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From: Chief, Naval Technical Mission to Japan.
To : Chief of Naval Operations.

Subject: Target Report - Japanese Electronics Training and Operating Techniques.

Reference: (a)"Intelligence Targets Japan" (DNI) of 4 Sept. 1945.

1. Subject report, covering Target E-29 of Fascicle E-1 of reference (a), is submitted herewith.

2. The investigation of the target and the target report were accomplished by Lieut. E. K. Smith, USNR, with the assistance of Lt. (jg) T. S. Montgomery, USNR, Lt.(jg) P. S. Gilman, USNR, Lt.(jg) R. R. Boggess, USNR, and Lt.(jg) K. C. Lamott, USNR, interpreters.

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JAPANESE ELECTRONICS TRAINING AND OPERATING TECHNIQUES

"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945

FASCICLE E-1, TARGET E-29

FEBRUARY 1946

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

ELECTRONICS TARGETS

JAPANESE ELECTRONICS TRAINING AND OPERATING TECHNIQUES

The investigation of electronics training and operating techniques was limited to the Japanese Navy, because (a) the Navy electronics program was generally further advanced than the Army's and (b) Army electronics training has been studied by the U.S. Army Signal Corps. This study was directed principally at training techniques, since operation methods have been covered in reports describing the various items of equipment. Searches for unusual utilization techniques were included in the investigation of training.

The training programs for all personnel connected with operation or maintenance of radar (all types), radio and communications, MAD, and special applications of radar were studied. Sonar training has not been included, since it is covered in NavTechJap Report "Japanese Submarine Operations", Index No. S-17. Details of the various training programs are presented in the body of the report. The following is a summation of the general characteristics of Japanese electronics training disclosed by the study:

1. Japanese training methods were entirely conventional, and no innovations or new techniques in instruction were discovered.

2. Electronics training was handicapped by the lack of technical aptitude or background in the average Japanese.

3. Training was handicapped by the inferiority of the Japanese electronics equipment.

4. Selection methods for students and instructors were conventional and well-planned.

5. Little use was made of training devices, except for simple classroom training aids.

6. Presentation of a number of different subjects usually was made consecutively, rather than concurrently.

7. All technical training courses were divided into phases of complexity, with only the most promising graduates being allowed to progress to a more advanced course. The remainder were assigned to subordinate jobs in the field.

8. When faced with the necessity of shortening a course, the Japanese resorted to specialization on one type of equipment, or even one specific set.

9. The Navy High command did not support training activities whole-heartedly, particularly for operations of a "defensive" nature.

In general, the Navy electronics training programs were well-planned, and if adhered of, probably would have produced competent personnel. As the war progressed, however, the Navy high command ordered quantity output even at the expense of quality, necessitating shortening of courses, lowering of entrance requirements, and dispersal of instructor personnel. The result was a marked decline in quality of output material until, near the end of the war, many of the graduates were incompetent to perform their duties.

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REFERENCES

A. Japanese Personnel Interviewed:

Capt. S. INOUE, IJN, Chief of First and Second Sections of the Electrical Bureau, Navy Technical Department. Previous duty in the Training Bureau, Navy Ministry, and as Instructor in Communications, Tenth Air Fleet. (Expert in Communications -- At present Chief of Communications for the Navy Demobilization Bureau).

Comdr. F. MORI, IJN. Naval Aviator. In charge of Electronics Training, Naval Air Headquarters. Previous duties in various Air Groups, and in the Personnel Bureau, Navy Ministry. (Specialist in airborne electronics).

Lt. Comdr. T. OKAMOTO, IJN. Naval Aviator. Staff, GHQ, Grand Escort Fleet, and previously Staff, First Escort Fleet. (Specialist in anti-submarine warfare).

Lieut. K. MORI, IJN. Radar Instructor at Chogo Radar School, and Research Officer at Second Naval Technical Arsenal. (Specialist in radar).

B. Related NavTechJap Reports:

NavTechJap Report "Japanese Submarine Operations", Index No. S-17. (Includes the Japanese Navy training program for sonar equipment.)

NavTechJap Report "Japanese Magnetic Airborne Detector", Index No. E-14. (Covers MAD equipment and tactical use in anti-submarine warfare.)

For a discussion of related reports of other intelligence agencies, see Enclosure (A).

INTRODUCTION

The Purpose of this investigation was to study Japanese training and operating techniques in the field of electronics, and to summarize briefly the information obtained, with particular emphasis on those techniques which might differ from the conventional.

