 Dec. 1941-1 Jan. 1943, 1.
 7. Hq WCACTC to C/AC, 20 Dec. 1941, in 353.902, Training, General.

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graduated.

Harlingen, Tex., also offered advantages for gunnery training. The winters were mild, the hot summers were tempered by constant Gulf winds, and the railroads were near enough to offer good transportation facilities. One disadvantage which led to hesitations in choosing the site was its proximity to the Mexican border, a factor which restricted flying to the south. However, this objection was overcome, and the War Department announced on 6 May 1941 its approval of the location; though some of the personnel to operate the school arrived by 1 September 1941, training activities did not begin before Pearl Harbor, and the first class did not graduate until January 1942.⁹ Harlingen was originally constructed to handle a student load of 600, which meant a graduating class of 120 each week. In July 1942 the quota was increased to 940, and in October of that year to 1,320. In April 1943, when the course was expanded to six weeks, the quota was 1,920. Later the requirements were in terms of graduates each week. A total of 360 was required in August 1943, and 475 in November of that year. The latter figure may be compared with the original weekly quota of 120 in 1942. This school had 4,953 graduates in 1942, 15,682 in 1943, and 4,009 during the first two months of 1944.¹⁰ The fact that there were slightly more than 80 per cent as many graduates during the first two months of 1944 as during all of 1942 is suggestive of the rapid expansion

8. Ibid., 8 Dec. 1941-1 Jan. 1943, 86; ibid., 1 Jan. 1943-31 Dec. 1943, 81.

9. History of Harlingen Army Air Field, 1 May 1941-1 March 1944, I, 1-7, 20-22; II, 1.

10. Ibid., V, 45-55.

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of the school.

Tyndall Field as a site for a flexible gunnery school was agreed upon by Army authorities and representatives of the chamber of commerce of Panama City, Fla., as early as September 1940. Authorization for the school was given on 15 April 1941, and though 2,000 troops had arrived there from Eglin Field by 7 December 1941, classes did not begin for students until 23 February 1942. A significant factor in its choice was that the Gulf of Mexico afforded large over-water areas which could be used for aerial gunnery ranges. There were strong indications by the end of 1941 that Tyndall Field could not handle the volume of air traffic necessitated by the expanding gunnery program; hence, steps were taken which resulted in the activation of a sub-base at Apalachicola, Fla., on 10 July 1942. The school had 8,091 graduates in 1942, a figure which may be compared with a total of 39,452 by the end of August 1944.

An instructors school for flexible gunnery was activated at Fort Myers, Fla., on 5 July 1942, the first class started 7 September, and more than 3,000 men had been graduated by the end of the year.

More than a year elapsed from the time that the West Coast Training Center investigated the site near Kingman, Ariz., until it was approved on 27 May 1942 as the location for a flexible gunnery school. As far as climatic conditions, transportation facilities, and lands suitable for

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11. History of Tyndall Field FGS, 1 Jan. 1939-7 Dec. 1941, 4, 6; ibid., 7 Dec. 1941-31 Dec. 1942, 1, 9.
 12. Ibid., 7 Dec. 1941-31 Dec. 1942, 34-36.
 13. For 1942 figures see AFFTC Consolidated Flying Training Report, Dec. 1942. The total figures were given the writer in interview with Lt. Col. Robert A. Gardner, Chief, Flexible Gunnery Div., 11 Sep. 1944.
 14. History of Buckingham Army Air Field, Installment 1, II, 33-35, 150. There will be a discussion in a later chapter of the activities of this school.

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air-to-air firing ranges were concerned, Kingman had decided advantages. There was a water supply problem, however, which was not solved until engineers found supplies of water not at first thought available. The school was activated 4 August 1942, though training did not begin until the middle of January 1943. The late start made it possible to fashion a program which would reflect the sound experiences and avoid the mis-¹⁵takes of the earlier schools. Kingman graduates numbered 10,861 in¹⁶ 1943.

In a climate mild in winter and hot in summer, but usually tempered by southeast breezes, and in a location once a wasteland, from which on a clear day can be seen the mountains of Mexico 85 miles distant, is the Laredo Army Air Field. The gunnery school there was activated 12 August 1942, and the first aerial gunnery class started 30 November¹⁷ of the same year and was graduated the first week of January 1943.

Yuma Army Air Field was at first an advanced pilot training school, but was officially changed to a radio flexible gunnery school on 11 November 1943. For approximately one month the gunnery program paralleled the pilot training one, after which the latter was abandoned. Though there were only 113 graduates by the end of 1943, there were at that¹⁸ time 1,655 students enrolled.

15. History of Kingman Army Air Field, Installment 1, 1-5, 15.

16. Ibid., Installment 2, 250.

17. History of Laredo Army Air Field, May 1942 to January 1943, 1-3, 9.

18. History of Yuma Army Air Field, Installment 3, 15, 182, 189.

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The following are the numbers graduating from the several flexible gunnery schools during the period from activation until 31 August 1944:

Las Vegas	44,246
Harlingen	36,494
Tyndall Field	39,452
Fort Myers	33,118
Laredo	27,077
Kingman	24,008
Yuma	<u>10,431</u>
Grand Total	214,826

The weekly output of graduates at the end of August 1944 for all flexible gunnery schools was 3,500, a figure which represents an annual¹⁹ production rate of 182,000. There were 3,209 graduates for the week ending 16 June 1944, while the total for the four previous weeks was²⁰ 12,618. In July 1943 AAF Headquarters devised plans which it felt would result in an annual production rate of 180,000 gunners by March²¹ 1944. The relative success of its plans is indicated by the weekly ratios given above.

The creation and expansion of flexible gunnery schools was, of course, linked with the problem of securing an adequate number of students who could meet the requirements of the gunnery program. The problem was not solely one of determining physical, mental, and technical qualifications, but also of creating psychological conditions which would be most conducive to satisfactory results. In an immediate action letter sent 10 August 1942 to all who had high official connection with the AAF training program, Headquarters laid down a detailed program of entrance re-

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19. The above figures were supplied the writer by Lt. Col. Robert A. Gardner, 11 Sep. 1944. Figures given by AFTRC, Statistical Control Unit, for the total number of graduates through 31 Aug. 1944, are 215,404.
20. Daily Diary, AFTRC, 21 June 1944.
21. AC/AS, Plans to AC/AS, Training, 11 July 1943, in AAG 353E Training.

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quirements for attendance at flexible gunnery schools, and described the status of those who graduated from such schools. Those who entered did so voluntarily. They must be between the ages of 18 and 30 inclusive, 5 feet, 10 inches or less in height, and 170 pounds or less in weight. They were required to pass the Army General Classification Test with a score of at least 100 and make a satisfactory score on the Mechanical Aptitude Test. Nonspecialists or specialists such as airplane mechanics, radio or radar operators, and aircraft armorers were eligible for admission, provided they were below the grade of staff sergeant. Upon graduation all enlisted men below the third enlisted grade who had graduated from an AAF school of any of the three specialist types indicated above would be immediately appointed to the grade of staff sergeant, and all other graduates below the fourth enlisted grade would be immediately appointed to the grade of sergeant. All graduates were authorized to wear a combat crew badge.

As far as physical and mental requirements were concerned, the tendency after the summer of 1942 was to lower them. During the fall months the requirements for passing the Mechanical Aptitude Test were lowered from 100 to 85 and subsequently to 80, and for the General Classification Test from 100 to 85. Even these steps did not suffice to fill the quotas, as indicated by the complaint of the Flying Training Command that men who did not meet the above requirements were being assigned to

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- 22. Hq AAF to CG's, all air forces and commands and CO's, all AAF stations and activities in Continental U. S., 10 Aug. 1942, in AFACF 353, Gunnery, General.
 - 23. History of Harlingen Army Air Field, 1 May 1941-1 March 1944, II, 8.
 - 24. History of Buckingham Army Air Field, Installment 1, II, 42.

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flexible gunnery schools. By July 1943 the physical requirements for trainees also had been modified. The age limits were then 18-35, requirements as to height, minimum 60 and maximum 72 inches, and as to weight, not less than 100 nor more than 180 pounds.

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The crews of bombardment airplanes differed as to personnel included in the respective types of planes. When the flexible gunnery program was in the early stages, the Chief of the Air Corps issued a directive in which provision was made for a crew of eight on heavy bombardment planes and of three on all light bombardment types. The only difference in the requirements for B-25 and B-26 planes from those for B-17 and B-24 was one gunner instead of two.

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After the gunnery program was more fully developed, however, there was an expansion in the heavy bombardment crew with the addition of more enlisted specialists.

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Of the various aircrew members, only the pilots were exempted from flexible gunnery training. Such a requirement varied, however, in its application to navigators and bombardiers. In July 1942, when advanced bombardier schools were unable to absorb the flow of trainees assigned from preflight schools, it was decided to send men assigned to bombardier training to flexible gunnery before they entered the preflight course. The same procedure was followed in the case of navigators. Limited

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- 25. Hq AFFTC to CG AAF 28 Jan. 1943, in AAG 353, Gunnery Training.
 - 26. AC/AS, Personnel to Maj. John W. Stanley, 27 July 1943, in ibid.
 - 27. C/AC to CG's, WCASTC, GCACTC, SEACTC, ACTTC, 9 Jan. 1941, in AAG 353.9B2, Training, General.
 - 28. Information on crew members of types of bombardment planes was obtained from a chart made accessible by Lt. Col. W. L. Clark, Flexible Gunnery Div., 9 Jan. 1945.

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capacity combined with priority given to career gunners made it impossible for flexible gunnery schools to accommodate all who were scheduled to take the training. Even after the policy was changed in December 1942, and only preflight graduates might go to gunnery schools, the existing situation was not altered to the extent that all bombardiers and navigators received flexible gunnery instruction. In 1944 there was considerable discussion of the wisdom of requiring gunnery training for these two groups. So many bombardiers and navigators were required that it was not considered feasible to give all of them instruction beyond their special duties. It was pointed out also that the establishment of a B-29 Flexible Gunnery School and the increasing emphasis upon more gunners made it impossible for the existing schools to carry out the accelerated program if navigators and bombardiers were routed through the gunnery course. A navigator's gunnery duties were not important, it was contended, because he had no primary gun position on a B-24 and fired only the side nose guns on a B-17. In April 1944 bombardier and navigator officers and cadets were no longer required to take gunnery training, but soon afterward Headquarters AAF requested that those groups be given as much of such training as possible.

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29. Memo for General Perrin by Brig. Gen. R. W. Harper, 3 Sep. 1943, in AAG 353, Gunnery Training; AAF Historical Studies: No. 5, Individual Training of Bombardiers, 16, 42.
30. For discussion and decisions see R&R, AC/AS, Training to AC/AS, OC&R, 18 March 1944; R&R, AC/AS, OC&R to AC/AS, Training, 21 March 1944, in AAG 353, Gunnery Training; AFTRC Monthly Progress Report, March, 1944; Maj. Gen. R. W. Harper to CG 4th AF, 11 May 1944, in AAG 353 Gunnery Training; memo for General Perrin by Brig. Gen. R. W. Harper, 3 Sep. 1943, in ibid.

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During 1942 and the early part of 1943 AAF authorities became convinced of the need of special mechanical training for those who expected to take flexible gunnery training. The development of mechanical aptitudes gave one an initial advantage over the nonspecialist in understanding flexible gunnery techniques. After the volunteer system was abandoned, it was found that "persuasion and salesmanship" in securing acquiescence in the compulsory gunnery program were easier "when the students were graduates of technical schools giving them an introductory knowledge of some of the basic skills involved in flexible gunnery." Thus the abandonment of the voluntary system early in 1943 gave momentum³¹ to the move for restricting training to specialists only. Most elaborate plans were worked out for obtaining from factory schools students³² to be trained as aerial engineers and likewise as gunners. In December 1942 the Chief of the Air Staff declared that flexible gunnery was "primarily for enlisted specialists" who were "qualified as airplane mechanics, radio operators or armorers." Nonspecialists, he claimed, in many cases could not qualify for training and had to be eliminated.³³ The results were unfilled quotas and unnecessary expense. The order, however, which directed that basic soldiers were no longer to be trained in flexible gunnery but only in mechanics, did not come until 27 April³⁴ 1943. This policy continued for approximately three months, after which nonspecialists were again placed on a par with specialists. The

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31. History of Harlingen Army Air Field, 1 May 1941-1 March 1944, II, 8.
 32. Hq AAF to CG 2d AF, 7 Sep. 1942, inclosing directive of 5 Sep. 1942 to AFTTC; AFRIT to CG AFTTC, 5 Sep. 1942, in AAG 353.9F, Training, General.
 33. C/AS to CG's, all AF's, commands, etc., 11 Dec. 1942, in AAG 353, Gunnery Training.
 34. Brig. Gen. R. W. Harper to CG AFTTC, 27 April 1943, in ibid.
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reason was the expansion of the program, which was designed to produce as soon as possible 140,000 gunners a year. In the words of General Arnold, flexible gunnery training in the Training Command and the training air forces was to be given "a priority on personnel, base facilities, and equipment, including combat type airplanes, ahead of all other training activities in the United States." At the same time that General Arnold was writing these words designed to bolster the program, Brig. Gen. R. W. Harper was indicating its breakdown into the following groupings:

Bombardiers and Navigators	40,000
Radio Operator Mechanics	16,667
Armorers	16,667
Airplane Mechanics	16,667
Non-specialist career gunners	50,000

Officers as well as enlisted men were trained at flexible gunnery schools. In answer to a request from the Technical Training Command for information as to officer training, Headquarters AAF referred to a memorandum of 9 September 1942 in which it was stated that bombardier, navigator, observer, and radar officers were eligible for the gunnery courses. Some of the officers became instructors and some performed administrative and supervisory duties.

Morale of flexible gunnery students was affected by numerous factors. Graduate gunners became either staff sergeants or sergeants. There were complaints from the training air forces that these grades were too high, with the result that the Military Personnel Division of the Air Staff

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35. R&R, CG AAF to AC/AS, Training, 3 Aug. 1943, in AAG 353A, Gunnery Training; 1st ind., (Hq WDC and 4th Army to CG AAF 25 July 1943) AC/AS, Personnel to CG WDC & 4th Army, 2 Aug. 1943, in AAG 353, Gunnery Training.
36. Brig. Gen. R. W. Harper to CG AFTRC, 3 Aug. 1943, in AAG 353A, Gunnery Training.
37. Hq Technical School, AFTRC, Boca Raton, Fla., to CG AFTRC, 19 Jan. 1943, and 2d ind., AFTRC to CG AFTRC, 27 Jan. 1943, in AAG 353, Gunnery Training.
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made a rule late in 1943 to the effect that specialist gunners might not be ranked higher than sergeants or other enlisted men higher than corporals. AAF Headquarters, however, felt that the application of such a principle had the effect of lowering morale because it forced some to reduce their rank in order to become gunners. Under existing tables of organization, radio operator mechanics, airplane mechanics, and armorers might train in grade up to and including technical sergeant, and other personnel sent to gunnery schools to train as career gunners could not be above the grade of sergeant. In March 1944 it was decreed that specialists and career gunners might train in grade up to and including technical sergeant and sergeant, respectively, so that they would be assured of no reduction in rank.

Until 16 January 1943 flexible gunnery training was on a volunteer basis. The theory was that greater enthusiasm would prevail, morale would be higher, and efficiency greater than if the compulsory principle were applied. To a great degree, however, these expectations were not met. Some of the men sent to gunnery schools were averse to training after they discovered what their duties were. In September 1942, at a time when there was much demand for specialists elsewhere, the Flying Training Command restricted flexible gunnery volunteers to nonspecialists and eliminated aviation cadets. The personnel of the schools at that time was therefore of inferior quality. Before the end of the year it

33. These policies and changes are discussed in Brig. Gen. R. W. Harper to AFPM, 28 Feb. 1944; R&R, AFPM to AG/AS, Training, 6 March 1944; 3d ind. (Hq AFTRC to CG AAF, 19 Feb. 1944), Hq AAF to CG AFTRC, 9 March 1944, all in ibid.

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became apparent that specialists were highly desirable as gunnery material and also that the numbers contemplated in flexible gunnery plans for 1943 could very probably not be met under the volunteer system. All these factors resulted in the abandonment of that system.

Whether more good or evil would result from the change was one of the most significant questions concerning the flexible gunnery program during 1943. Just before the compulsory policy was put into effect, the Flying Training Command protested against it. After intimating that numerical needs had not been met because the command had no jurisdiction over the procurement of students, that Headquarters predicted that compulsory service would cause the elimination rate to rise to approximately 35 per cent of the total number enrolled. Assuming that students were not supposed to be made to fly, it felt that this high rate of elimination would "be due largely to candidates who, seeking a transfer from Replacement Centers, will not make the statement they do not desire to fly, before being ordered to the Flexible Gunnery Schools and beginning training."

There is evidence that the initial results of the compulsory system were not good. The Southeast Training Center had its director of altitude training units make an inspection of Tondall Field early in February 1943, and the result was a rather startling report as to the reaction to required training. Many were afraid of flying and were using altitude chamber tests as a means of securing disqualification. Some who did not

39. History of Eastern Flying Training Command, Installment 2, II, 968-69, 972-74; History of Central Flying Training Command, Installment 3, 661-62, 665; History of Buckingham Army Air Field, Installment 1, II, 38-41.

40. Hq AFFTC/AFRIT, 10 Jan. 1943, in AFAST-353, Gunnery, General.

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express fear complained that they had never volunteered for aerial gunnery. The director felt that a bad mental situation was thus being created, and he recommended the voluntary system.⁴¹ This report led the Southeast Training Center to direct the commanding officer at Tyn dall Field to make an investigation of the conditions alleged to exist. The investigation among the students showed dissatisfaction with aerial gunnery to such an extent that it caused "the flight surgeon deep concern." Many did not know at the classification centers that flexible gunnery training was required, and, upon hearing that an expressed fear of flying was a cause of elimination, "flocked" to the hospital to express the fear and avoid the training. This situation, however, was viewed as a natural result of the transition from a voluntary to a compulsory basis. It was recommended that requirements be made clear at the classification centers, so that elimination could take place there.⁴²

Thus, as General Harper stated it, the problem that arose was whether a good enough educational and sales job could be done on prospective students to keep the gunnery program, from a practical standpoint, on a voluntary basis. By the end of June he expressed the view to the Commanding General of the Flying Training Command that "The splendid job of publicity designed to accomplish this and which is now being conducted by your Public Relations Office has come to the attention of this Headquarters. The results of their efforts are already evidenced by the

41. Office of the Surgeon, Hq SEAFTC to C/S SEAFTC, 5 Feb. 1943, in AAG 353, Gunnery Training.

42. Hq SEAFTC to CG Tyn dall Field, 15 Feb. 1943, and 1st ind., CG Tyn dall Field FGS to CG SEAFTC, 23 Feb. 1943, in *ibid*.

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improved attitude of the students arriving at gunnery schools."

The elimination rate of 35 per cent predicted by the Flying Training Command did not materialize. In a report on the flexible gunnery program's elimination policy in October 1943, Headquarters of the Central Flexible Gunnery Instructors School indicated that 10 per cent of the students failed to continue the gunnery course. A final examination, on which the passing grade was 70, cut off 2 per cent. Ground range deficiency and air range deficiency were responsible for the other 8

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per cent. One year before this time, when the training was voluntary, the elimination rate in the four flexible gunnery schools then in existence was as follows:

Harlingen	16.1
Las Vegas	9.7
Fort Wivers	10.4
Tyndall Field	5.2

Lack of standardization of instruction and differences in facilities were reasons assigned for differences in the rate in the respective schools. The mean average for the four is strikingly similar to the 1943 figure. Fear of flying continued to be a valid reason for elimination. "In no case," stated a Flying Training Command Memorandum of 5 May 1944, "should a trainee be ordered to fly or threatened with dis-

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ciplinary action if he refused."

43. Brig. Gen. R. W. Harper to CG AFFTC, 30 June 1943, in ibid.

44. Hq CFGIS to AG/AS, Training, 20 Oct. 1943, in ibid.

45. 3d ind. (AFRIT to CG AFFTC, 30 Oct. 1942) Hq AFFTC to CG AAF, 21 Nov. 1942, in AFACF 353, Gunnery General.

46. AFTRC Monthly Progress Report, May 1944, 16, 17.

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Though prior to 1941 there were no specialized flexible gunnery schools, six were established before the end of 1942 and one in 1943. The following is the chronological order in which they came into existence: Las Vegas, Tindall, Harlingen, Fort Myers (instructors), Kingman, Laredo, and Yuma. By 1 September 1944, 214,826 gunners had graduated from the seven schools, while the weekly production at that time was 3,500. In securing students, physical and mental requirements were sometimes conditioned by unfilled quotas. The shift from voluntary to compulsory training, determined largely by the needs of an expanding program, gave rise to a morale problem, which seems to have been satisfactorily adjusted after an educational campaign had "sold" the flexible gunnery program. A bombardment crew included pilots, radio operators, bombardiers, navigators, photographers, and observers. With the exception that bombardiers and navigators were exempted during a brief period in 1944, only pilots were not required to take gunnery training. Eliminations because of training deficiencies and fear of flying amounted to approximately 10 per cent of those trained.

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Chapter II

THE PROBLEMS OF INSTRUCTOR AND OFFICER PERSONNEL AND OF TRAINING EQUIPMENT

It was natural that in the early stages of the gunnery program instructors should be trained in too brief a time period and in a somewhat haphazard fashion. They were sometimes obtained from technical schools and at others from the ranks of enlisted men in the flexible gunnery schools. The procedure may be explained in some detail as applied at Tyndall Field. There, late in January 1942, provision was made for a special short course for instructors. Officers gave instruction to armorers who had just arrived from Lowry Field. After one week the prospective instructors were given a quiz, consulted as to their choice of subjects to teach, and then classified and assigned to the officers for further preparation. This course lasted approximately four weeks. Six weeks after regular student classes began, a policy was put into effect of retaining 10 men from each graduating class to be used as instructors. Though at first this step was taken arbitrarily, later the men were consulted as to their wishes and particular talents.¹

During most of the year 1942 there was considerable dissatisfaction among instructors because of low rank, dissatisfaction which was all the

1. History of Tyndall Field FGS, II, 9-10. Early efforts to secure instructors are also described in History of Eastern Flying Training Command, Installment 2, II, 953-55, 957 ff.

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more acute in view of the fact that students graduated as sergeants and staff sergeants, while instructors remained privates and corporals. In August of that year, however, Headquarters, AAF made provision for promoting members of the instructional staff to sergeant or staff sergeant, a step which greatly improved morale.²

During 1942 there was instituted the flight system of instruction, a product of Brooks Field experience, under which each instructor carried his flight or unit through every subject in the course. There were both advantages and disadvantages under such a system. Personal contact with the students on the part of the instructor and logical organization, by him, of the entire course were the main advantages. The most obvious weakness was the instructor's lack of sufficient preparation to conduct every phase of training. Members of the teaching staff varied in respect to ability in mastering subjects, so it was deemed wise after a period of experimentation to assign teaching duties in terms of the respective abilities of those performing them.³ The flight system had failed in practice, despite the apparently sound theory behind it.

The pressing need for more and better prepared instructors and for standardization of procedure in flexible gunnery schools led to the creation late in 1942 of the Central Flexible Gunnery Instructors School at Fort Hivers. Objectives in the establishment of the school in addition to the above were gunnery research, preparation and distribution

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2. History of Buckingham Army Air Field, Installment 1, II, 57; History of Las Vegas FGS, 8 Dec. 1941-1 Jan. 1943, 8.
 3. History of Buckingham Army Air Field, Installment 1, II, 54, 56-57; History of Las Vegas FGS, 8 Dec. 1941-1 Jan. 1943, 9-13.

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of data pertaining to flexible gunnery, and the giving of technical
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 advice on that subject.

Elaborate plans were made in 1943 to expand and improve the school. In directing the establishment of a psychological research unit there to assist in selection and training of instructors, AAF Headquarters declared that such selection and training constituted "one of the most
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 critical problems in flexible gunnery training." Headquarters im-
 pressed upon the Flying Training Command the need for more instructors in the First, Second, Third, and Fourth Air Forces and suggested pro-
 cedures necessary to meet that need. Students entering flexible gun-
 nery schools were to be screened for the following qualifications:
 "(a) A minimum GCT of 120 or (b), a minimum GCT of 110, if the student
 is a college graduate or has had previous teaching experience. (c) At
 least a high school education. (d) The ability to express himself.
 (e) The willingness to be an instructor." In addition to these qual-
 ifications, in order to enter the instructors school, students would
 have to graduate in the upper 25 per cent of their class, and would,
 after admission, be required to pass periodic examinations in order to
 remain in school. Under this plan the number of instructors was to
 be increased by 2,000 by 1 June 1944. This number or estimate included
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 the replacing of 1,000 regarded as deficient in training. The Training

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4. History of Eastern Flying Training Command, Installment 3, II, 815-16; T.C. Memo No. 50-13-2, 28 July 1943.
 5. Brig. Gen. R. W. Harper to CG AFTRC, 20 Aug. 1943, in AAG 353, Gunnery Training.
 6. Brig. Gen. R. W. Harper to CG AFTRC, 27 Aug. 1943, in *ibid*.

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Command agreed to this proposal in large part, though it did suggest a⁷ larger quota from the air forces to the instructors school. In January 1944 it was ordered that graduates of the instructors school who were assigned to the training air forces be increased from 45 per cent to 70 per cent of the total, and soon thereafter that the staff of the school be increased.⁸ The persistency of these efforts at expansion is further explained by the report of a conference on training, held at Fort Worth in January 1944, that there was a need for 6,665 instructors and that it would require 54 weeks to meet that need.⁹

In the early stages of the program there was no systematic way of securing flexible gunnery officers. They were obtained from various placed, and not because they were especially equipped for the duties they were to assume.¹⁰ Those duties consisted mainly of flying on missions with students, handling disciplinary problems, and supervising the work of enlisted men and of instructors, particularly that of the latter.¹¹

In line with the more precise and scientific developments that were taking place in 1943 in respect to the gunnery program, the Training Command in November of that year took steps to establish at the instructors school at Fort Myers a special four-week course for the training of gunnery officers.¹² Before long the command was requesting

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7. 1st ind. (Brig. Gen. R. W. Harper to CG AFTRC, 27 Aug. 1943) Hq AFTRC, to AC/AS, Training, 17 Sep. 1943, in ibid.
 8. AFTRC Monthly Progress Reports, Jan., Feb. 1944.
 9. Report, Training Conference, Hq AFTRC, 10-12 Jan. 1944, 10-d.
 10. History of Buckingham Army Air Field, Installment 1, II, 61-63; History of Eastern Flying Training Command, Installment 3, II, 851-52.
 11. Interview with Lt. Col. W. L. Clark, 9 Jan. 1945.
 12. History of Eastern Flying Training Command, Installment 3, II, 852.

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that the gunnery school be located at Laredo, Tex., on the grounds that housing and training facilities at Fort Myers were overtaxed and that instruction for officers was "completely dissimilar" to that for enlisted instructors. ¹³ The school was removed to Laredo on 29 May 1944, ¹⁴ but in the early part of that month the instructors school had been removed there also.

Headquarters AAF and the report of a training conference held at Fort Worth both stressed early in 1944 the need for approximately 1,500 officers in addition to those available. They were to be assigned after graduation to schools or to the air forces at home or abroad, and their grades, with a few exceptions, would range from lieutenant to major. ¹⁵ Replving to a communication from the Training Command requesting information as to the qualifications and requirements for gunnery officers, General Harper indicated that they must be within the age limits, 23-35, must be graduates of flexible gunnery schools and among the upper 25 per cent of their graduating classes, and have high personal efficiency ratings. He designated as follows eight sources from which such officer material might be drawn: ¹⁶

1. TC flexible gunnery officers.
 2. Training Air Forces flexible gunnery officers.
 3. Combat forces flexible gunnery officers.
 4. Officers being returned from combat.
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13. Eq AFTRC to AG/AS, Training, 5 April 1944, in AAG 353A, Gunnery Training.
 14. AFTRC Monthly Progress Reports, May, June 1944.
 15. Report of Training Conference, Hq AFTRC, 10-12 Jan. 1944; R&R, Brig. Gen. R. W. Harper to AFTRC, 11 Feb. 1944, in AAG 353, Gunnery Training.
 16. 1st ind. (Hq AFTRC to CG AAF, 5 April 1944) Maj. Gen. R. W. Harper to CG AFTRC, 10 May 1944, in AAG 353A, Gunnery Training.

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5. Officers graduating from AAF Officers Candidate School.
6. Enlisted Combat Gunners who are commissioned in combat theaters.
7. Officers on duty with the Air Forces who applied for flying training, passed all tests, and then were banned from such training.
8. All other officers on duty with the Air Forces.

In May 1944 the gunnery officers course, which already had been increased to 5 weeks, was extended to 6, and the flow of students was fixed at 30 per week for 6 weeks, and 50 a week thereafter. ¹⁷ By 3 January 1945 a total of 693 officers had graduated from the gunnery officers school. ¹⁸

In brief, improvement in instructor personnel was secured by transition from haphazard methods of selection to more scientific methods. Late in 1942 there was established at Fort Myers a Central Flexible Gunnery Instructors School which had as its objectives not only training of instructors and standardization of procedures but also gunnery research, distribution of data pertaining to flexible gunnery, and the giving of technical advice on that subject. Care was exercised in the selection of students for the school. The abandonment of the flight system of instruction, which made inevitable the assigning of too many complex problems to each instructor, was conducive to greater efficiency. Need for more officers with better training led to the creation late in 1943 of an officers gunnery school.

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17. Progress Report, April 1944, Hq AFPC, 17 May 1944, 15.
 18. Interview with Maj. Thomas V. Hart, Flexible Gunnery Div., 11 Jan. 1945.

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The problems involved in the establishment of a sound program of flexible gunnerv training were not only those that had to do with securing and using effectively human materials--students, instructors, and officers--but also those involved in the procurement of necessary equipment, such as planes, trainers, turrets, and other essentials. In its broader aspects this problem is properly one for treatment under some other phase of AAF history; but insofar as it conditioned vitally the operation of the training program, it deserves treatment here.

Since flexible gunnerv was in its infant stages at the advent of World War II, there naturally arose a question as to the utility of potential equipment. Experimentation was one way of determining utility, and a study of the experiences of the RAF was another. In the fall of 1941, Maj. William L. Kennedy, who studied many phases of English gunnerv training, made a report to the Chief of the Air Corps on synthetic devices used by the RAF in gunnerv training. He discussed the pros and cons of 13 devices, such as panoramic trainers, spotlight trainers, platform tracer trainers, and, though concluding himself that some were desirable and others undesirable, recommended the creation of a board
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of officers to study and evaluate them. Although the board was not created, the Training and Operations Division was given the authority to evaluate and was requested to send its conclusions to the Materiel
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Division and to the Air Force Combat Command. In order to help meet the "primary need" of the time, namely, "training devices for fixed and

19. R&R, Maj. William L. Kennedy to C/AC (through Chief, T&O Div.), 9 Oct. 1941, in ^{AAG}413.6A, Miscellaneous Trainers.)

20. R&R, C/AC to Chief, T&O Div., 14 Oct. 1941, in ibid.

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flexible gunnery," arrangements were made between the Materiel and Training and Training and Operations divisions for representatives of Wright Field to visit the flexible gunnery schools being established at Las Vegas, Harlingen, and Panama City.²¹

In the case of trainers, not infrequently it was necessary to compare them as to utility or to experiment with them for the purposes desired. In the summer of 1942 the Director of Individual Training of the AAF submitted to the Flying Training Command correspondence in respect to the Turnbull Gunnery Trainer with a request for consideration and recommendations. The reply was that the trainer was not needed in flexible gunnery, because "the present Spotlight Trainers give sufficient training in turret manipulation for basic instruction, and the Waller and 3A-2 Gunnery Trainers, which will be in operation very shortly, perform the same functions as the Turnbull Trainer in a more satisfactory manner."²²

Though the Air Service Command had developed and was "about to procure in quantity" E-5 Gunnery Trainers, AAF Headquarters felt that they were so similar to the product built by F. S. Hurley as to justify a comparison of the merits of the two by the proper personnel at Wright Field.²³ After being used for a time, an aerial gunnery device presented by Col. J. H. Graham was discontinued because the Waller

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21. Inter-office memo, Chief, EE Sec., Materiel Div., Wright Field, to to Chief, Materiel Div., OCAC, 22 July 1941; Chief, Armament Br. to Chief EE Sec., Materiel Div., Wright Field, 6 Aug. 1941, in ibid.
 22. AFRIT to CG AFFTC, 31 July 1942, and 1st ind., Hq AFFTC to AFRIT, 21 Aug. 1942, in AAG 472, Aerial Gunnery Trainers.
 23. Hq AAF Chief, EE Sec., Wright Field, 26 Aug. 1942, in ibid. In September, when E-5 trainers were in use, the Hurley product was being considered as "supplementary" to the E-5.

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trainer incorporated "all the desirable features proposed in the Fair-child device with the exception of aircraft identification," which could²⁴ be accomplished without the necessity of such elaborate equipment.

During the early stages of the pressing need for flexible gunnery equipment, the Jam Handy products received very favorable consideration. In a letter to General Arnold in September 1942, J. A. Pool, chief designer of the Jam Handy organization, explained at length the adaptability of its devices to the gunnery program. He emphasized especially gun camera equipment, designed to make possible simulated combat operations, and a lead computing sight, claimed to be simple in its operations. It was said of the camera gun that "it allows actual practice of gun firing in aerial combat with built-in means to indicate, accurately and easily on the films, where the point of aim was as well as where it should have been." The computing sight was described as of such a nature that there "will be no lead problem for the gunner in the turret of a bomber when he is being attacked by a pursuit plane. He will simply have to place the attacking plane on the moving spot of light in his sight."²⁵ During the same month the Flying Training Command requested a large number of Jam Handy trainers, and General Arnold expressed

great interest in the products of the corporation.²⁶ Illustrative of the pressing need for equipment was the following sentiment in a reply of the West Coast Training Center to a request that Las Vegas supply

24. AFRIT to CG AAF, 23 June 1942, in ibid.

25. J. A. Pool to Lt. Gen. H. H. Arnold, 9 Sep. 1942, in ibid.

26. Memo for Lt. Gen. H. H. Arnold by AFRIT, 12 Sept. 1942; Lt. Gen. H. H. Arnold to John A. Pool, 14 Sep. 1942, in ibid.

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the Wendover Army Air Base with four E-1 gunner-v trainers: "Las Vegas has forty type E-1 Trainers and requires forty." Since the lack of this apparatus was general in the flexible gunner-v schools, the Flying Training Command requested the Air Service Command to meet the need.²⁷ Despite the uncertainty over the continued use of E-5 trainers, by the summer of 1942 the modified type was proving its efficacy, especially since its installation could accommodate the Martin and Bendix upper²⁸ and the Sperry upper and lower turrets.

A significant phase of the supply problem was the relationship involved between the Army and the Navy. The latter frequently had contracts of such a character with supply organizations that it was necessary for the Army to negotiate for equipment through the Navy. This procedure is well illustrated in securing 3A-2 trainers for the flexible gunner-v schools. The Jam Handy organization had an agreement to furnish them to the Navy, but arrangements were made to allocate some to Army gunner-v schools. At first one was allocated to Las Vegas for instructional purposes, then 32 were requested, and later in the year, 52, which the Navy agreed to furnish between 1 October and 10 November. Before the first shipment was made to Las Vegas, however, an officer of that school was required by the Navy to go to Detroit and study the "use and maintenance" of the trainer, so that he would be

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27. Director of Training, Wendover Field to CG Wendover Field, 6 June 1942; 4th ind., Hq WCAFTC to CG AFTTC, 20 June 1942; 5th ind., Hq AFTTC to CG AFASO, 30 June 1942, in *ibid*.
 28. AFRII to CG AFTTC, 21 July 1942, in *ibid*; AFRBS to Chief, Field Services, AFASO, 24 Aug. 1942, in 413.6B, Miscellaneous Trainers.

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able to give instruction in its operation. The cost of the trainer²⁹ with films and other equipment necessary for its use was \$2,065.50.