The first step in the investigation was to make a thorough study of the reports and interrogations in the field of electronics which had already been accomplished by NavTechJap and other technical intelligence agencies. This preliminary investigation disclosed several points which guided the remainder of the project. First, in general, the Japanese Navy electronics program was further developed than the Army's. Second, the material aspects of the electronics equipment had been quite thoroughly covered in various intelligence reports already completed. Third, the normal methods of operation were covered quite adequately in the reports describing equipment. It was decided, therefore, to limit this study to the Japanese Navy electronics program. Japanese Army electronics has been studied by the U. S. Army Signal Corps.

It was decided also to approach the subject primarily from a point of view of training, since standard techniques for operating the various items of equipment are described in reports on equipment, and any special utilizations or operational methods could be investigated in connection with the training programs. An example of this type of approach is the search for any special methods of topographical siting of land based early warning radar while investigating the training program of the early warning radar groups.

The material for this report was gathered largely from interrogations of Japanese Navy personnel who had been connected with the various training and utilization programs, both in headquarters and operating units. It was found that since the Japanese Navy carefully had burned all textbooks and documents pertaining to training, and since the subject matter was essentially of a non-material nature, these interrogations were the most fruitful source of information. In addition, a considerable amount of data was obtained from reports of other intelligence agencies. These documents are referred to in this report.

The training programs for the following types of equipment merited investigation: Radar (all types, including associated equipment such as countermeasures, and special uses, such as navigation by radar), radio and communications, magnetic airborne detectors, and sonar. Each type is broken down in accordance with the functions of the personnel trained; i.e., operators, maintenance men, etc. Training in the use of sonar is not included, as that program has been covered separately in the anti-submarine warfare section of NavTechJap Report, "Japanese Submarine Operations", Index No. S-17.

The presentation of the assembled information includes a brief summary of overall trends in Japanese training during the war, a general review of the characteristics of Navy electronics training, and a summary of each training program.

THE REPORT

Part I

OVERALL TRENDS IN JAPANESE TRAINING

Almost all Japanese training programs followed the same general pattern during the war. The low-output peacetime plans were expanded considerably in the early part of 1942, and then training proceeded at a more or less constant rate. In late 1943, both Army and Navy realized that another expansion was necessary, because of prolongation of the war and unexpectedly high personnel losses in operations, and so, in early 1944, the training organizations were greatly enlarged in capacity. The peak output of trained personnel was reached in the fall of 1944, although the goals previously established never were attained. The effects of Allied bombing, fuel shortage, shortage of personnel, and other causes combined to reduce all training operations steadily until the spring of 1945, at which time some programs, such as flight training, practically ceased. After this time, some ground training courses continued, but all training thereafter was directed generally toward a suicidal defense of the home islands.

Part II

GENERAL CHARACTERISTICS OF NAVY ELECTRONICS TRAINING

Japanese training methods appeared to be entirely conventional, and no innovations or new techniques in instruction were discovered. Technical training courses were invariably divided into two sections, theory and practice. The theory subjects were taught in normal classroom manner, using lectures, demonstrations, and student recitations, with 15-25 students in the average class. Practical work on operational equipment was taught in the classroom, the explanations being supplemented by the use of cutaway models and training films where possible, and was concentrated to a great extent on maintenance practice.

One vital factor was immediately apparent in all training, the absence of technical aptitude and background in the average Japanese. This is attributed at least in part to the non-emphasis in the public schools on basic scientific subjects, with the result that long periods of fundamental education in mathematics, physics, etc., would have been necessary to prepare a man properly for technical military subjects. During the war, particularly the latter part, this time was not available.

Another factor which had a marked effect on all electronics training was the inferiority of Japanese equipment. All personnel interrogated agreed that their radar and radio were considerably more difficult to operate and maintain than foreign equipment, and that this increased the difficulty of training electronics personnel. For example, in the radar operators' schools, it was necessary to use a substantial portion of the time allocated for operation instruction to maintenance practice, merely to keep the equipment operating. There was virtually no concept of "human engineering" attempting to fit the machine and its operation to the man who must operate it.

Indications are that the expansion of the training programs in 1943-1944*, marked the beginning of a sharp decline in quality of the output material. There are a number of reasons for this drop in proficiency: Substantial shortening of all courses, lowering of entrance requirements, decrease in number of instructors, withdrawal of experienced instructors to other duties, shortages of equipment and supplies, and harassing action of Allied air attacks.

The underlying cause for almost all of these items can be traced to the Navy high command and the Personnel Bureau, which ordered quantity output, even at the expense of quality, and in many cases over the protests of the officers more directly concerned with operations and training, who felt that a greater net operational result would have been obtained with somewhat fewer but more highly trained personnel.

Methods of selection of personnel for the electronics programs appear to have been sound, involving more-than-average education, knowledge of electricity, and suitability for electrical work, as determined by tests (See Reference B, Item 15). However, the acute demand for more personnel necessitated the lowering of the admission requirements for all courses, with marked detrimental results in the quality of the graduates. No mechanical or psychological aptitude tests were used in the selection of electronics personnel. The Japanese electronics programs were handicapped by the fact that amateur short wave radio work had been illegal for some time prior to the war. The result was that Japan, unlike most other nations, had no reservoir of men who were familiar with at least the basic elements of electricity.

The training programs were impeded in some cases by the failure of high ranking officers to recognize the program's importance and to provide support in obtaining equipment, personnel, etc. This factor was particularly true in new forms of equipment such as radar, in which case the personnel interrogated felt that the high command did not understand the equipment or the operating problems connected with it. It was stated also that the traditional Japanese concept of warfare - that any operation of an "attack" nature was more important and more desirable than a "defensive" operation - also had a detrimental effect on training activities, particularly in such fields as anti-submarine warfare, which was regarded as essentially "defensive" in nature and, therefore, of secondary importance.

The Japanese Navy made very little use of training devices and prior to 1943 there had been virtually no concept of "synthetic" training. However, under the pressure of necessity, the development and use of training equipment was begun in 1943-1944. The devices developed were limited almost entirely to the simpler type of demonstration and display panel. At the surface radar school at CHOGO, for example, a number of electric circuit panels and working mock-ups of radar components were used to supplement classroom lectures. The need for the more complex type of device, such as synthetic generation of targets for radar sets and simulation of submarine contacts on MAD equipment was recognized, but the development of such equipment was only in the thought stage at the end of the war. The lack of progress in this field can be attributed to the non-existance of a central agency responsible for such development. Although in 1943 a Training Aids Branch was established in Army Air Headquarters to coordinate the program, it acted merely as a clearing house for ideas and was never assigned the responsibility of development and production of equipment. The Navy never established any central organization for training equipment, although the First Naval Technical Arsenal at YOKOSUKA was designated for construction of devices upon request. In practice, neither organization functioned satisfactorily because of lack of interest and lack of responsibility. The devices that were made were all developed locally by the individual schools, and such local development was handicapped by the lack of

*Prior to this change subjects were well covered with adequate time allocated and with instructing staffs that were satisfactory in both numbers and quality.

initiative and engineering skill of instructor personnel, and by lack of support from above in obtaining supplies, etc. The devices, with the exception of the pre-war "Link" trainer, are crude in construction. Training films were used to a limited extent.

One characteristic of Japanese training of electronics technicians was the division of all of the courses into basic and advanced stages, without any substantial difference in subject matter. The advance course usually was only an extension of the basic course, but with more thorough and detailed coverage of the same subjects. In all cases, the men with the highest grades in the basic course moved directly to the advanced course, whereas the remainder were assigned to operational duties. Thus in a field unit, technicians with advanced course training were placed in the more responsible positions, and those who graduated only from the basic course filled subordinate jobs.

This division of training programs into two phases frequently was carried one step further with a "special" course for the top graduates of the advanced course. These men were destined either for key jobs or for duty as instructors.

Another characteristic of the electronics training program was the system generally used of studying only one subject at a time, and then progressing to the next one. The merits of teaching different subjects consecutively rather than concurrently were not known, but the use of this plan appears to have been based on experience and, therefore, undoubtedly had some practical value for this type of course.

The standard Japanese division of maintenance functions appears in the training programs. Three classes on maintenance work were available: Minor repairs by the operators, intermediate repairs by maintenance men, and major overhauls at naval arsenals or civilian manufacturing plants. This division was reflected in the training plan, since all operators received some maintenance instruction and were expected to be qualified for limited repair work.

Selection methods for instructors for the electronics training program were well-planned and effective. A majority were taken from the top graduates of the advanced and special courses, but a substantial minority were officers with field experience who were returned on rotation. Flight instructors were mostly experienced personnel, and almost all instructors for special operational training, such as anti-submarine warfare, had had operational experience.