In May 1942 the Flying Training Command spoke of the urgent need for fixed and flexible gunnery of a range estimation and target identification trainer which had been developed by the Reflectone Corporation of Stamford, Conn. It stated that 260 were required at once and requested the Air Service Command to arrange with the Navy to supply³⁰ that number. The arrangements were made, under the terms of which the first unit was to be delivered in approximately five weeks of the date of order and the remainder at the rate of 50 per week. Additional agreements were made, first for 90 more trainers and then for 233, which made a grand total of 583. Of these, 420 were assigned to flexible gunnery schools.³¹ Steps were taken also to secure first 14 and then eight additional Waller trainers through the Navy Department in³² 1942.

Sometimes difficulties in regard to equipment arose because it was not clear as to where the procurement authority resided. When Headquarters

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29. For negotiations and agreements see Hq AFFTC to CG AFASC, 2 May 1942; Chief, Bureau of Aeronautics, Navy Dept., to CG AAF, 1 June 1942; Hq AFFTC to CG AAF, 10 June 1942; Bureau of Aeronautics to CG AAF, 21 July 1942; Hq AFFTC to AFRBS, 15 Aug. 1942; Personnel Officer, Bureau of Supplies and Accounts, Navy Dept., to Jam Hand Organization, 31 Aug. 1942, in AAG 472, Aerial Gunnery Trainers.
30. Hq AFFTC to CG AFASC, 29 May 1942, in AAG 413.6B, Miscellaneous Trainers.
31. Chief, Bureau of Aeronautics to CG AAF, 22 July 1942; Chief, Bureau of Aeronautics to AFRBS, 19 Sep. 1942, in *ibid.*
32. Memo for Chief, Materiel Div., OCAC by Chief, Contract Sec., Wright Field, 18 Feb. 1942; Hq AFFTC to AFRBS, 26 June 1942, and 1st ind., AFRBS to Chief, Field Services, AFASC, n.d., in AAG 472, Aerial Gunnery Trainers.

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AAF inquired of the Procurement Services Division the reason for delay in delivery of the parts necessary to install tow target equipment in A-20 and A-29 airplanes, that division replied that its responsibility ceased when provisions for installing the equipment were made in the production airplanes. Procurement of materiel itself, it was alleged, was a responsibility of the Air Service Command. In fact, ultimate responsibility at this time (1942) for placing contracts and for subsequent administration of them was in the hands of the Materiel Division. Though Supply and Maintenance Services suggested a division of such responsibility with the Air Service Command, Headquarters AAF decided that it should remain in the hands of the Materiel Division. ³³

A rapidly expanding training program bears a relation to the problem of equipment similar to that which a combat army bears to the problem of supply. In neither case do available numbers have much significance unless there is coordination on the one hand with facilities and on the other with supplies. During 1943 and 1944, especially, the personnel needed for flexible gunnery were greatly increased and therefore gave rise to the vital question as to whether training facilities, for which much ground had been laid in 1942, could keep pace with the number of trainees. Even during 1942 the Director of Individual Training had suggested that the training period be extended to seven ³⁴ days a week, so as to make less acute the shortage in airplanes.

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33. R&E, Asst. for Supply and Maintenance Services to C/AC, 28 Jan. 1942; C/AC to Asst. Exec. for Technical Planning and Coordination, OCAO, 10 Feb. 1942, in AAG 353.9DL, Training, General.
 34. AFRT to CG AFFTC, 11 Aug. 1942, in AAG 353.9E, Training, General.

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In August 1943 the Flying Training Command, just after General Arnold had set 140,000 flexible gunnerv graduates a year as the goal, gave an estimate of the equipment needed for the forthcoming program as compared with that at hand. The following table shows the wide discrepancy between the two:

<u>Item</u>	<u>Basis of Issue</u>	<u>Total require- ments for six weeks' course</u>	<u>Additional requirements for six weeks' course</u>
G. S. A. P. Camera	1 per 15 students	1,220	990
Trainers E-8, Spotlight E-1	1 per 35 students	530	383
Sights, Reflector, 70 Mil.	1 per 5 students	3,678	2,434
Trainer, Range Estimation	1 per 23 students	798	370
Trainer, Turret Trailer E-5	1 per 15 students	1,226	574
Trainer, Waller Gunnerv	1 per 329 students	55	13

The need of planes continued to be acute in 1944. Among the recommendations of the training conference held at Fort Worth in January 1944 was one that fighter airplanes for use in flexible gunnerv training should "be given higher priority." When General Harper requested from the Flying Training Command its reactions to criticism of the flexible gunnerv program by Assistant Secretary of War for Air, Robert A. Lovett, the reply emphasized as one of the main difficulties connected with the program the lack of planes. Since 24 February there had been a cancellation of delivery of 50 B-24J's, and information had been given from AAF Headquarters that 50 per cent of currently assigned B-17 planes

35. Hq AFTRC to AG/AS, M&D, 21 Aug. 1943, in AAG 353A, Gunnerv Training. The above is not the complete table, but is sufficient to illustrate the point under discussion. The estimates are for all flexible gunnerv schools, including the instructors school.
36. Report of Training Conference, Hq AFTRC, 10-12 Jan. 1944, 12-d.

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would not be available. The fighter aircraft situation was described as "even worse." Much emphasis had been placed upon this type "in order to properly simulate fighter attacks during camera gunner training," yet of approximately 260 such planes needed, only 26 were available for flexible gunner in February 1944. Since this reply was a defense against criticism, one would naturally expect as strong a statement of the command's case as possible. One of the main reasons for delay in instituting the B-29 gunner course was the lack of equipment.

In March 1944 Maj. Gen. Follett Bradley, at the suggestion of AAF Headquarters, made a report on the flexible gunner situation. What he has to say of equipment, particularly sights and turrets, is of more than usual significance:

It is axiomatic that agencies of training should be supplied in first priority with equipment suitable for the instruction of students in the equipment which they will use in combat. For effective gunner training, gunner schools, OTU's, RTU's and staging areas must have Poorman trainers and synthetic training devices and all types of computing and compensating sights and turrets which the gunners passing through will use in combat. That is not now the case. Many turrets are worn out. Computing sights are scarce, and the newer compensating sights, K-10 and K-11, are entirely lacking even though hundreds are in warehouses awaiting installation in turrets that will not be available until late summer. It is useless to procure modern, high performance equipment, necessarily delicate, unless the users are thoroughly familiar with it before entering the combat zone. I cannot stress too strongly the necessity for the assignment in first priority of new equipment to the Air Forces Board and to interested training agencies to permit the development of tactics and the training of personnel, respectively. Because the flexible gunner program is behind and needs new impetus, ample funds should be made available for such new construction as may be necessary.

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37. Brig. Gen. R. W. Harper to CG AFTRC, 1 March 1944, and 1st ind., Hq AFTRC to AG/AS, Training, 19 March 1944, in AAG 353A, Gunner Training.
38. 1st ind. Maj. Gen. R. W. Harper to CG AFTRC, 17 April 1944, Hq AFTRC to CG AAF 29 April 1944, in *ibid*.
39. Memo for C/AS by Maj. Gen. Follett Bradley, 28 March 1944, in AAG 353, Gunner Training.

It is easier to criticize than to praise, easier to see defects than virtues. Transformation from a peace to a war status, whether in training gunners or in some other phase of the war effort, was a complex and herculean task, the accomplishment of which was not always according to schedule nor without confusion. When one considers then the magnitude of the problem itself and adds to that the experimentation oftentimes necessary before a decision was made in regard to the use of equipment, he can evaluate more fairly the positive achievements in providing facilities for flexible gunner training. A report on conditions at the Harlingen school in 1942 emphasized the lack of turrets but also the fact that experiments were being conducted with various turret types.

It can thus be seen that, though the extent of the need of planes, trainers, turrets, and other training essentials varied from time to time, the need was never completely met. Experimentation and a study of the experience of the RAF system helped to determine the character of the equipment desired. Arrangements were made with the Navy to secure range estimation, Waller, and other types of trainers. This action was necessary because of the exclusive contracts the Navy had for that equipment. Recommendations by training conferences and the insistence of the Flying Training Command during 1944 upon the need of fighter aircraft for gun camera missions were factors in stimulating increased efforts for assignment of such aircraft to the training agencies.

40. Hq AFMTC to CG AFFTC, inclosing report of Capt. Edward Elliott, Jr., 22 July 1942, supplied to author by Major Elliott, 11 Sep. 1944.

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Chapter III

THE PATTERN OF TRAINING

Most of the preceding discussion has had to do with factors that conditioned training in a vital way but not with training itself. Most of the remainder will represent an analysis of training practices, the problems to which they gave rise, and the solutions or attempted solutions of the problems. The choice of topics for treatment is not easy, because there is such a close interrelation among the main phases of the gunnery program. Aircraft recognition, sighting and firing systems, and turret operations are closely interwoven, and yet, for purposes of discussion, will be handled separately. Academic instruction and ground and air firing are mutually supplementary aspects of the training course, all subject to modification in the light of experience.

The content and comparison of the curricula of flexible gunnery schools are necessary to an understanding of the discussion of specific training problems. Planning of curricula and preparation of textbooks was the work, in large part, of Maj. W. L. Kennedy and Col. Delmar T. Spivey. The former, after a study of the English flexible gunnery schools in the summer of 1941, prepared the first five weeks' course at Harlingen and aided in the preparation of

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textbooks to be used there. Colonel Spivey, project officer at Buckingham Army Air Field, performed a similar service for that station. In the early stages of their existence, flexible gunnery schools used as guide books Training Manual 1-271 and a Navy Department booklet, "Air Gunnery." After examining all available publications on gunnery in his planning for the school and comparing the results of his investigation with the subject matter of the two books, Colonel Spivey suggested to AAF Headquarters the preparation of another text embracing some principles from each of the former ones.²

The curricula of flexible gunnery schools were naturally somewhat experimental in nature, particularly in the early stages of training. One of the first plans tentatively agreed upon by the Chief of the Air Corps and the West Coast Training Center contemplated four weeks of instruction. The first week would be devoted to familiarization with equipment and duties; the second, to sighting problems and laboratory work; the third, to ground range exercises and firing; the fourth, to air range exercises and firing. The following year, 1941, the feeling that there should be more emphasis on air range exercises and firing resulted in a five instead of a four weeks' program.³

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1. History of Central Flying Training Command, Installment 3, III, 665-67.
 2. History of Eastern Flying Training Command, Installment 2, II, 979-80.
 3. History of Las Vegas FGS, 1 Jan. 1939-7 Dec. 1941, 7-8, 82-84; ibid., 8 Dec. 1941-1 Jan. 1943, 3.

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Further discussion of programs of instruction will be clarified by including here three such programs. They are for the years 1942⁴ (a revision of the 1941 program), 1943, and 1944.

<u>1942</u>	<u>Hours</u>
Orientation	1
Safety precautions	3
Description and nomenclature of equipment	16
Ballistics	2
Gun Installation	10
Sights	5
Sighting and sight harmonization	15
Aircraft recognition and estimation of range	12
Methods of fire on various courses	2
Turret manipulation--Spotlight Trainer	7
Firing	74
Tactics	3
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<u>1943</u>	
Caliber .50 machine gun	40
Caliber .30 machine gun	6
Malfunctions	20
Turrets	50
Sighting	44
Aircraft recognition	20
Ground firing	48
Air firing	52
Total	<hr/> 280

<u>1944</u>	
Caliber .50 machine gun	41
Turrets	44
Sighting	32
Aircraft recognition	10
Interphone procedure	4
Final comprehensive examination	2
Physical Training	36
Ground firing	64
Air training program	48
Phase checks	7
	<hr/> 290

4. Program of Instruction for the Training of Aerial Gunners (Flexible), W 4076 AC, 2-20-41, Rev. 1-5-42, W-7680, A. F.; T. C. Memo No. 50-13-1, 12 Aug. 1943; T. C. Memo No. 50-13-1, 31 May 1944.

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In July 1942 the curriculum provided for 210 hours of instruction, not including 40 hours of military training, during five weeks as compared with 150 early in the year. The increase was a result of the need for additional and more thorough instruction and of the adoption of the flight system of instruction under which a small group had one instructor assigned for all subjects, including range firing. This system, whatever its advantages, required more time on the part of the instructor in those phases in which he was not well prepared. Hours in the ground school were increased nearly one-half. In recognition of the imperative need of coping with unfamiliar atmospheric conditions, a course was added in oxygen and high-altitude flying.⁵

Suggestions for lengthening the flexible gunnery course from five to seven weeks had been made before the end of 1942. The result of this discussion was a compromise under which the increase was from five to six weeks, a change made effective by a Flying Training Command Memorandum of 5 April 1943.⁶ The abandonment of the volunteer system, the expansion of the gunnery program, and the growing need for more scientific training in the light of the experience of modern-day combat were all factors in the increase to six weeks. The change from the volunteer system with a consequent increase in numbers meant on the whole less efficient personnel which required more instruction. In reference to the lessons of experience as a factor in the change, it has been said that "this extension had become necessary as a result of the

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5. History of Las Vegas FGS, 8 Dec. 1941-1 Jan. 1943, 9-12, 16, 37.
6. Project Book, CG AFFTC, Flexible Gunnery Sec., 30 Oct. 1942, 8 April 1943.

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gradual accretions which had been made to the original curriculum until it was humanly impossible to accomplish all the training required within the five week period."

Prior to the summer of 1943 a fluid system of instruction and a lack of precise standards of proficiency made it difficult for schools to rate personnel, though they did try to devise methods for so doing. However, in the Training Command Memorandum of 12 August 1943, the main requirements of which are given above, the most detailed and precise instructions were given as to the standards to be attained before graduation and assignment to OTU and RTU training. The directive defined those standards in such phases as gunnery, sighting, aircraft recognition, turret operation, and air firing. Definition of procedure and standards was also a marked characteristic of the curriculum of May 1944. The contrast in this respect between the program of 1942 and those of 1943 and 1944 suggests an evolutionary trend from haphazard experiment toward scientific precision.

Understanding of guns was a sine qua non of sound flexible gunnery training. Many students had had so little experience with any kind of firearm that familiarization with shotguns and the .22-caliber rifle was required as well as with machine guns. Prior to the year 1943 there were many handicaps to instruction concerning guns and the use of them. In the earliest programs of instruction provision was made

7. History of Harlingen Army Air Field, 1 May 1941-1 March 1944, II, 7.

8. T. C. Memo No. 50-13-1, 12 Aug. 1943.

9. T. C. Memo No. 50-13-1, 31 May 1944.

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for familiarization with .50-caliber guns, but there were indeed few to
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be had. At Las Vegas during 1942 there were assigned half as many
.50-caliber as .30-caliber, but often there was a total of only two
guns for teaching a class of 20 students. Training aids designed to
familiarize students with firearms were unobtainable there during that
11
year.

All during 1942 the schools under the Eastern Flying Training
Command were compelled to use the .30-caliber gun because ammunition
for the .50-caliber was not available. They were also hampered by the
lack of guns and by the use of the AT-6 airplane, which was not adapted
to anything more than the simplest of beam shooting and was supplied
with a very unstable mount for the aerial gunner. The situation
improved, however, in 1943. By the first of that year the assignment
of a number of B-34 planes to Tyndall Field had facilitated gunnery
operations. Later, .50-caliber guns and training aids were received
12
in greater numbers.

The first class at Harlingen had but one gun, a .30-caliber
machine type, on which to practice assembly and disassembly. In
February 1942 the only type airplane available there was the AT-6,
which was too light to accommodate the .50-caliber gun. Because of
this undesirable situation there was an "impossibility of giving the

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10. Program of Instruction for the Training of Aerial Gunners
(Flexible), W 4076 AC, 2-20-41, Rev. 1-5-42, W-7680, A. F.
 11. History of Las Vegas FGS, 8 Dec. 1941-1 Jan. 1943, 17-19.
 12. History of Eastern Flying Training Command, Installment 2, II,
999, 1002, 1004; ibid., Installment 3, II, 885-87.

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students all the aerial training required of good turret gunners by firing only the hand-held .30-caliber machine gun from the rear cockpit of the AT-6 airplane.¹³ The assignment of B-34 planes in July 1942 made it possible to fire twin .30-caliber guns and a .30-caliber waist gun from a Martin turret. The gunnery situation was still further improved when, early in 1943, both Harlingen and Laredo were made B-24¹⁴ training schools. This designation was in line with the policy of specialization in planes then being followed at all flexible gunnery schools.

During 1943 increased efforts were made to bring about a greater degree of familiarization with guns. In a flexible gunnery conference held at Buckingham Army Air Field on 7 May 1943, the numerous representatives of both the Army and the Navy recommended that before graduation gunners must be able without assistance and coaching to demonstrate their knowledge of "the nomenclature and functions of the machine gun, ability to strip and reassemble the gun and correct the most common malfunctions."¹⁵ At Buckingham Field during the summer of 1942, 28 hours were devoted to weapons and 8 to malfunctions, and at Fort Myers in December of that year 30 hours to weapons and 10 to¹⁶ malfunctions. By way of contrast, the Training Command in August 1943 required that 40 hours be devoted to the .50-caliber machine gun,¹⁷ 6 to the .30-caliber, and 20 to malfunctions.

13. History of Central Flying Training Command, Installment 3, III, 670-71.

14. Ibid., 671, 688.

15. History of Eastern Flying Training Command, Installment 3, II, 830-32.

16. Ibid., Installment 2, II, 976-78.

17. T. C. Memo No. 50-13-1, 12 Aug. 1943.

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The Training Command also provided in great detail the instructions to be given in respect to weapons. The student must know the nomenclature and functions of all parts of the .50-caliber gun and the sequence of the functions. He must be able blindfolded to field-strip and reassemble the gun after the parts had been purposely mixed in very confused fashion, and able also to adjust on the gun proper headspace, the oil buffer tube, and the direction of feed. Add to these, 17 operations required when the student was not blindfolded and one understands to some degree the significance of this phase of training. The early emphasis upon the .30-caliber gun and the later upon the .50-caliber made the problem even more complex, because it was necessary¹⁸ to study the differences between the two.