Since virtually all Japanese training courses were shortened drastically during the war, an investigation was made of the problem of how to teach essentially the same subject matter in shorter time. Generally speaking, two methods were used; proportional reduction of time in all subjects, and specialization on one type of equipment with a minimum reduction in the time spent on the subjects which were applicable to that specialty.

The latter method appears to have had better results, and was therefore applied to such an extent that at the end of the war a radar technician was being trained only for one particular model of one type of radar. However, the personnel interrogated were unanimous in the opinion that the shortening of the courses had in every case reduced the proficiency of the graduates.

In studying the Japanese electronics training program, it must be borne in mind that the Japanese electronics equipment itself was, in general, several years behind that of the U. S. In the field of radar, for example, no operational PPI scope had been developed, the concept of fighter direction was in its infancy, and countermeasure equipment was still largely in the development stages. Therefore, the search for training methods for such advanced uses of radar as blind bombing and navigation was fruitless, since the equipment for such uses never had become operational.

The Japanese training devices were made principally in the fields of aviation and technical training. No devices are known for surface activities such as shiphandling and ASW training, nor was any equipment developed for such advanced operations as guided missile control. No devices for use in meteorology training are known, and there was no knowledge of pressure pattern navigation.

Part III

ELECTRONICS TRAINING ORGANIZATION AND SCHOOLS

Figure 1 is a simplified chart of the Japanese Navy training organization. All non-aviation schools were under the military command of the local Naval Districts, which in turn reported directly to the Navy Ministry. The aviation schools were all units of the various training Air Forces, which reported to Air Headquarters under the Navy Ministry. Personnel quotas and assignments were made by the Personnel Bureau of the Ministry, and training plans and curricula for non-aviation schools were laid down by the Training Bureau. For aviation schools, training plans were made by the Training Section of Air Headquarters. In both cases, the central training agency exercised technical control directly over the schools, as indicated by the broken lines on the chart. The actual organization was considerably more complex, but has been reduced in Figure 1 to the bare essentials since this information is only for general background.

Figure 2 is a chart of all the Navy training establishments for radar and radio, with types and lengths of courses indicated, and the flow of personnel shown. Where available, the annual rates of output are included; these figures are usually the maximum attained during the war, and can be considered a good average for the year 1944. In accordance with the Japanese organization, the chart is divided into three sections: Surface, airborne, and aircrewmen.

It should be noted that Figure 2 shows only the major courses. There were a number of special courses for small groups, and variations on the basic plans shown, but these have been omitted since their inclusion would tend to obscure the more important points without contributing any new information.

The section of the chart dealing with aircrewmen has been simplified by not attempting to show the individual basic training and flight training schools for cadets, since the courses of each of the schools in a group were the same, and they were not primarily communications schools. The typical flow of pilot and observer candidates is included, however, to show the sources of personnel who later specialized in radio or radar, and to indicate the collateral communications training received by other flight personnel.

Part IV

TRAINING OF OPERATORS AND MAINTENANCE MEN FOR SURFACE RADAR

Radar training in the Japanese Navy began in 1942 at the Yokosuka Communications School. To meet the expanding radar program, the Chogo Radar School was constructed and began operations in 1944. All operators and maintenance men for land and ship based radar were trained at CHOGO thereafter. A maximum output rate of about 7000 per year was attained.

Two major courses were given at CHOGO, the "Ordinary" course, lasting six months, and the "Advanced" course, of ten months duration. The Ordinary course, given to men with no previous radar experience, graduated radar operators, whereas the Advanced course, limited to men with previous knowledge of radar, produced personnel qualified in both operation and maintenance.

Personnel entering the Ordinary course were selected from volunteer applicants, either new recruits or seamen from the fleet. The educational prereq-

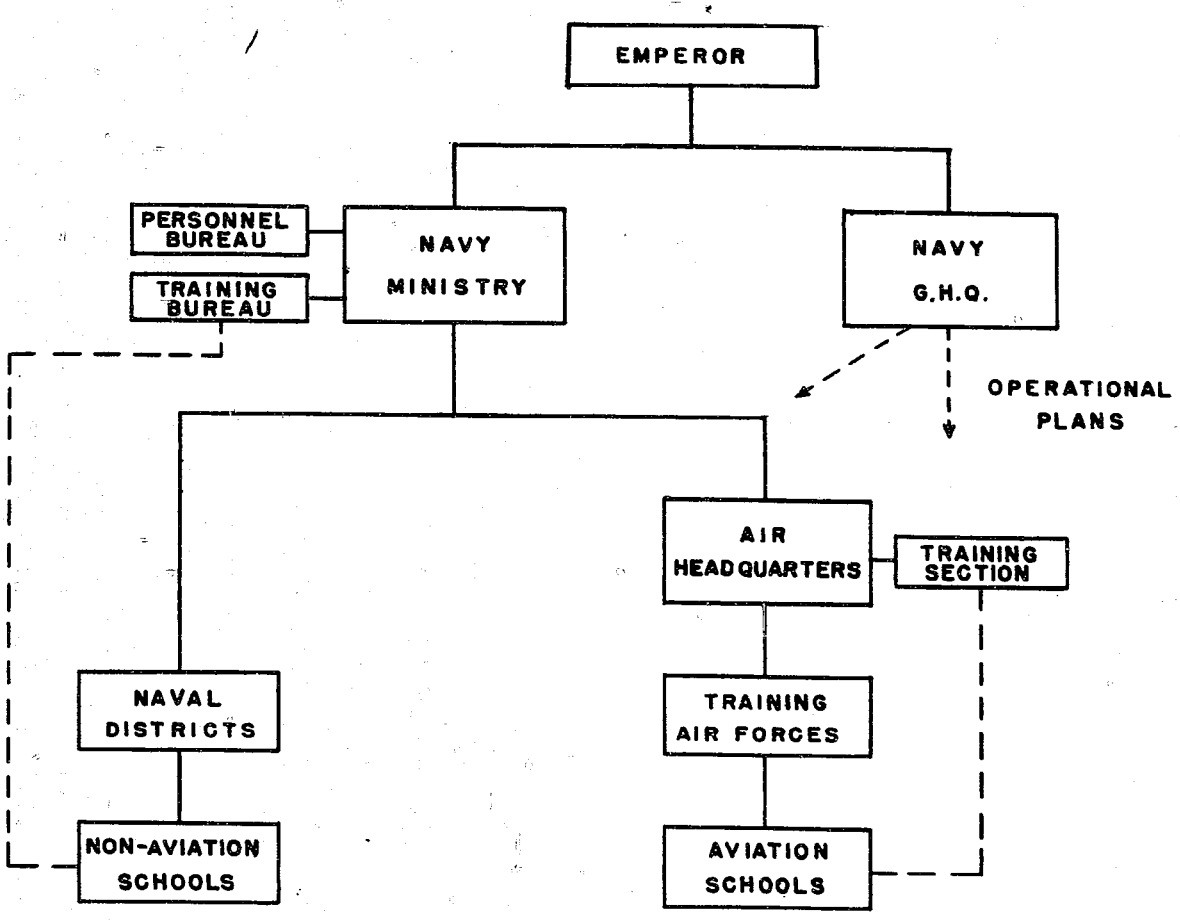

Figure 1

JAPANESE NAVY ORGANIZATION FOR TRAINING

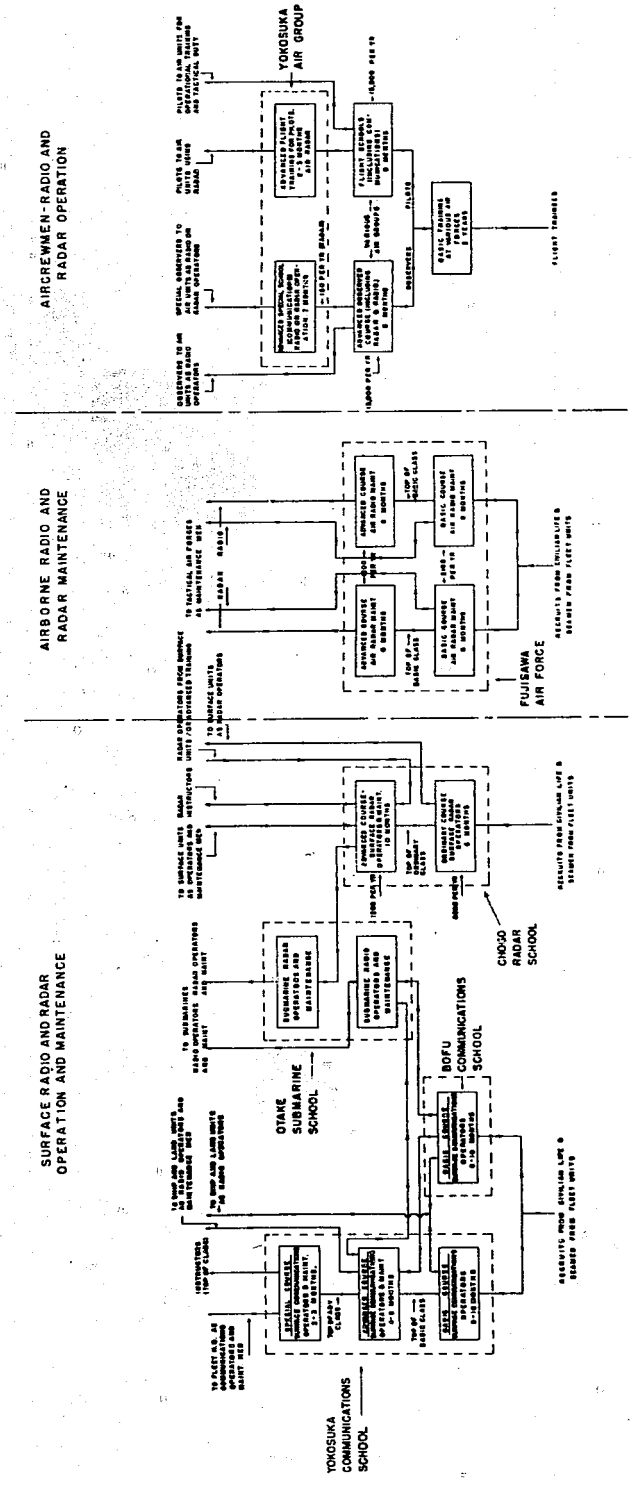

Figure 2

DIAGRAM OF JAPANESE NAVY RADIO AND RADAR TRAINING ACTIVITIES

uisite was two years of Middle School (high school), and candidates were required to pass an examination involving basic electricity and mathematics. For the Advanced course, graduation from Middle School was required, as well as satisfactory performance on an examination including electricity and radar. Some of the Advanced course students came from operational units, and upon graduation became petty officers or warrant officers. The radar program was popular, with more applicants than could be accepted. Instructors for the school were selected largely from the top graduates of the Advanced course.

The curriculum of the Ordinary course can be broken down as shown below. The breakdown is not entirely sequential, since physical training, for example, was spread over the entire period.

Indoctrination (Mathematics, English, Japanese, etc.)	1 month
Theory of Electricity and Electric Waves	1 month
Operation of Radar Equipment (Instruction)	2 months
Operation of Radar Equipment (Practice)	1 month
Physical training	1 month

A similar breakdown for the Advanced course is as follows:

Theory of Electric Waves	2 months
Theory of Radar	2 months
Radar Operation	2 months
Maintenance and Repair	3 months
Practice on Operational Equipment	1 month