The malfunction phase of gunnery training, as already suggested, received considerable attention. At the Las Vegas school throughout 1942 the ground firing course included trips to a malfunction range where runaway guns and stoppages were illustrated. The course at the range after March 1942 was concentrated in the fourth week of school, so that it would have a close time connection with theoretical instruction along this line. An idea of the development of this type of training may be gained by reference to the fact that there were at Las Vegas in January 1942, 12 instructors on the range using six .30-caliber machine guns as compared with 33 instructors in October using thirty-six .50-caliber and ten .30-caliber guns. In 1943 the weapons and

18. Ibid.

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STRIPPING GUNS AND DETECTING MALFUNCTIONS



MINNEAPOLIS STRIPPING GUNS AND DETECTING MALFUNCTIONS. A large group of students and instructors are standing in a line under a long, open-sided wooden structure, possibly a covered walkway or a large shelter. The scene is outdoors with trees visible in the background.



MALFUNCTION RANGER. In almost every run there is a malfunction. The student is expected to diagnose and correct. Malfunctions are used to prevent students from inferring any classes that to expect on particular run to time.

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malfunctions courses were integrated under the direction of one
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officer.

The opening of the harmonization range at Tyndall Field in 1942 demonstrated that students were receiving insufficient instruction in gun malfunctions. The result was the establishment of a separate range where a complete course was given in those malfunctions likely to occur in .30- and .50-caliber guns. Before the year was over harmonization ranges were abandoned at both Tyndall and Buckingham fields, because so much emphasis had been placed upon instruction and firing
20
at the malfunction and moving target ranges.

The Training Command in 1943 provided for increased and detailed attention to malfunctions. Seven were enumerated which the student was expected to determine by their symptoms: (a) failure to feed into feedway, (b) failure to extract from ammunition belt, (c) failure to feed into the chamber, (d) failure to fire, (e) failure to control fire, (f) failure to extract from chamber, and (g) failure to eject. Methods of determining malfunctions or their symptoms and the procedure to follow on the range were included in the 20-hour course.
21
Range work was assigned 12 hours or 60 per cent of the total time.

In a report to Headquarters AAF in August 1944, the IX Bomber Command complained of weaknesses in preflight procedure as a defect in flexible gunnery training and expressed the opinion that thorough

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19. History of Las Vegas FGS, 8 Dec. 1941-1 Jan. 1943, 55-57; ibid., 1 Jan. 1943-1 Jan. 1944, 77.
20. History of Eastern Flying Training Command, Installment 2, II, 963-64; ibid., Installment 3, II, 879.
21. T. C. Memo No. 50-13-1, 12 Aug. 1943.

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preparation on the ground would eliminate the causes of inoperative guns in combat. Headquarters AAF agreed that there was no standard preflight procedure, and suggested to the Training Command that, through cooperation with the four training air forces, a standardization program²² be devised.

So obvious is the connection between recognizing aircraft and operating guns that it is not surprising to find in the early programs of instruction provisions in regard to recognition. Twelve hours were to be devoted to aircraft recognition and range estimation, and training aids were to be supplied for the course. In 1943, 20 hours were required for this type of instruction, and the procedure in imparting²³ it was given in more precise and detailed fashion.

As was true of all early phases of flexible gunnery training, acquiring knowledge of aircraft was beset with difficulties. Manuals had to be prepared. Information was lacking. The aids necessary to instruction were not immediately available. As the course was planned, it involved knowledge of the exact dimensions and detailed features of planes. In order to identify structural dimensions, wing span and fuselage length of aircraft were emphasized. The system was named 'WEFT' (wings, engines, fuselage, and tail). The student was expected

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22. Maj. Gen. R. W. Harper to CG AFTRC 9 Aug. 1944, with attached report of IX Bomber Command, in AAG 353A, Gunnery Training. The term "preflight procedure" as used in this paragraph has broader implications than its application to this chapter, but does include the gunnery developments discussed above.
23. For early program see Program of Instruction for the Training of Aerial Gunners (Flexible), W 4076 AC, 2-20-41, Rev. 1-5-42, W7680, A. F.; for later program see T. C. Memo No. 50-13-1, 12 Aug. 1943.
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to become familiar with German, Japanese, Italian, Russian, British,
24
and American aircraft.

This system did not prove very satisfactory. A gunner was expected to remember too many things during the very short time when he was preparing to resist an attack. Schools received information concerning a new system, known as the Renshaw or "flash" system. It was introduced by Professor Samuel Renshaw, of the Department of Experimental Psychology at Ohio State University, and resulted in the establishment there of the United States Naval Training School in Aircraft Recognition. Late in 1942 many officers of the Flying Training Command entered this school, and in 1943 the system taught there was generally adopted. 25

A competent observer of the results of flexible gunnery training in a combat theater has declared that aircraft recognition is more a matter of tactics than of visual acuity. The enemy flying Allied captured aircraft has on occasion, he states, approached and shot down American bombers. Information given months before is often obsolete at the time of action, and furthermore at such time a gunner is too 26
busy planning to resist attack to apply theoretical knowledge. Easier methods of aircraft recognition resulted in a reduction in the 27
hours devoted to it from 20 in 1943 to 10 in 1944.

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- 24. History of Eastern Flying Training Command, Installment 2, II, 980-981; History of Buckingham Army Air Field, Installment 1, II, 93-94; History of Las Vegas FGS, 8 Dec. 1941-1 Jan. 1943, 21-23.
 - 25. History of Buckingham Army Air Field, Installment 1, II, 95; History of Eastern Flying Training Command, Installment 2, II, 981-982; ibid., Installment 3, II, 870.
 - 26. Hq 15th AF to CG AAF, 9 May 1944, in AAG 353, Gunnery Training.
 - 27. T. C. Memos No. 50-13-1, 12 Aug. 1943, 31 May 1944.

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On the basis of comparison of three typical programs of instruction, it may be stated that an evolutionary process was going on in flexible gunnery training in respect to both quantity and quality. The quantitative trend is illustrated by the requirement of 150 hours of instruction early in 1942, 210 in July of that year, 280 in August 1943, and 290 in May 1944. The qualitative trend is illustrated by the more precise definition of standards and procedure in the programs of 1943 and 1944 than in those of 1941 and 1942. Though hampered by lack of guns and planes, especially the type of plane in which the .50-caliber gun could be used, AAF authorities directed increasing attention during 1943 to stripping and reassembling guns and correcting common malfunctions. Aircraft recognition was stressed, but after the substitution of the simpler Renshaw or "flash" system for the more complicated WEFT one in 1943 not as many hours of instruction were devoted to that subject.

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Chapter IV

SIGHTING AND FIRING SYSTEMS

In the attempt to answer the question as to how to hit the target or get the fighter before he destroyed the bomber, AAF authorities for several years sponsored experimentation which was still in progress in August 1944. Closely connected with this experimentation was the problem of equipment, which has been discussed in a general way in a previous chapter. Ranges had to be constructed during the earliest stages of training, and fighter aircraft had to be secured in increasing quantity as new conceptions of firing training came into vogue. Jam Handy, Waller, E-8 Spotlight, Tracor, and other trainers were not always available when needed.

"The firing at clay pigeon targets with a shot gun mounted to simulate a flexible gun in a plane is entirely feasible, and a layout of targets to give a variety of angles can be readily arranged at any station." The above quotation is a portion of the reply made by Headquarters of the Air Corps Technical School at Chanute Field to a query of the Chief of the Air Corps in regard to some approved aspects of RAF aerial training. Headquarters at Maxwell and Lowry fields were in agreement with the idea expressed, though the latter suggested in greater detail the practical application of the experiment. The mount for the shotgun, Lowry officials suggested, should be centrally located

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with respect to a number of trap houses, located in different directions from the gunner, so that he would have to watch for clay pigeons from numerous angles.¹

The above suggestions were incorporated to some extent in the ground range exercises provided during the early stages of flexible gunnery. Trap ranges were the simplest devices used for trainees, many of whom did not know the rudiments of the handling of guns. It was an easy system in which to instruct and for which to secure equipment. Trap shooting in its simplest form was a straightaway method of firing with shotguns. In an effort to improve the value of the training, guns were placed on a flexible mount, designed to simulate machine gun mounts used "on the jeep ranges and on the malfunction range." The experiment did not work out well in practice, and with the development of skeet ranges trap suffered a decline.²

Skeet ranges, constructed according to direction of the American Skeet Association, were constructed in a semicircular fashion with stations on the circumference and one at the center of the semicircle. Firing took place from these stations at targets thrown from trap houses. This practice gave the student not only greater familiarization with the operation of guns but with the important factor of lead.³

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1. Correspondence, between OCAC and Lowry, Maxwell, and Chanute fields, June-July 1940, in AAG 353.9B1, Training, General.
 2. History of Buckingham Army Air Field, Installment 1, II, 133-34; History of Kingman Army Air Field, Installment 2, 59-61.
 3. History of Eastern Flying Training Command, Installment 2, II, 962; History of Buckingham Army Air Field, Installment 1, II, 128-30.

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There developed differences of opinion over skeet shooting especially after the adoption in 1943 of the system known as position firing. In a Training Command Memorandum of August 1943, provision was made for 10 hours of instruction in skeet, 8 hours of which was regulation skeet, and for the firing of 150 rounds.⁴ In the fall of 1943 there were modifications of this program. Skeet firing was reduced to a minimum of 100 rounds and regulation rules were no longer applicable. On both skeet and moving-base ranges the principle of position firing was to be put into effect, that is, as far as possible gunners were to fire at targets when they were in a position corresponding to that from which a plane would make an attack.⁵

This theory was not very well applied in practice, for one of the main objections after this time to skeet shooting was that it was not in harmony with position firing. In a letter to the Chief of the AAF Training Aids Division, Capt. Lee J. Grattan of the same division criticized skeet firing as practiced in flexible gunnery schools on the ground that it stressed lead ahead of the target and shooting from a stationary position. Shooting from such a position, he claimed, was contrary to the principle of aerial gunnery, and lead ahead of the target was in conflict with position firing which taught "the student gunner to fire between the attacking ship and the tail of his own plane," or behind the target. General Harper replied at length to this letter, which had been transmitted to him. He agreed that skeet

4. T. C. Memo, No. 50-13-1, 12 Aug. 1943.

5. History of Eastern Flying Training Command, Installment 3, II, 876-77.

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shooting was in conflict with the position firing system of sighting, but pointed out that tow-target firing and the use of rail target cars on ground ranges, in requiring a lead ahead of the target, were "contradictory to the deflections taught in Waller and Jam Handy Trainers, in air-to-ground firing and on gun camera missions." He stated that there appeared to be no disagreement "about the value of high tower and moving base skeet shooting," and that standard skeet, which was being studied, was retained because it taught familiarization with weapons⁶ and gave some trainees their first knowledge of firearms.

This type of firing thus seems to have had both advantages and disadvantages. As late as May 1944, however, a gunnery officer in a theater of action, who had formerly been director of training of a Flying Training Command gunnery school, strongly condemned skeet firing as not offering the gunner any type of shot he was likely to be able to use in a defensive position on a bomber. He suggested that skeet equipment be used to set up another moving-base shotgun range where⁷ the position firing theory could be applied.

Moving-base ranges, which also made possible skeet shooting, were designed to afford opportunity for firing at moving targets from a moving mount. Trap houses and trucks or cars constituted a part of the necessary equipment, and air-to-ground firing as well as ground firing

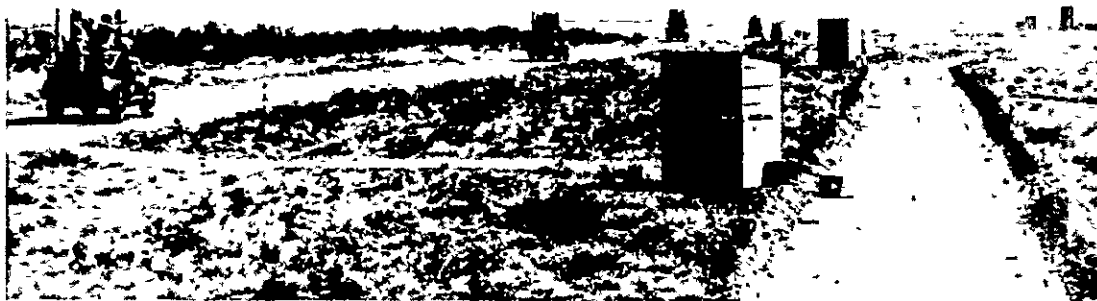
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6. Capt. Lee J. Grattan to Chief, TAD, 25 Jan. 1944; 1st ind. (Chief, TAD to AC/AS, Training, 11 Feb. 1944) Brig. Gen. R. W. Harper to Chief, TAD, 19 Feb. 1944, in AAG 353, Gunnery Training.
7. Hq 15th AF to CG AAF, 9 May 1944, in *ibid*.

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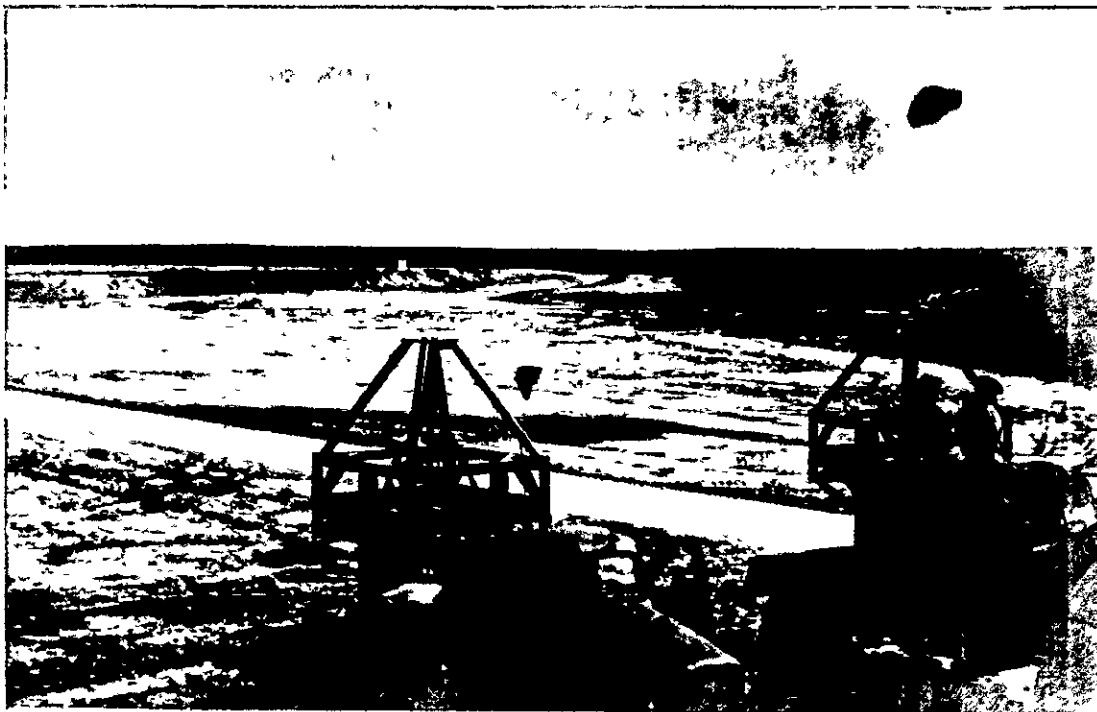
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MOVING BASE RANGES

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MOVING BASE RANGES



MOVING BASE TARGET RANGE. The target and its tractor ride the oval track. The tractor is traveling at 10 miles an hour and firing at a target from the rear. The target is a rectangular block of wood from the tractor as the tractor moves.



MOVING BASE TARGET. Turrets are mounted on the back of the truck, and the moving target (white square in center of the picture) on a jeep traveling at about 25 miles an hour. The vehicle, protected by the embankment, has no driver, but moves along a guide rail.

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was possible on such ranges.

Throughout the flexible gunnery program, naturally much attention was paid to sights and the principles of sighting. In early 1942, 20 of the 150 hours of instruction were devoted to those matters. The student was required to study ring and bead, reflector, compensating, and telescopic sights, and matters related to sighting such as bullet deflection, relative speed of opposing planes, and tracer firing. In 1943, 44 of 288 hours of instruction were devoted to sighting. Eight hours were given to range estimation, 12 to the Jam Handy trainer, and six to the Waller trainer. The Jam Handy trainer, in providing actual combat conditions on a large screen, was well adapted to range estimation and to an understanding of all ballistic factors. Furthermore, its flexibility enforced the correction of errors. Its defects consisted of a small observing area and a failure to give strictly accurate scores. The Waller trainer, larger and more intricate than the Jam Handy, was also designed to train gunners under the most realistic combat conditions available.

The problem of the best manner of sighting a flexible gun was a continuous one. In the early stages of the gunnery program the conditions under which the trainee operated were not as trying or complex as later, and yet in 1942 the student seemed confused by the experiments applied. It has been said that "during 1942 gunnery students had

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8. Program of Instruction for the Training of Aerial Gunners (Flexible) W 4076 AC, 2-20-41, Rev. 1-5-42, W-7680, A.F.
 9. T. C. Memo No. 50-13-1, 12 Aug. 1943.
 10. History of Eastern Flying Training Command, Installment 2, II, 983-85.

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to become familiar with six different types of iron ring sights and four varieties of optical sights." The same authority has given the following excellent description of the relative speed system of sighting, which was the first scientific system:

The gunner was taught to use the following sequence of action in sightings: (1) recognize the enemy ship, (2) estimate the range with 800 yards as the critical distance for opening fire, (3) estimate the difference in speed between his ship and the enemy ship by holding the sight stationary for one second, (4) compute the lead according to a definite table which he had memorized, and (5) open fire. Under combat conditions there was usually no target in sight by the time the student had gone through this involved system of computing the lead.¹¹

The apparent-motion system simplified somewhat the method of computing lead which was employed earlier, but this system was still complicated.

Another experiment was the use of tracer as an aid to sighting. This had been tried during World War I, but had been abandoned because it gave the gunner the impression he was hitting the target when he was not, and because flight speeds were then slow enough to allow the use of an alternative system of sighting. It was believed, however, that the increased flight speeds during the present war made its use practicable, provided it was used in conjunction with other sighting systems.¹² In June 1942 the Flying Training Command felt so strongly the "great need" for a tracer trainer that it urged the acquisition of a British model, if one in the experimental stages in the United

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11. Ibid., 1010-11. For further discussion of sights and sighting systems see History of Kingman Army Air Field, Installment 2, 83-91.
 12. British Report on use of Tracer as aid to Air Sighting. . . , from Intelligence Sec. OCAC to AC/S, G-2, 15 Oct. 1940, in AAG 353.9B1, Training, General.

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States at that time did not prove satisfactory.

Approximately one year after this time Headquarters AAF indicated to the Commanding General of the Fourth Air Force that not more than 10 per cent of the ammunition used by an aerial gunner would be loaded with tracer and that it should be fired during the final training phase. It was claimed that when gunners resorted to tracer they depended upon it entirely, and to the complete neglect of their gun sights. After students were proficient as a result of training, they might explore the possibilities and proper use of tracer. In the

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light of the above letter, it is understood why a Training Command Memorandum of August 1943 provided that a brief time should be devoted to the study of the "Limitations of Tracer." Tests at the Kingman

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Army Air Field in the fall of 1943 suggested in a practical way the defects in tracer firing. One of these tests involved the use of an AT-23 for towing a target at high speed and a B-17 for air-to-air firing against the target. The tow plane did all of the maneuvering. The experiment produced poor results, for "in every case the individual whose tracer appeared to be piercing the target and who might be considered to have high scores received no hits on the target, and in every case the individuals whose tracer appeared not to pierce the target were in all cases the individuals who received hits on the target." 16

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13. Hq AFFTC to CG AFAMC, 8 June 1942, in AAG 413.6B, Misc. Trainers.
 14. Brig. Gen. R. W. Harper to CG 4th AF (through CG WDC), 21 July 1943, in AAG 353, Gunnery Training.
 15. T. C. Memo No. 50-13-1, 12 Aug. 1943.
 16. Hq Kingman Army Air Field to CG AFWFTC, 6 Oct. 1943, in AAG 353, Gunnery Training.

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It is claimed that tracer, if its illusion is controlled, has distinct advantages. It makes possible visual checking of harmonization of guns and sights, and indicates whether there is proper lead in deflection shooting. However, the student "must realize that he sees the light, not the bullet; and he must realize that light does not give the same effect of distance as a bullet. For example, a bullet half the size of another bullet is twice as far away. But a light half the size of another equal light, is not twice as far away; in fact, when it is twice as far away, it is only a quarter the size of the other."¹⁷

It should be emphasized that aerial gunnery was much more perplexing to the gunner than ground exercises. Flying, often at great heights and at great speed, and attempting under such conditions to hit a target of small size were far more difficult matters than shooting at a target from the ground or from a moving truck. Moving-base ranges provided a valuable type of experience for the early part of the gunnery course but, of course, did not provide the necessary aerial exercises. In 1943 the Flying Training Command, encouraged by reports from the African theater which indicated considerable success in high deflection shooting through a course in air-to-ground shadow firing, requested the Western Flying Training Command to make a series of tests along that line. The tests which, as pointed out, proved unsuccessful as far as tracer air-to-air firing was concerned were encouraging as regards air-to-ground firing. Ground strafing missions against fixed

17. History of the Army Air Forces Proving Ground Command, Part 3, Gunnery Training, 1935-1944, 118-19.

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ground targets proved that lead was necessary toward the rear of the gunner's own aircraft. A third test was described as follows: "Shadow missions utilizing B-17 firing from two waist guns and lower ball turret and AT-23 making simulated attacks on B-17 by the use of the AT-23's shadow. All missions conducted at an altitude of approximately 300 feet above Red Lake and fire observed by dust or water splashes made by guns firing at the AT-23's shadow." At ranges of from 600 to 100 yards, the bursts of dust which were seen by individuals in the B-17 firing aircraft enabled them to get a reasonably accurate assessment of lead. The experiment showed further the possibility of utilizing a suitable type of pursuit aircraft in such a way that an accurate pursuit curve of attack could be flown.¹⁸

Position firing was one of the most important developments in flexible gunnery during 1943 and 1944. This is based upon an understanding of the course or curve which a plane had to fly in order to attack a bomber and consists in firing upon the attacking plane when it is in a position to make an attack. This principle is contrary to that of computing sights and ballistics, except in a limited degree, and, as was true of so many phases of the gunnery program, gave rise to differences of opinion. One of the first points which it seemed necessary to settle was the distance at which to fire, for then the student could be taught to estimate that distance on an outdoor range. Was firing to begin before the plane was close enough to attack, or

18. Hq Kingman Army Air Field to CG AFWFTC, 6 Oct. 1943, in AAG 353, Gunnery Training.

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should it be near enough the bomber to enable shots directed against the fighter craft to have a reasonable prospect of being effective? Under the position-firing system the latter was the answer. Six hundred yards was the distance determined upon by AAF authorities after "thorough¹⁹ consideration."

High AAF officers differed sharply over the merits of position firing. This was a much discussed topic at the flexible gunnery training conference held at Tampa in April 1944. Brig. Gen. U. G. Ent, Commanding General of the Second Air Force, declared at that meeting that three main factors were working against standardization and simplification of flexible gunnery training. They were, first, the controversy over methods of sighting flexible guns and the ranges at which they were effective, second, the controversy as to effectiveness of computing sights then in use, and third, the controversy over tow-target practice versus "blank ammunition fired simultaneously with the gun camera."

General Ent declared that zone and position firing were practically identical, that they were "based upon firing at fighter aircraft when they are in a position to make an attack." In reply to those who felt that firing should begin at a range of 1,200 yards, although the aircraft was not in a position to make an attack, he claimed that tests conducted at the University of New Mexico and reports from theaters of action indicated that the .50-caliber machine gun could not be fired accurately at a distance beyond 600 yards. It was also pointed out that

19. For a discussion of this matter see correspondence between Chief, TAD and AC/AS, Training, 14 Oct. 1943-12 Jan. 1944, in AAG 353, Gunnery Training.

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reports and experiments indicated that computing sights then in use on B-17's and B-24's were not accurate under combat conditions. It was believed by some, however, that the General Electric Computing Sight used on the B-29 incorporated "all known principles and should give very accurate results."²⁰

There was agreement between General Ent and Dr. E. W. Paxson, of the Proving Ground Command, as to the main problems of flexible gunnery. According to the latter they were computing sights, supporting fire for bombers against mass attacks by enemy fighters, and general gunnery equipment in relation to effective firing.²¹ Colonel Worden of the Second Air Force strongly defended position firing as the first and only method capable of use in combat. He stated that at the training conference in Colorado Springs, held in September 1943, he had contended that the most pressing need in gunnery training was a sighting system, but that the one in use seven months later was merely a stop-gap. "Please don't think," the colonel continued, "that the Second Air Force, or anyone else today, knows the solution."²²

Maj. Gen. Follett Bradley, Sperry Corporation consultant, referred to his own recommendations which had been made to the Chief of the Air Staff and approved, and in them as in his remarks at the Tampa conference²³ he disagreed "violently" with what General Ent had recommended. General

20. Report of Flexible Gunnery Training Conference held at Headquarters, Third Air Force, Tampa, Fla., 12, 13, 14 April 1944, 16-20.

21. Ibid., 36-41.

22. Ibid., 46.

23. Ibid., 21 ff.

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Arnold had requested that General Bradley investigate and report on the flexible gunnery situation, and he spent 10 days in March 1944 in so doing. His conclusions were that position firing should be taught, but that the student should have it impressed upon him that it should be used only "if his guns are not equipped with automatic computing or compensating sights" and "if his automatic sights are not functioning properly." Skill, he claimed, could be acquired in operating sights, tracking, and ranging if enough training were given along those lines. He contended that supporting fire was essential to bomber formations, and not fire directed only at fighters attacking on the pursuit curve and within the 600-yard zone. Position firing, in his opinion, was "taught for the same reason that a man is taught to swim--not that swimming is man's method of traveling through water, but to save his life in case his boat is sunk."²⁴

The report, which covered more than the points considered, was termed by Maj. Gen. Barney M. Giles as "excellent," and he assured General Bradley that he had "directed the action required by the proper agencies of this Headquarters to start putting our gunnery training on a paying basis."²⁵

The Tampa training conference did not decide this controversy. A committee representing the Second Air Force recommended that gunners be taught to open fire at ranges of 600 yards or less, but that a

24. Memo for C/AS by Maj. Gen. Follett Bradley, 28 March 1944, in AAG 353, Gunnery Training.

25. C/AS to Maj. Gen. Follett Bradley, 3 April 1944, in ibid.

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decision on elimination of present computing sights not be made until the completion of current tests by the permanent Committee on Sights, Sighting Methods and Flexible Gunnery Equipment. A Committee on Support Fire recommended a study of the relation between position firing and support fire but held that for training purposes the gunner be instructed to fire only at targets within the 600-yard range. In June 1944 the Training Command directed that a study be made of the need to include the relative-speed system of sighting in the flexible gunnery curriculum. This action was taken as the result of a report of representatives of the command who, when visiting combat theaters, had heard it strongly suggested that this system be used as well as that of position firing.

The unsettled question of sighting was given attention from many angles during 1944. The National Defense Research Committee, which had previously concerned itself with certain specific AAF projects on gun sights, sighting methods, and flexible gunnery equipment, participated with AAF agencies early in 1944 in the formation of a committee to coordinate and evaluate data on sights and other flexible gunnery equipment. In March the Training Command was directed by Headquarters AAF to take part in the deliberations of this committee.

In May the Flexible Gunnery Division of Headquarters, AAF requested

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- 26. Report of Flexible Gunnery Training Conference held at Headquarters Third Air Force, Tampa, Fla., 12, 13, 14 April 1944, Appendix, 114, 120.
 - 27. AFTRC Monthly Progress Report, June 1944, 18.
 - 28. R&R, Brig. Gen. R. W. Harper to AG/AS, MM&D, (thru AG/AS, OC&R), 28 Jan. 1944; Brig. Gen. B. W. Chidham to Liaison Officer, AAF, 24 Feb. 1944, in AAG 353, Gunnery Training.
 - 29. AFTRC Monthly Progress Report, March 1944, 12.

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the Training Command to prepare a syllabus of instruction on the K-9 and K-11 sights for distribution to gunnery schools and to the Fourth Air Force, and also to prepare a description of those sights and the K-10 for publication in the first revision of "Gunnery Information File."³⁰

During the same month the Sperry company advised AAF Headquarters of progress on the K-13 compensating sight, so as to expedite³¹ plans for its early use at gunnery schools.

Plans were taken to facilitate the use of the K-13, for in June AAF authorities took steps to secure for that purpose eight E-8 Spotlight trainers for each training air force station conducting flexible gunnery training. In August arrangements were made with the Navy to train men in the use of the K-15 sight. This was a new device which was to be installed in production aircraft, in the B-24 Martin turret beginning in November 1944, and in the Sperry upper, B-17, and Sperry Ball, B-17 and B-24, three months later.³²

Headquarters of the IX Bomber Command stressed simplification of sighting methods as one of the main needs of flexible gunnery, and in some parts of the European Theater of Operations a special one-week³³ course in sighting was being given. At the AAF training and gunnery conference held at San Francisco 31 July to 2 August 1944, simplification

30. Daily Diary, Flexible Gunnery Div. 22 May 1944.

31. Sperry Gyroscope Co. to CG AAF, 23 May 1944, in AAG 353A, Gunnery Training.

32. Daily Diary, Flexible Gunnery Div., 19 June 1944, 1 Aug. 1944.

33. Maj. Gen. R. W. Harper to CG AFTRC, 9 Aug. 1944, with attached Report of IX Bomber Command; Maj. Gen. F. L. Anderson to Lt. Gen. Barney M. Giles, 23 June 1944, in AAG 353A, Gunnery Training.

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of sighting was stressed as an urgent need. Col. W. G. Garland of the Eighth Air Force, a man who was considered well qualified on the basis of experience to discuss the actual problems and experiences of the various overseas commands, suggested that "gun sights be reduced to a minimum, preferably one for turrets and one for hand held guns." The two which he recommended were the K-13 and the K-15. Brig. Gen. Richard C. Sanders, Chief of Staff of the IX Bomber Command, suggested the elimination of the "theory of sighting and ballistics as distinct subjects in teaching gunnery." The report of a flexible gunnery committee urged that the National Defense Research Committee set up a project at Eglin Field to assist in a service test on sighting.

The most significant experiment in flexible gunnery training from the summer of 1943 to 1 September 1944 was the gun camera mission. This was regarded as a system which would more nearly approximate combat conditions than any which had yet been devised. As described in a special report prepared at the Central Instructors School, this training phase involved the installation of an AN [Army-Navy] Gun Camera in gun positions on bombardment airplanes, and the assessing and scoring of the film. A detailed experiment was conducted at the instructors school. Fifty-three students who had received training on the Sperry upper Local Turret were allotted 50 feet of film, enough for three to five attacks.

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34. Minutes of the AAF Training and Gunnery Conference, 31 July, 1-2 Aug. 1944, Headquarters Fourth Air Force, San Francisco, 3.
 35. Ibid., 6.
 36. Ibid., Committee Reports, 7.

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All of the firing was done from the Sperry upper Local Turret of a B-17. The attacking ship was, in all cases, an AT-6. All of the attacks were made from the beam or early quarter. The instructor controlled the camera, turning it on when the AT-6 turned in to attack and turning it off at the breakaway. This gave a continuous picture of the attack from the beginning to the breakaway. The student-subject was instructed to track the attacking aircraft at all times when it was bearing on his own aircraft in a pursuit curve.

The report emphasized two points in particular: (1) that the camera should be turned on when the attacking ship made the turn-in and all during the attack, but off when it made the breakaway, (2) that the scoring technique was not sufficiently standardized to produce satisfactory results.

As early as the summer of 1943 detailed provisions had been made for 24 hours of instruction on the G. S. A. P. Camera. It is significant, however, that the Training Command Memorandum which required this course stated that "pending receipt of necessary camera equipment the missions listed above will be performed without photography."³⁸ This phase of the program led to increasing demand for special training for photographic personnel because it was essential that gunners see the results of their efforts very soon after the mission was completed. Training officials believed that "the immediate processing of the film, the prompt assessment of the film by the student and instructor, and the maintenance and repair of the gun camera and film processing equipment will require a department staffed with skillfully

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37. Hq Buckingham Army Air Field to CG AFETTC, 6 March 1944, including Progress Report (10 Feb. 1944) on Training Committee Report on Gun Camera in connection with Flexible Gunnery, in AAG 353, Gunnery Training.
38. T. C. Memo No. 50-13-1, 12 Aug. 1943.

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trained personnel." It was estimated that this type of personnel requirement for a replacement training unit station would be about 50 per cent of that required at a flexible gunnery school and 25 per cent at an operational training unit station.³⁹ The growing importance of the aerial photographer as a part of the crew led to his inclusion in the gunnery training program itself.⁴⁰ There had been, in fact, before this time a feeling that combat photographers should be given gunnery training. Oftentimes there had been a refusal to include them with the bomber crew on the ground that they were "dead weight."⁴¹

The use of the gun camera resulted in increasing emphasis upon fighter aircraft for flexible gunnery training stations. Though the chief emphasis came in 1944, Major Kennedy as early as 1941, after his study of the British flexible gunnery system, had spoken of the necessity of having "permanently assigned fighter type aircraft for making attacks against cinema guns and for teaching proper methods of gunnery control and tactics."⁴² General Harper declared in March 1944 that in order to simulate fighter attacks in connection with camera gunnery training, which he considered the most realistic training of all, 260 pursuit type planes were necessary.⁴³

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- 39. Brig. Gen. R. W. Harper to CG AFTRC, 21 Sep. 1943, in AAG 353, Gunnery Training.
 - 40. Daily Diary, AFTRC, 4 Aug. 1944.
 - 41. R&R, Technical Services Div., OC&R, to Reconnaissance Br., OC&R, 14 Dec. 1943, in AAG 353, Gunnery Training.
 - 42. Maj. W. L. Kennedy to C/AC, 8 Oct. 1941, in AAG 353.9C1, Training, General.
 - 43. 1st ind. (Brig. Gen. R. W. Harper to CG AFTRC, 1 March 1944) Hq, AFTRC to AC/AS, Training, 19 March 1944, in AAG 353A, Gunnery Training.

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In April 1944 Headquarters of the Third Air Force presented an elaborate argument to Headquarters, AAF in favor of the use of fighter assigned aircraft against the gun camera. The true pursuit curve, it was claimed, could not be obtained by the use of towed targets, but by actual attack on bombardment aircraft. It was proposed to have returned combat pilots briefed with bombing crews where attacks previously planned would "be made for the benefit of gunners using non-computing gun sight." Such pilots, it was believed, could impart information of value to the gunners in regard to forthcoming attacks. AAF Headquarters stated that the proposal from the Third Air Force had been received with favor by the four training air forces, but directed that in carrying out the four prescribed gun camera missions training would be performed on fighters making pursuit curve attacks, and not on combined training missions where pursuit planes were acting as escort.⁴⁴ The policy was further clarified in June 1944 when the commanding generals of the four air forces were directed to accomplish two combined bomber-fighter missions and were informed of the permanent assignment of fighter aircraft and pilots at bombardment bases. This assignment was made so that the minimum of four gun camera missions⁴⁵ could be performed for each crew member.

A training conference held at Fort Worth early in January 1944 gave hearty indorsement to AN Camera missions and declared that .