Under this plan, students were instructed in all types of surface radar. However, when the need for more trained personnel became acute, the Advanced course was shortened to seven months. Thereafter, a man studied only one of the three major types: Shipborne, early warning, or "attack" (fire control and searchlight) radar. Since the results were not satisfactory, further subdivisions were effected, and at the end of the war a student studied only one specific set.

The methods of teaching were conventional and adequate operational equipment was available. The classroom sets were arranged with the antennae just outside and controllable mechanically from the class. In addition, some sets located outdoors were connected to a central information center, and the men were trained in both radar stations and plotting rooms. One of the information centers was a mockup of a ship's fire control room.

Aircraft were used wherever possible for practice targets, although unsatisfactory liaison with the Air Force caused difficulties in obtaining aircraft when needed. None were assigned to the school for that purpose. Since no equipment was developed for generating synthetic targets, free ballons carrying metal reflectors were used. The balloons, released at ranges up to 40 Km, were considered satisfactory for tracking training, but were subject to wind conditions. Attempts also were made to use fixed calibration targets in training.

The upper 20% of the classes in the Ordinary course went directly into the Advanced school, with the remainder assigned directly to field units as operators. Upon completion of the Advanced course, assignment to radar units in maintenance and supervisory operating capacities followed, although the top 10% of this class were usually designated instructors. Instructors occasionally were sent to ships temporarily for explanation of new types of radar.