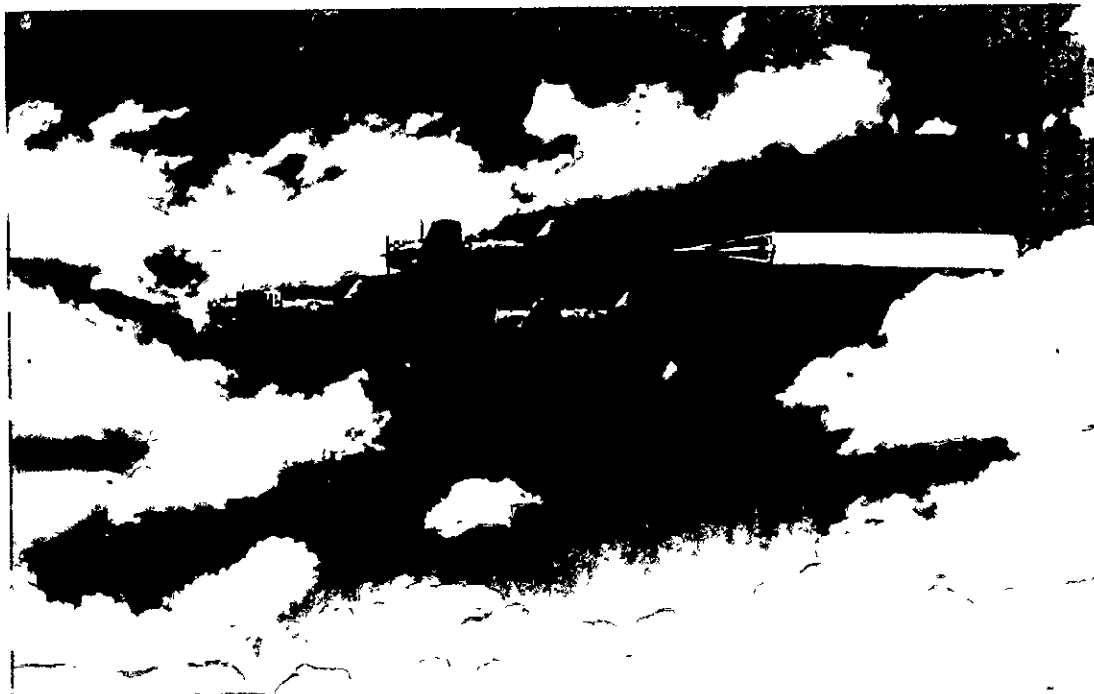
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44. Hq 3d AF to CG AAF, 28 April 1944; AG/AS, Training to CG 4th AF, 26 May 1944, in AAG 353, Gunnery Training.
45. Daily Diary, Flexible Gunnery Div., 2 June 1944.

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AIR-TO-AIR-FIRING



AERIAL TOW TARGET FIRING. Three AT-6's line up to be in firing on a sleeve target. The towing plane is not shown in the photo. This type of firing does not approximate combat as the target cannot be maneuvered to simulate an active target.



GUN CAMERA MISSION. With the assistance of the gun camera, the AT-6 is realistic. Here an AT-6 isolates and fires on a target. The target is in the top turret of a -26, fired at the target by the AT-6.

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the procurement of fighter airplanes should "be given higher priority."

The constant agitation for this type of plane helps to explain the attitude of AAF Headquarters mentioned above. The conference urged also four air-to-air firing missions at 20,000 feet and eight air-to-ground missions against pursuit-curve targets.⁴⁶

It seems that the value of air-to-ground firing was generally recognized, but air-to-air firing against tow targets was not usually regarded with favor after the development of the gun camera program. Though it has just been pointed out that a training conference in January indorsed air-to-air firing at high altitude, that type of training received sharp criticism at the Tampa flexible gunnery training conference in April 1944. General Ent gave an exhaustive argument on the merits, or alleged merits, of gun camera training and aerial tow-target practice. Towing airplanes could not present the towed target on a pursuit curve, and therefore battle conditions could not be approximated. Much equipment and personnel were necessary to operate a towing mission, and its alleged advantage in offering practice with computing sights was offset by the fact that this kind of sighting was restricted to only one gun position on the B-24 and two on the B-17. The gun camera would afford the realism of combat and would have all of the advantages which were claimed for air-to-air firing. Col. H. P. Huglin, commanding officer of the Kingman Flexible Gunnery School, agreed with General Ent. He claimed that it was now possible not only

46. Report, Training Conference, Hq AFTRC, 10-12 Jan. 1944, 11, 12-d.

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to assess film on computing sights, but to assess and score the number of hits on flexible gun positions with non-computing sights. This method he regarded as superior to "such inaccurate and unsatisfactory methods as tow target firing," a system that might be eliminated if sufficient aircraft were made available for gun camera training.

A Second Air Force recommendation at the same conference was to the effect that tow-target work be eliminated from the training program in the training air forces but retained in the flexible gunnery schools.

Representatives of the Fifteenth Air Force recommended the abolition of tow-target aerial practice and held that there should be emphasis upon air-to-ground practice and gun camera exercises. They advanced the usual arguments in respect to the first and the third of these systems and claimed further that air-to-ground firing, in making possible air orientation and handling of guns in an aircraft, secured all of the advantages that air-to-air firing could offer.

In the spring of 1944 so much confusion existed as to how to fly tow-target missions for flexible gunners that Headquarters AAF gave careful instructions on that point. It was explained that one type of mission was for hand-held weapons and the other for the use of turret weapons. The firing plane should always remain on an even course, and any necessary rotating and maneuvering should be done by the tow plane.

47. These ideas may be found in Report of Flexible Gunnery Training Conference held at Headquarters Third Air Force, Tampa, Fla., 12-14 April 1944, 16, 19, 20, 54.

48. Ibid., Appendix, 114.

49. Hq 15th AF to CG AAF, 9 May 1944, in AAG 353, Gunnery Training.

50. Maj. Gen. R. W. Harper to CG 1st AF, 24 April 1944, in ibid.

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Thus it appears that the policy was to try to improve rather than to abolish aerial tow-target training. In August, however, the Flexible Gunnery Division stated that "the training value of Air-to-Air firing at tow targets is negligible compared to that obtained from gun camera missions, air-to-ground missions, and performance of the standardized phase checks."⁵¹

Two other factors gave additional vigor to the gun camera program during the summer of 1944. The training and gunnery conference at San Francisco recommended the assignment of additional fighter aircraft and fighter pilots for the purpose of conducting combined training, and the Flexible Gunnery Division expressed approval of standardization of the gun camera program suggested by the Camera Training Committee which met in June at the instructors school at Laredo, Tex. To aid the development of this program, the Flexible Gunnery Division made provision for additional camera installation equipment.⁵²

A recent development in flexible gunnery training is burst control. The first shot from the flexible gun is directed toward the target in normal fashion, but after that, unless control is effective, the shots tend to go wild. At the Tampa gunnery conference in April 1944, burst control instructions were given serious consideration, though before that time much attention had been paid to the matter by

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51. R&R, No. 2, AC/AS, Training to APTAI, 28 Aug. 1944, in AFACT 353, Gunnery, General.
52. Minutes of the AAF Training and Gunnery Conference, 31 July, 1-2 Aug. 1944, Committee Reports, 4; Daily Diary, Flexible Gunnery Div., 14 June 1944, 2 Aug. 1944.

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Col. William H. Hanson of Tyndall Field. In May this type of training was required in the gunnery schools and in the training air forces.

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The method of procedure has been briefly described as follows: "One mission will be flown at medium altitude and one at oxygen altitude with the target held at ranges of one hundred and fifty to two hundred yards at no relative motion. It is desired that the training Air Forces accomplish their high altitude tow target work in the same fashion. At the present time bursts will average between ten and fifteen rounds each."

The preceding discussion suggests that the trial and error process was very marked in the development of sighting and firing systems. During the early stages of the gunnery program the student was required to be familiar with too many sights; consequently, the later emphasis, especially in 1944, was upon a reduction of that number. Many felt that the relative speed system of computing sights was too complicated to be practical, and they advocated in its place position firing, which is based upon an understanding of the course or curve a plane has to fly in order to attack a bomber and consists in firing upon the attacking plane when it is in a position to make an attack. Some condemned both skeet and air-to-air tow-target firing on the basis that the gunner did not fire at a target in the relative position of an attacking plane; others defended these two practices because of the familiarity

53. AC/AS, Training to CG's, all Training Air Forces, with inclosures of Report of Col. William H. Hanson, 27 May 1944, in AAG 353, Gunnery Training. An explanation of burst control was given the author by Lt. Col. Robert A. Gardner, in an interview 11 September 1944.

they offered with the use of arms. Tracer firing afforded a convenient method of locating a target, but in practice it was often illusory so its use was restricted. The most significant development in flexible gunnery during the first eight months of 1944 was the gun camera mission. The use of the camera installed in gun positions on the bombardment plane and the assessing and scoring of the film enabled the student to have a continuous picture of the attacking plane from the time of action to the breakaway and to judge the results of his own firing. This type of training required skillfully trained photographic personnel and a large number of fighter aircraft.

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Chapter V

The Turret Problem

Flving at high altitude under abnormal atmospheric conditions amid the presence of fighter opponents that may strike at any time and at any angle and attempting to fire accurately under such conditions present a situation entirely different from firing at a ground target. Add to the aerial situation suggested the necessity of understanding and manipulating a turret and the picture becomes even more complicated. Turrets had to be installed in planes for which they were adapted, sights had to be installed in turrets, power had to be provided for operation, and the whole delicate mechanism, to be effective, had to be kept in balance.

The importance attached to the understanding of turrets may be indicated by reference to the programs of instruction in 1942 and 1943. In the former year 20 hours were assigned to turret drill and 15 to turret maintenance; in the latter, 18 to turret manipulation and 32¹ to turret maintenance. Maintenance consisted in part of installing and boresighting guns, mounting sights, checking the operation of the fire interrupters and of the turret, gun, and sights, and loading

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1. Program of Instruction for the Training of Aerial gunners (Flexible) W 4076 AG, 2-20-41, Rev. 6-3-42, W-7680, A. F.; T. O. Memo No. 50-13-1, 12 Aug. 1943.

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ammunition. Manipulation consisted in part of adjusting the sights properly, entering and leaving the turret correctly, locating and using correctly all switches, interphone connection, and oxygen connection, and engaging and disengaging all clutches. Much of the manipulation had to be done when the gunner was blindfolded. The two operations--maintenance and manipulation--were, it appears from the above description, so complementary as often to make one unable to distinguish between them.

In order to improve the quality of maintenance training, steps were taken in the fall of 1942, at the suggestion of the Director of Individual Training, to develop a program on central sighting station and remote-control turret equipment. In response to this suggestion, it was recommended that station operator gunners be given a special gunnery course on central sighting station equipment which "should include all necessary calibration, adjustment, minor repairs and inspection." Power turret and gun sight specialists, it was suggested, "should be selected from graduates of the turret school and given an additional course on maintenance of central sighting station equipment."² Remote control, however, did not actually come into effect until the use of the B-29 in 1944.³

The slow progress in turret training in 1942 is an interrelated phase of the slow, yet gradual, progress which was being made in other

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2. R&R, AFRIT to AFDMR, 19 Sep. 1942; R&R, AFIDE to AFRAD and AFRBS in turn, 26 Oct. 1942, in AAG 353A, Training.
 3. Interview with Maj. Edward Elliott, Jr., AC/AS, M&S, 11 Sep. 1944.

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phases of flexible gunnery training during that experimental year. The lack of any technical training on the part of many students combined with the required knowledge of numerous turrets made the task doubly difficult. Such trainers as the E-1 Spotlight and E-5 did not at first prove satisfactory for that type of training. Securing of equipment, as pointed out elsewhere, was a major problem. Frequently parts needed for the repair of turrets were not available, and sometimes when repair was not necessary trained personnel were lacking for operation. A special board of officers, created to investigate training being conducted by the four-engine schools of the Flying Training Command and of the replacement training units, reported that in the Second Air Force many gun turrets in training airplanes, though not in use, had not been removed so as to be used elsewhere. In many cases the planes were not being used because damage had resulted from the mishandling of the turret structure by insufficiently trained personnel.⁴

Maj. Gen. Barton K. Yount declared on 25 June 1942, that "although the scheduled production of gunners per month is approximately 2000 there is not one airplane in the gunnery schools mounting a turret."⁵ Even after turrets were mounted on planes, there remained the problem of coping with atmospheric conditions while manipulating a turret. To clear malfunctions, adjust guns and gun solenoids, and reload ammunition

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4. Special Board of Officers to CG AAF, 3 Nov. 1942, in AAG 353A, Training; History of the Second Air Force, 7 Dec. 1941-31 Dec. 1942, I, 268-69. For further evidence of difficulties, see History of Buckingham Army Air Field, Installment 1, II, 113-23; History of Harlingen Army Air Field, II, 29-30, 39-40; History of Eastern Flying Training Command, Installment 2, II, 991 ff.
 5. Project Book, CG AFFTC, Flexible Gunnery, Sec. 25, June 1942, 3.

when flying at high altitude was not an easy task. During the latter part of 1942 Headquarters AAF urged the Flying Training Command to see to it that all students received training in high altitude flying and in the actual use and adjustment of oxygen equipment. Such a policy had been initiated in the three training centers as early as 7 July 1941, but shortage since that time of the necessary type of plane had prevented execution of the policy. Renewed efforts, it was stated, would be taken along that line.

The most significant step taken in connection with this phase of training was the provision, early in 1943, for specialized turret training. There were in use at that time in the air forces six types of turrets: Consolidated tail, Sperry upper and Sperry lower, Martin upper, Bendix upper and Bendix lower. To understand all or any considerable number of them seemed to many too difficult an undertaking and represented an unwise scattering of the energies and efforts of the gunner. Moreover, the assigning of particular turrets to particular planes and special designations of the latter to the respective gunnery schools helped simplify the problem of equipment. Several factors were responsible for the triumph of the specialization principle. Through its Sperry maintenance representatives in England, the Air Service Command reported the unfavorable attitude in that country toward the training the turret gunner was receiving in the United States. Those

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6. AFRIT to CG AFFTC, 10 Oct. 1942, and 1st ind., Hq AFFTC to AFRIT, 5 Nov. 1942, in AAG 353A, Training.
 7. History of Buckingham Army Air Field, Installment 2, II, 113.

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representatives felt that there was too much emphasis upon training men as radio operators or engineers instead of as gunners and upon diversified rather than specialized turret training. A report of a special board of officers stated that students were not being trained in aerial turret gunnery, that they were often assigned to the use of equipment with which they were unfamiliar, and that low morale was due in part to fear generated by lack of special training.

The Flying Training Command heartily urged the specialization idea. It claimed that unless seven weeks of training were provided shortages of instructors and equipment would make it impossible to give proper instruction in all types of turrets. Thorough familiarity with one, it felt, would pave the way for quicker familiarity with others. It requested that a survey be made showing the required number of gunners on designated types of turrets and the necessary assignment of airplanes equipped with the same type of turret as that used for instructional purposes. Before the end of 1942 both the Directorate of Individual Training and the Directorate of Bombardment

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8. Memo for AFRDB by Hq AFASO, 22 Oct. 1942, in AAG 353.90, Training General.
 9. Special Board of Officers to CG AAF, 3 Nov. 1942, in AAG 353A, Training.
 10. Hq AFFTC to AFRIT, 27 Oct. 1942, in AAG 353, Gunnery Training.

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TURRET TRAINING



TURRET INSTRUCTION IN THE CONTROL ROOM. The instructor is pointing out the function of the various controls to the students. The students are seated at the control console.



TURRET TRAINING. The instructor is showing the students how to operate the turret. The students are seated at the control console.

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had expressed agreement with the Training Command.

In December 1942 steps were taken to put the turret specialization program into effect, and on 3 January 1943, in accordance with the authority received, the Flying Training Command gave orders to translate the policy into action. Accompanying this move or just before it was the designation of flexible gunner schools for training in specialized aircraft. Laredo and Harlingen became 100 per cent B-24 schools, Las Vegas and Kingman 100 per cent B-17, Panama City 50 per cent B-26 and 50 per cent B-25, and Fort Myers 60 per cent B-26 (E-34) and 40 per cent light and dive bombardment. The Second Air Force at this time took the graduates from the first four, or the heavy bombardment schools; the Third Air Force took the graduates from Panama City and Fort Myers.

The orders and actions described above did not settle all differences of opinion over the specialization policy. In July 1943 the Military Personnel Division of Headquarters AAF suggested a return to

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11. R&R, AFRIT to AFRDB, 31 Oct. 1942; R&R, AFRDB to AFRIT, 22 Nov. 1942, in AAG 353A, Gunner Training. In this same communication, AFRDB indicated the following basis for computing the numbers of flexible gunners required in terms of individual turrets: (a) Sperry trained--engineer and radio operator gunners on B-17, radio operator gunners on B-24, armorer gunner on B-17; (b) Martin trained--engineer gunners on B-24, armorer engineer and radio operator gunners on B-26, bombardiers and navigators on B-26; (c) Consolidated trained--armorer gunners on B-24; (d) Bendix trained--bombardiers and navigators on B-24, armorer engineers and radio operators on B-25, bombardiers and navigators on B-17, bombardiers and navigators on B-25. This estimate was evidently based on the assumption that all flexible gunners would have technical training, though at that time such was the wish but not the policy of AAF Headquarters.
 12. Project Book, CG AFFTC Flexible Gunnery Sec., 11, 21 Dec. 1942, 11, 29 Jan. 1943.
 13. AFRIT to AFFMP, 10 March 1943, in AAG 353, Gunner Training.

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the policy of multiple turret training. In the opinion of that division the change was justified because of the increased emphasis on the heavy bombardment program, as evidenced by the agreement with AC/AS, Training that all graduates of gunnery schools during July would be sent to the Second Air Force. In disagreeing with the suggestion, AC/AS, Training pointed out the impossibility of an enlisted gunner understanding the operation and preflight maintenance of the 10 tactical turrets then installed in light, medium, and heavy bombardment aircraft. This office spoke of the possibility, however, of having one of the two light bombardment schools change to specialization in heavy aircraft.¹⁴

The equipment problem was improved, but, of course, not solved, when the turret specialization idea went into effect. As previously stated, the policy itself helped to simplify the problem. The Flying Training Command indicated a shortage of 195 of the 830 power-operated turrets needed.¹⁵ Misassignment of gunners in terms of their preparation was noticeable, to some extent, after the specialization program went into effect. Headquarters, Tndall Field complained that its graduates were sometimes assigned to B-17 units where they had to use the Sperry and Consolidated turrets, though Tndall was specializing in Martin and Bendix turrets.¹⁶ In phase checks that were carried out at Mountain Home Army Air Base in Idaho, men from both Kingman and Tndall fields were checked for proficiency in turrets with which they

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- 14. R&R, AFFMP to AC/AS, Training, 20 July 1943, R&R, AC/AS, Training to AFFMP, 5 Aug. 1943, in AAG 353A, Gunnery Training.
 - 15. Hq AFFTC to AFRIT, 9 Jan. 1943, in AFACT 353, Gunnery, General.
 - 16. Tndall Field FGS to CG SEAFTC, 1 July 1943, in AAG 353A, Gunnery Training.

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were not supposed to be familiar. AAF Headquarters queried the Commanding General of the Second Air Force as to why graduates of Kingman and Las Vegas had been consigned to B-24 units, and the Flying Training Command, in urging AO/AS Training to impress upon the training air forces that turret specialization was the accepted principle in the flexible gunnery schools, emphasized the additional work that would have to be done in operational training if they did not accept the principle. ¹⁸ As late as July 1944 a report on flexible gunnery from the IX Bomber Command urged the use in combat of the same type of aircraft and the same type of equipment in which training had been given, ¹⁹ but declared that this principle was often not followed.

The policy of turret specialization was modified to some extent in 1944. Though the Flexible Gunnery Instructors School had been training the student in only one type, it was required in February that he be trained in all turrets and other gun positions on the plane to which he was to be assigned. Since some instructors were to be returned to the station of the command from which they originally came and some were to be assigned to the training air forces, those proportions would have to be determined before plane designations could be known. It was also necessary to know what percentage of those to be assigned to air

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17. Hq Mountain Home AAB to AO/AS, Training, 12 Nov. 1943; Hq Kingman Army Air Field to CG AFWETC, 26 Nov. 1943, in AAG 353, Gunnery Training.
 18. 1st ind. (Hq Mountain Home AAB to AO/AS, Training, 12 Nov. 1943), Brig. Gen. R. W. Harper to CG AFTRC, 20 Nov. 1943; 2d ind. (Hq Kingman AAF to CG AFWETC, 26 Nov. 1943), AFTRC to AO/AS, Training, 2 Jan. 1944, all in AAG 353, Gunnery Training.
 19. Maj. Gen. R. W. Harper to CG AFTRC, 9 Aug. 1944, with attached Report of IX Bomber Command of 22 July 1944, in AAG 353A, Gunnery Training.

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forces would be trained on the respective bombardment planes. It was decided that 30 per cent of the graduates of the school should be returned to their original stations and 70 per cent should go to air forces. Of the 70 per cent to be assigned to air forces the percentage for each type airplane was indicated as follows: B-24, 50%; B-17, 40 %; B-25, 4%; B-26, 4%; B-20, 2%; B-29, included in B-17 percentages. In May 1944 the Training Command was authorized to delete all instruction in turrets for radio operator mechanics, but to train all other gunners, whether instructors or not, in the "gun positions on the airplane for which they are specifically trained." This order did not represent an abandonment of the specialization principle, for turret specialization was provided in detailed fashion in a Training Command Memorandum of 31 May 1944. That same memorandum, however, required the gunners to be "familiar" with the various gun positions on the plane. Emphasis on one turret along with detailed individual aircraft specialization now became the aim. It seemed

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20. Hq Fort Myers AAF to CG AFTRC, 13 Jan. 1944, and 2d Ind., Hq AFTRC to AG/AS, Training, 27 Jan. 1944, and 3d ind., Brig. Gen. R. W. Harper to CG AFTRC, 4 Feb. 1944, in AAG 353, Gunnery Training.
21. Daily Diary, Flexible Gunnery Div., 13 May 1944; AFTRC Monthly Progress Report, April 1944, 15.
22. T. C. Memo No. 50-13-1, 31 May 1944. The following table shows the provisions in regard to turret specialization:

B-24 Airplanes:

(1)	Bombardier	--	Nose turret
(2)	Navigator	--	Nose turret
(3)	Engineer	--	Waist gun
(4)	Radio operator	--	Waist gun
(5)	Career gunner	--	Top turret
(6)	Career gunner	--	Nose turret and ball turret
(7)	Career gunner	--	Tail turret
(8)	Armorer gunner	--	Ball turret

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logical that along with increased facilities for gunnery training there should be at least multiple training to the point where it made for greater coordination on the part of interdependent members of an individual bomber crew.

It is obvious from the preceding discussion that considerable progress had been made in solving the turret problem since that June day in 1942 when, in the words of General Yount, not an airplane in the gunnery schools was mounting a turret. Opinions of some who had had connection with the combat air forces suggest the progress that had or had not been made. Col. V. L. Zoller of the Fifteenth Air Force felt that the basic training gunners received was "good," that "barring the necessity of using gunners in positions other than that for which

22. (contd.)

B-17 Airplanes:

(1) Bombardier	--	Chin turret
(2) Navigator	--	Waist gun
(3) Engineer	--	Waist gun
(4) Armorer	--	Waist gun
(5) Radio operator	--	Waist and radio hatch guns
(6) Career gunner	--	Top turret
(7) Career gunner	--	Tail turret
(8) Career gunner	--	Waist gun and ball turret

B-25 Airplanes:

(a) Mechanic gunner	--	Upper turret
(b) Armorer gunner	--	Tail turret and waist gun
(c) Radio Operator	--	Waist gun

B-26 Airplanes:

(a) Mechanic gunner	--	Upper turret
(b) Armorer gunner	--	Tail turret and waist gun
(c) Radio Operator	--	Waist gun

A-20 Airplanes:

(a) Mechanic gunner	--	Tunnel gun and upper turret
(b) Armorer gunner	--	Upper turret and tunnel gun

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classified and perhaps modifications with which they are not familiar, that is, modifications of new equipment, the gunner usually does show the knowledge necessary to operate his position." According to Capt. A. M. McIlvain of the Fifth Air Force, "only a small percentage" of gunners had been "taught the proper method of head space and solenoid adjustments," and many had "forgotten how to properly enter and leave a turret." Many "were very familiar with the Martin turret" but sometimes had to use other turrets with a resulting lack of success. Speaking for the Seventh Air Force, Col. L. E. Boutwell emphasized the point that those with "extensive training in the Martin Turret" often found the training of little use because they were required to use the Consolidated type.²³

In the early part of the year 1944, the Military Intelligence Division of the War Department General Staff made a report indicating serious deficiencies in the training of turret gunners sent to European theaters. In some cases, it was stated, they were "afraid to enter the turret in the air," and in others they did "not know what to do" when they entered it, with the result that too much time had to be devoted to training in combat areas. When asked by G-3 what was being done to correct these deficiencies, AAF Headquarters replied that action had been "taken within the limitations of base facilities, personnel and equipment." The reply emphasized that according to training standards

23. These opinions are found in Minutes of the AAF Training and Gunnery Conference, 31 July, 1-2 Aug. 1944, Hq 4th AF, San Francisco, Appendix B, 11, 30; 31, 33.

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every gunner was required manually to perform phase checks on all turret functions.²⁴ The sweeping character of these phase checks is illustrated by the fact that gunners were expected to be checked twice in the flexible gunner schools, twice in the OTU's, and twice in the combat theaters.²⁵

The securing of turrets and of planes in which to install them was a prerequisite to training in maintenance and manipulation, operations which were particularly difficult during high altitude flying. Hence, much time was devoted to this phase of training. During the early stages of specialized gunner training the gunner was required to be familiar with all types of turrets, but after much criticism of his lack of proficiency he was required early in 1943 to specialize in one turret. Coupled with this policy was one which helped solve the problem of equipment, namely, assigning particular turrets to particular planes and special designations of the latter to the respective gunner schools. Improvement in training techniques by 1944 seemed to justify a modification of the specialization principle, and thereafter gunners were required to be familiar with all gun positions on the plane to which they were assigned. Phase checks to determine proficiency and attempts to prevent malassignments were significant policies in respect to turrets during 1943 and since.

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24. G-3 to CG AAF, 9 Feb. 1944, with attached Report of MID of 14 Jan. 1944, and 1st ind., Maj. Gen. R. W. Harper to G-3, 13 March 1944, AAG 353A, Gunner Training.
25. Maj. Gen. R. W. Harper to Chief, TAD, 8 May 1944, in ibid.

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Chapter VI

CONTINUITY AND CONTROL OF TRAINING

The graduate of a flexible gunnery school had learned much that was theoretical and much that was practical. Indeed, the task which it was hoped he would complete, first within five weeks and then within six, was so complex and exacting as to make the term "learned" a relative one. If, as has been said, "we learn to do by doing," the question may arise as to how often and how carefully it is necessary to perform actions before the learning process is satisfactory. Flexible gunnery training was, to some extent, experimental in nature and often gave rise to differences of opinion as to the wisest policies to be followed. Inquiry, discussion, and the willingness to profit by the lessons of experience were fundamental factors in the steady improvement that was manifest in the training program as time went on.

It was evident as the program unfolded that the student was not retaining those skills he was supposed to have mastered. In 1942 headquarters of the Kingman school urged the sending of necessary equipment to operational training stations so that they might give refresher courses in flexible gunnery. This step was urged on the ground that gunnery students, who were said to be usually of a low intelligence level, had a tendency during operational training to forget what they learned in the gunnery school.¹ In a report during

1. Hq Kingman Field FGS to CG WCAFTC, 17 Sep. 1942, in AAG 353, Gunnery Training.

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the same year, a special board of officers, concerned partly with the conduct of training by replacement training units, suggested three reasons as to why such training was unsatisfactory. There was a lack of equipment, students were often required to use equipment with which they were not familiar, and they often lost too much time in moving from one station to another. The board suggested control of replacement training by the Flying Training Command as the best solution to the problem.² The Director of Military Requirements urged the Second Air Force to use every local effort and ingenuity possible to give continuity to training. Not only was such action necessary because of the detrimental character of absence especially from air-to-air firing, but also because of "the sketchy nature and brief period of the course of instruction in our Flexible Gunnery Schools."³

Early in 1943 the Director of Bombardment, convinced that the "proficiency" of the air units sent overseas had "been far from satisfactory," addressed to the headquarters of the Second Air Force a communication embracing 14 queries in regard to OTU training. Did OTU's have a standard program for combat crew members, and did they carry out the program in the same standard way? Had the program been coordinated with the course of training received by gunners in the flexible gunnery schools? How many hours of turret manipulation were given? How many high-altitude flying missions were given, and how much firing practice did gunners receive on such missions? What use was made of the aerial gun cameras? The above were some of the numerous questions. The reply stated that the OTU's did have a standard program

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2. Special Board of Officers to CG AAF, 3 Nov. 1942, in AAG 353A, Training.
3. AFDMR to CG 2d AF, 30 June 1942, in AFACF 353, Gunnery, General.
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and had attempted to carry it out in a standard way, but they had been hampered in so doing by lack of equipment, such as tools, spare parts, and tow-target planes. Each gunner had instruction in turret manipulation 4 hours a day for 4 weeks, and was given a total of 5 high altitude missions, during which he used oxygen equipment and the interphone system and fired guns to familiarize himself with malfunctions which might be due to freezing conditions. No gun cameras were used or were available. A considerable portion of the reply was devoted to an explanation of what was necessary to coordinate the gunnery school and OTU programs.

However, we have done away with a lot of theoretical training, as our trend is toward practical training. The men from the Flying Training Command Flexible Gunnery Schools are sent to the 18th Replacement Wing for distribution. Upon interviewing these men, we have found that they have not been sufficiently trained to be aerial gunners in heavy bombardment equipment. They do not know how to harmonize turrets, load ammunition and install in turrets; they do not know the use of K-3 and K-4 sights; they do not know how to install guns on the turrets or time solenoids for firing; they do not know how to detail strip the .50 caliber machine guns, and they do not know how to take care of any malfunctions which may occur in the action of the .50 caliber gun. We teach these men, upon their arrival, how to detail strip a .50 caliber gun blindfolded, and through a series of six steps we teach them how to be able to clear any malfunctions which may occur in the .50 caliber gun.

Late in 1942 and early in 1943 the Central Flexible Gunnery Instructors School had established liaison with the training air forces so that the latter and the flexible gunnery schools might better understand what each group was doing. Officers of the schools visiting the

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4. Brig. Gen H. L. Eubank to CG 2d AF, 12 Jan. 1943, and 1st ind., Hq 2d AF to AFRDB, 19 Jan. 1943, in AAG 353A, Gunnery Training.

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OTU's and RTU's were convinced that training in the schools was superior to that in the training air forces. In the latter instructors were often not satisfactory, equipment was frequently lacking, and no distinction was made between graduates of gunnery schools and basic soldiers. The visitors admitted, however, that there were defects in the preparation of graduate gunners and that the air forces were making vigorous efforts in the face of difficulties. It was pointed out also that too much time not infrequently elapsed between training⁵ periods.

Steps were taken in the summer of 1943 to try to correct situations which seemed to be interfering with the continuity of the gunnery program. On the basis of an inspection of the Second Air Force, the Air Staff prepared a report embracing recommendations in respect to training. The two most important were that gunnery instruction should be standardized both in the Training Command and the air forces, and that the Training Command should be directed not to graduate and ship personnel to the air forces until the students had reached a standard of proficiency which was felt to fit them for aircrew duty. AC/AS, Training replied that three steps had been taken to standardize training: (1) Training standards, acceptable to the Second Air Force, had been established and transmitted to the Training Command. (2) Steps had been taken to expand the authority, facilities, and staff of the Central Flexible Gunnery Instructors school, and since instructors of

5. History of Eastern Flying Training Command, Installment 3, II, 882-86.

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both the Training Command and air forces were processed through that school, uniformly trained instructors, standardized textbooks, and identical curricula were being provided for both groups. (3) The Training Command had been directed to establish gunnery wings to⁶ effect further standardization.

When phase checks given in the fall of 1943 demonstrated that students from Earlingen, Laredo, and other schools were deficient in many phases of training, AAF Headquarters addressed to the Training Command a communication asking information on various phases of the gunnery program in their schools. Were graduates ever held over during the course? What were the academic, phase check, ground firing, and air firing scores? What had been done to correct the deficiencies found? The reply to this searching inquiry emphasized mainly the point that nine months had elapsed between the dates when the students were graduated and were given the phase checks at the Mountain Home Army Air Base. "This Command," the reply went on, "is constantly striving to improve the product of the Flexible Gunnery Schools; however, unless action is taken to insure that graduating students arrive at Operational Training Units and Replacement Training Units with minimum delay, this Command does not feel it should be charged with the⁷ responsibility for the proficiency of flexible gunnery students."

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6. DC/AS to AC/AS, Training, 20 July 1943; Brig. Gen. R. W. Harper to DC/AS, 24 July 1943, in AFAC 353, Gunnery, General.
 7. Hq Mountain Home AAB to AC/AS, Training, 12 Nov. 1943; 1st ind, Brig. Gen. R. W. Harper to CG AFTRC, 20 Nov. 1943; 2d ind., Hq AFTRC to AC/AS, Training, 19 Dec. 1943, in AAG 353, Gunnery Training.

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At the Tampa Conference of April 1944, Brig. Gen. C. W. Sullivan, Air Inspector for the Training Command, stated that "the principal requirement, as we see it now, is a closer coordination with the training air forces, and the development of both scientific and practical devices."⁸ In February 1944 Robert A. Lovett, Assistant Secretary of War for Air, expressed the opinion that on the basis of reports he had from combat gunners, there had been since the summer of 1943 "substantial improvement" in the quality of gunners turned out by the gunnery schools. There were, however, "obvious deficiencies" in training which he felt could and should be corrected so that it would not be necessary to do so in theaters of action.⁹ The recommendations for greater continuity in training and for closer coordination to that end came from others who yet recognized the progress that had been made in flexible gunnery training.¹⁰ General Harper expressed dissatisfaction with the RTU system of training as compared with that in gunnery schools, and he urged the training air forces to take steps to improve the system.¹¹

In the attempt to check the deficiencies which stemmed in part from the lack of a continuous program, added emphasis was placed in

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8. Remarks of Brig. Gen. C. W. Sullivan in Report of Flexible Gunnery Training Conference held at Headquarters, Third Air Force, Tampa, Fla., 12, 13, 14 April 1944, 21. Gunnery Training.
 9. Memo for AG/AS, Training by R. A. Lovett, 15 Feb. 1944, in AAG 353, 7.
 10. See remarks of Col. W. G. Garland, 8th AF, and Col. J. F. Taylor, 9th AF, in Minutes of the AAF Training and Gunnery Conference, 31 July, 1-2 Aug. 1944, Hq 4th AF, San Francisco, Appendix B, 3, 19; Hq 15th AF to CG AAF, 9 May 1944, in AAG 353, Gunnery Training.
 11. Maj. Gen. R. W. Harper to CG's, 1st, 2d, and 3d AF's, 10 May 1944, in AAG 353K, Training.

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1944 upon three interrelated factors: phase-checks, standardization, and closer liaison among training agencies. Phase-checking, recommended early in 1943 by the Central Instructors School, was a method of finding out in a practical way whether the student could apply his knowledge, much of which had been theoretical. Though applied in a limited way at first, this practice was gradually extended to cover most phases of training. It was necessary before the end of 1943 for the Training Command to make it clear that phase-checking was not only for the purpose of discovering wherein the student was deficient, but was also for the purpose of correcting deficiencies. ¹²

In February 1944 the Training Command prepared and sent to all flying training commands a series of standard phase-check forms, so as to insure uniform minimum ability in flexible gunnery school graduates. ¹³ In April the Central Instructors School was asked by AAF Headquarters to prepare a program of instruction which would include what was necessary for flexible gunners of heavy-bomber crews to secure additional proficiencies and to retain those secured. This plan, which was to be presented to a gunnery conference scheduled to meet 17 July, but ultimately postponed until two weeks later, was to cover the following main points: (1) standard proficiencies, (2) quantity of training required on each subject, (3) proper timing or frequency of such training during the RTU phase, (4) type of equipment, lesson plan, or aerial missions

12. History of Eastern Flying Training Command, Installment 3, II, 865-66.

13. AFTRC Monthly Progress Report, Feb. 1944, 20-21.

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required on each subject, and (5) required phase-checking. The plan as developed was accepted by the training conference of early August, but before that time the Training Aids Division was requested to publish the standardized phase checks prepared by the instructors school and to distribute them to the flexible gunnery training agencies. Eleven checks were designated, and gunners were supposed to be checked twice in the gunnery schools, twice in the OTU's and twice while in combat theaters.
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The Flexible Gunnery Division took steps to see that all phase checks were given and passed during OTU training before a gunner went into the theater of action, and the division directed that after 31 August 1944 the second series of phase checks be given as near the end of the third phase as possible.
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Phase-checking was only one aspect of standardization. In February 1944 the conference report of the Flexible Gunnery Gun Camera Training Committee recommended that the instructors school prepare "a standardized, simple method of assessing and scoring film obtained with computing and non-computing sights," and that close coordination be established between the gun camera department and the sighting department at all installations training flexible gunners. It suggested further that

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14. Maj. Gen. R. W. Harper to CG AFTRC, 27 April 1944, in AAG 353, Gunnery Training.
 15. Maj. Gen. R. W. Harper to Chief, TAD, 8 May 1944, in AAG 353A, Gunnery Training.
 16. BAR, No. 2, AC/AS, Training to AFTAI, 28 Aug. 1944, in AFACT 353, Gunnery, General: Daily Diary Flexible Gunnery Div., 31 Aug. 1944.

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gun camera missions be placed on the same basis at OTU stations as other
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 missions.

At the Tampa training conference, representatives of the Second
 Air Force recommended that standardization of flexible gunnery train-
 ing be effected among the Training Command, training air forces, and
 18
 combat air forces. The San Francisco training conference endorsed
 the continuation training program which, at the suggestion of AAF
 Headquarters, the instructors school had prepared, and efforts were
 19
 made to develop and expand that program.

The idea of closer coordination of the agencies of control of
 flexible gunnery was one that naturally accompanied the move toward
 greater standardization. In his detailed report on training given in
 March 1944, General Bradley vigorously advocated the placing of flexi-
 ble gunnery training under the Commanding General of the 75th Training
 Wing. He pointed out how necessary it seemed to have a coordinating
 agency among the numerous commands, schools, and headquarters connected
 with the program. The placing of the Central Instructors School under
 20
 the 75th Wing he characterized as a "splendid move." The marked sig-

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17. Conference Report of Flexible Gunnery Gun Camera Training Commit-
 tee to AC/AS, Training from CO Harlingen Field FGS, 10 Feb. 1944,
 in AFACT files. There was another meeting of this committee at
 Laredo, Tex., in June, and soon thereafter AAF Headquarters ap-
 proved its recommendations for standardization. Daily Diary,
 Flexible Gunnery Div., 14 June 1944.
 18. Report of Flexible Gunnery Training Conference held at Headquarters
 Third Air Force, Tampa, Fla., 12, 13, 14 April 1944, Recommenda-
 tions of Committees, 14.
 19. Committee Reports of the AAF Training and Gunnery Conference, 31
 July, 1-2 Aug., 1944. Hq 4th AF, San Francisco, 14; Daily Diary,
 Flexible Gunnery Div., 31 Aug., 23 Sep. 1944.
 20. Memo for C/AS by Maj. Gen. Follett Bradley, 28 Mar. 1944, in AAG
 353, Gunnery Training. Later, however, jurisdiction over the in-
 structors school was placed directly in the hands of the AFTRC.
 See AFTRC Monthly Progress Report, May 1944.

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nificance of the instructors school as a liaison and standardizing agency has been well suggested by Brig. Gen. E. B. Lyon, Commanding General of the 75th Flying Training Wing. He pointed out that of its eight missions only two had to do with instructors. Among the others was the standardizing of flexible gunnery training throughout the AAF; the establishment of liaison and coordination between the flexible gunnery schools, the Training Command, the training air forces, and the air forces abroad; and coordination with Headquarters, AAF in the preparation of directives on flexible gunnery training. The move toward the establishment of a single wing over all the flexible gunnery schools was enhanced when the Committee on Organization of the Tampa conference gave its indorsement to such a plan.

Even before this indorsement a practical step had been taken in that direction when, in the face of some opposition, Harlingen and Laredo were transferred from the jurisdiction of the Central Flying Training Command to that of the Eastern Flying Training Command. In April and May, after considerable discussion, AAF Headquarters directed the establishment of a deputy to the Commanding General of the Training Command, whose duty was to supervise flexible gunnery training.

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21. Report of Flexible Gunnery Training Conference held at Headquarters Third Air Force, Tampa, Fla., 12, 13, 14 April 1944, 26, 27.
 22. Ibid., Appendix, 113.
 23. History of Central Flying Training Command, Installment 4, III, 505-507; AFTRC Monthly Progress Report, Feb. 1944, 20.
 24. AFTRC Monthly Progress Report, April 1944, 15; ibid., May 1944, 16, 17.

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This important official had numerous duties. The following were

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the most important:

- a. Supervision of the training and training activities of the AAF Instructors School (Flexible Gunnery).
- b. Maintaining liaison with the Assistant Chief of Air Staff, Training, Army Air Forces Board, Army Air Forces Materiel Command, Army Air Forces Proving Ground Command, the continental Air Forces, the Theater of Operation (through AFACT) and with other agencies concerned with the development of flexible gunnery tactics, equipment and training needs.
- c. Making necessary visits to the Flexible Gunnery Wings and schools of the AAF Training Command for the purpose of inspection and correction of deficiencies noted in the gunnery program and to observe and report to the Commanding General, AAF Training Command upon the standardization of instruction.
- d. Keeping the Commanding General, AAF Training Command informed as to the equalization of the distribution of equipment and personnel within the various Flexible Gunnery Schools.

The memorandum in its definition of functions of the deputy made it clear that all directives and official instructions to lower echelons would be coordinated in, and issued by Training Command Headquarters.

It is clear, from the preceding part of this chapter, that continuity and control of training go hand in hand. However efficient the instruction, a student within six weeks could scarcely be expected to master in satisfactory fashion the technique of flexible gunnery. How could deficiencies be corrected and how could skills be retained? Inquiry, criticism, and discussion along these two lines resulted in added emphasis, especially in 1944, by AAF authorities upon three interrelated factors: phase checks, designed to correct errors as well as to discover them; standardization, so as to prevent confusion resulting from instruction;

25. These duties, as finally assigned, are found in T. C. Memo No. 20-7, 27 June 1944.

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and closer liaison among training agencies, as an aid to standardization and as a means of preventing long time intervals between training periods. The expansion of the functions of the instructors school and the creation of a deputy to the Commanding General of the Training Command to supervise and coordinate flexible gunnery training were steps in the direction of the fulfillment of this triple program.

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Chapter VII

SUMMARY

Flexible gunnery training existed to some extent in the United States during World War I. Instruction was given in both ground and aerial exercises. The Lewis and the Browning aircraft guns were modified to meet flexible needs, though the changes in the latter took place too late in 1918 for it to be of much use during the war. The student was required to become familiar with the Norman Compensating Foresight and the Ring Sight, which were designed to gauge respective speeds of opposing planes. Between 1919 and 1940 no flexible gunnery schools were established, though a meager amount of gunnery training was given at some of the six flying schools then in existence. Provisions for flexible gunnery equipment in planes and specifications of guns to be used constitute additional evidence of at least continuing interest in such training.

Though in some cases preliminary steps had been taken as early as 1940 to establish specialized flexible gunnery schools, none was actually established before 1941. Plans toward this end were facilitated in the latter year when Maj. W. L. Kennedy made a comprehensive report based on a study of the RAF gunnery system. The following is the order in which the seven flexible gunnery schools came into existence:

Las Vegas, 25 January 1941	Kingman, 27 May 1942
Tyndall Field, 15 April 1941	Ft. Myers Instructors, 5 July 1942
Harlingen, 6 May 1941	Laredo, 12 August 1942
Yuma, 11 November 1943	

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In the face of all the numerous problems confronting these schools, they succeeded by August 1944 in reaching the annual rate of production of graduates which they had hoped to achieve by March 1944. That rate was 3,500 per week or approximately 180,000 per year. By 1 September 1944 the total number of graduates of the seven schools was 214,826.

The problem of student personnel may be viewed from a number of angles. Physical and mental requirements for admission to schools had to be determined, and the members of a bombardment crew to be given flexible gunnery had to be designated. Entrance requirements during most of 1942 were higher than they were late in that year and in 1943, a modification explained by pressure to fill increasing quotas. Pilots were not required to take the gunnery course, but beginning late in 1942 all other members of a bombardment crew, photographic personnel excepted, had to do so. This requirement, however, frequently was not carried out in the case of bombardiers and navigators. Career gunners had priority in flexible gunnery schools, with the result that school facilities often could not accommodate the full flow of bombardiers and navigators. The two latter groups were exempted from flexible gunnery training for a brief time in 1944, but photographic personnel, increasingly important after emphasis upon the gun camera, were subjected to the requirement in that year.

For a time during the fall of 1942 specialists, such as airplane mechanics, radio operators, and aircraft armorers, were in such demand for other activities that they were not admitted to flexible gunnery schools. This policy was changed late in 1942 because of the feeling that mechanics, with specially helpful aptitudes already developed,

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vere better material for gunnery training than nonspecialists. In April 1943 gunnery training was confined to specialists, to whom it was believed the compulsory features then in existence would be more acceptable than to basic trainees. However, after approximately three months the demand for numbers to meet the needs of a rapidly expanding program led again to the inclusion of nonspecialists in the training program.

Though other factors, such as the assigning of rank to a graduate gunner, entered into the morale picture, voluntary enlistment versus compulsion was the principal question of that character. Failure to fill quotas or to secure sufficient personnel under the voluntary system led to its abandonment in January 1943. AAF authorities differed over the wisdom of this step, and the immediate reaction of prospective trainees did not augur well for the change; however, within some months, after an educational campaign to "sell" flexible gunnery, the compulsory principle became more popular and the elimination rate of 35 per cent which the Flying Training Command had predicted that principle would produce did not materialize. This prediction was based on the theory that fear of flying, a cause for elimination along with ground and air range deficiencies and failure on the final examination, would greatly increase.

Competent instructors and officers were of course a desideratum in connection with the flexible gunnery program. Instructors were at first obtained from technical schools and from graduating classes of gunnery schools. Though not well prepared, for about a year they followed the flight system of instruction under which each instructor carried his flight through all courses. This system had advantages and disadvantages, but the latter seemed predominant with the result that the method was

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abandoned. In order to secure better instructors, facilitate gunnery research, and disseminate gunnery knowledge, the Central Flexible Gunnery Instructors School was established late in 1942 at Fort Myers.

The lack of gunnery officers and the lack of a systematic way of getting them resulted in the establishment in 1943 of a gunnery officers school at Fort Myers where a four-week course of special instruction was given. Subsequently the course was increased to five and then to six weeks. These increases were designed to meet the elaborate plans of AAF authorities for the training of 1,500 officers in addition to those available. Officers accompanied students on flying missions and supervised in general the work of students and instructors.

The operations of students, instructors, and officers were conditioned by the acquisition of satisfactory training equipment. Experimentation and Major Kennedy's report on 13 RAF synthetic devices were factors in deciding what was satisfactory. Many times the training program was hampered by lack of planes, turrets, trainers, cameras, sights, and other essentials. To secure some of this equipment it was necessary for AAF authorities to enter into negotiations with the Navy. At times it was necessary to determine the proper procurement authorities.

Among the early essentials of the training program proper were textbooks and curricula. In the preparation of these much credit is due Major Kennedy and Col. Delmar T. Spivey, project officer at Buckingham Army Air Field. There were two fundamental differences between the curricula of 1941-1942 and those of 1943-1944. The latter provided for a longer course and defined procedure and standards of proficiency with much more precision. Those standards were defined in such phases

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as gun familiarization, sighting, aircraft recognition, turret operation, and air firing. An understanding of guns was a sine qua non of any successful use of them; hence, much attention was paid to malfunctions and to the stripping and reassembling of guns. The tendency was to use the .50-caliber type, but its scarcity combined with lack of ammunition for it resulted in wide use of the .30-caliber for some time.

Recognizing aircraft was another phase of the program beset with difficulties. Aids necessary to instruction were lacking. To know the dimensions and features of numerous planes was not easy, so the WEFT system of recognition gave way to the "flash" or Renshaw system.

The heart and essence of a successful training program consisted in finding a way to hit the fighter before it destroyed the bomber. Sighting and firing systems thus received a major share of attention. One of the simplest of firing devices, which had at least the virtue of offering greater familiarity with arms, was trap shooting. More valuable was skeet-firing, an activity so arranged that the gunner had to make allowance for the factor of lead. Skeet was condemned by some on the ground that the shooting was from a stationary position and that it involved lead ahead of the target instead of behind it. Others defended it because it gave familiarity with firearms and was, in part, practiced from a moving base.

The problem of sighting a flexible gun has been a continuous one during the flexible gunnery training program. During 1942 gunnery students had to become familiar with 10 different types of sights. When the gunner tried to estimate the difference in speed between his plane and that of the enemy (the relative speed system of sighting), he became

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involved in a very complicated process of computing lead. A possible way of simplifying that process was through the use of tracer, which seemed to offer the possibility of visual checking of harmonization of guns and sights and of indicating proper lead in deflection shooting. Tracer, however, unless used with care was found to be very deceptive, and limitations were placed upon its use.

Position-firing, which is based upon an understanding of the pursuit curve of attack, consists in firing upon the enemy plane when it is in a position to make an attack. There was some difference of opinion over this system, which assumed much prominence during 1943 and 1944. Many held that it simplified the sighting problem, but others contended that it was wise to use automatic computing sights so as to fire at planes before they were in a position close enough to attack. The tendency was to use this system but reduce and simplify computing sights without abandoning them. The favored sights were the K-13 and E-15.

From the summer of 1943 through August 1944 the most significant development in connection with flexible gunnery training was the gun camera mission. This training phase involved the installation of a gun camera in gun position on bombers and the assessing and scoring of the film. This system was felt to come nearer to approximating actual combat conditions than any other that had been devised. It necessitated increased photographic personnel and large consignments of fighter aircraft. Fighter aircraft attacking bombardment planes on a true pursuit curve, it was claimed, represented training far superior to that given when firing against aerial towed targets. There was a feeling that air-to-ground firing gave practice not only in handling aerial

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~~Malassignment of gunners and insufficient preparation~~ were the main points of criticism of turret training after the specialization principle was adopted. AAF Headquarters and the Flying Training Command cooperated to correct the first defect and placed increasing emphasis upon careful phase checks to correct the second. Improvement was made to the point where it seemed to justify in 1944 a modification of turret specialization. Thereafter instructors and students were to be familiar with the gun positions on the airplane to which they were assigned.

Another problem in connection with flexible gunnery was that of retention of skills once acquired. Until agitation took place and corrective steps were taken, students were allowed too much time between training phases and hence not only failed to retain what had been learned but did not derive the additional benefits of continuity. Those responsible for training in the schools and in the OTU's, respectively, each blamed the other somewhat for the existence of this defect.

In the attempt to check the deficiencies which stemmed in part from the lack of a continuous program, emphasis in 1943 and 1944 was placed upon three interrelated factors: phase checks, standardization, and closer liaison among training agencies. Phase checks, which were required with increasing frequency in the flexible gunnery schools, the OTU's, and the combat theaters, were for the purpose of correcting as well as discovering deficiencies. The Central Flexible Gunnery Instructors School, which in 1944 was temporarily placed under the 75th Flying Training Wing and then under the Training Command, became increasingly a standardizing and coordinating training agency. Other significant steps in the standardizing and liaison process were the transfer,

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of the Harlingen and Laredo schools from the jurisdiction of the Central Flying Training Command to that of the Eastern Flying Training Command and the creation of a deputy to the Commanding General of the Training Command. The duties of this official were to supervise and inspect gunnery training activities and to coordinate the activities of all agencies connected with that training.

This presentation has been developed in terms of a conception of problems and their solution or attempted solution. There were problems that arose in connection with factors that conditioned training and in connection with training activities proper. It is impossible to divorce the one group from the other or to conceive of instruction in the schools as an activity apart from the next phase of training. The phenomenal expansion of the flexible gunnery program made the interrelationship of all of its phases more pronounced, and this increasing interdependence resulted in 1943 and 1944 in added emphasis upon administrative control.

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G L O S S A R Y

AAB	Army Air Base
AAF	Army Air Field; Army Air Forces
AAG	Air Adjutant General /former custodian of AAF Central Files/
AC/AS	Assistant Chief of Air Staff
AC/S	Assistant Chief of Staff
ACTTC	Air Corps Technical Training Command
AF	Air Force
AFACT	AC/AS, Training
AFAMC	Materiel Command
AFASC	Air Service Command
AFOTTC	Central Flying Training Command
AFDMR	Director of Military Requirements
AFDETTC	Eastern Flying Training Command
AFETC	Flying Training Command
AFMP	Military Personnel Division
AFRAD	Director of Air Defense
AFRBS	Director of Base Services
AFRDB	Director of Bombardment
AFRIT	Director of Individual Training
AFS	Advanced Flying School
AFTAI	Air Inspector
AFTRC	Training Command
AFETC	Technical Training Command
AFWETC	Western Flying Training Command
Asst.	Assistant
Br.	Branch
C/AC	Chief of the Air Corps
C/AS	Chief of the Air Staff
CFGIS	Central Flexible Gunnery Instructors School
CG	Commanding General
CO	Commanding Officer
DC/AS	Deputy Chief of the Air Staff
Dept.	Department
Div.	Division
Exec.	Executive
FGS	Flexible Gunnery School

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GCACTC	Gulf Coast Air Corps Training Center
GCAFTC	Gulf Coast Air Force Training Center
Hq.	Headquarters
MID	Military Intelligence Division
M&D	Materiel, Maintenance, and Distribution
M&S	Materiel and Services
OCAC	Office of the Chief of the Air Corps
OC&R	Operations, Commitments, and Requirements
OTU	Operational Training Unit
R&R	Routing and Record Sheet
RTU	Replacement Training Unit
SEACTC	Southeast Air Corps Training Center
SEAFTC	Southeast Air Force Training Center
Sec.	Section
TAD	Training Aids Division
T. C. Memo	Training Command Memorandum
T&O	Training and Operations
WCACTC	West Coast Air Corps Training Center
WCAFTC	West Coast Air Force Training Center
WDC	Western Defense Command

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353.9C2	Training, General
353.9D1	Training, General
353.9E	Training, General
353.9F	Training, General
353.9G	Training, General
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