No training in the use of radar countermeasures was included, since the equipment was still in the development stage, and no instruction was given in navigation by radar. Siting methods for land based radar were covered by lecture. No special techniques for determining optimum location were used, the only method used being a visual inspection of the area to determine the highest pos-

sible location.

A research section was attached to the school and worked on problems such as filtering and evaluating information from a group of early warning stations.

The Chogo School is considered to be an excellent training installation. New and well-planned, it probably represents the best in Japanese electronics training.

Part V

TRAINING OF OPERATORS AND MAINTENANCE MEN FOR SURFACE COMMUNICATIONS

Training of radio operators and maintenance men for surface and land units of the Navy was conducted at two locations, the Yokosuka and Bofu Communications Schools. There were two major courses in surface communications, Basic (8 to 10 months), and Advanced (4 to 6 months). The Basic course was given at YOKOSUKA and BOFU, but the Advanced course was given only at YOKOSUKA.

The Basic course was intended to produce radio operators only. The most promising of these graduates were assigned to the advanced course to study either advanced operation or maintenance. In addition, there was a special course of three months duration into which the top members of the Advanced classes moved for additional work in either operation or maintenance.

Personnel for the Basic course were selected from new recruits, were taken as young as possible (down to 16), and were required to have had two years of middle school and be able to pass a competitive examination stressing mathematics.

Training methods used in all three courses were conventional, and closely paralleled those used at the Shogo School for surface radar, already described. It will be noted in the following breakdowns of the courses (by subjects) that code training was stressed heavily in all courses.

BASIC COURSE

General Education and Indoctrination ..... 1½ months
Fundamental Electricity ..... ½ month
Code Instruction and Practice, and Equipment Operation .... 6 months

ADVANCED COURSE

Equipment Operation and Code Practice ..... 4 to 6 months
OR
Maintenance ..... 6 months

SPECIAL COURSE

Equipment Operation and Code Practice ..... 3 months
OR
Maintenance ..... 3 months

No training devices except automatic classroom code sending machines and components of operational radio equipment were used.

Most of the radio operators graduating from the Basic Course as operators, or as maintenance men from the Advanced Course, were assigned directly to operational units, with the exception of those progressing to a more advanced course. A small number of each category went to the Otake Submarine School for operational training in submarine communications. Personnel completing the Special Course went to either Fleet Headquarters as communications experts, or were designated instructors.

Instructors for the Yokosuka and Bofu schools were given an informal training course varying in length from two to several months, depending on time available.

In summary, the Navy surface communications schools are believed to have been adequate for their purpose as far as operators were concerned. Maintenance results were not as satisfactory. Japanese personnel felt that the surface radio courses generally were more successful than radar or aviation courses because they were older and better established.

Part VI

TRAINING OF MAINTENANCE MEN FOR AIRBORNE RADAR AND RADIO

It should be noted that for surface radar and communications, both operators and maintenance men were drawn from the same sources, trained at the same schools, and took the same basic courses; whereas in the Naval Air Force, the two functions of air operation and ground repair were considered to be entirely separate.

All training in maintenance of airborne radio and radar was conducted at the Fujisawa Air Force, which was a part of the Thirteenth Combined Air Force. Four major courses were given; Basic and Advanced radar maintenance, and Basic and Advanced radio maintenance, each of which was of six months duration. An output rate of 2100 per year for the Basic courses and 1200 per year for the Advanced courses was reached.

Entrance requirements and selection methods for the Basic courses were about the same as for the Yokosuka and Bofu communications schools, and will not be repeated here. The Advanced courses were open only to Basic graduates, with approximately 50% of the Basic students being selected for Advanced training. Graduates of all courses were assigned to various Air Forces for tactical duty, and it was expected that additional operational training would be received in those units, although toward the end of the war this training usually did not materialize. Most of these men performed ground repair work, but since large aircraft usually carried a maintenance man in the crew, a few were assigned to flying duty.

The same division by subjects can be made for both radio and radar maintenance courses, the differences lying in the types of equipment studied. The outlines of the courses are as follows:

BASIC RADIO (ALSO RADAR)

Indoctrination	1 month
Fundamentals of Electricity	½ month
Equipment Construction	2½ months
Equipment Adjustment and Operation	1 month
Maintenance	1 month

ADVANCED RADIO (ALSO RADAR)

Equipment Construction	2 months
Equipment Adjustment and Operation	1 month
Maintenance	3 months

In each of the Basic courses, the first three months were devoted to theory and the second three months to practical maintenance. The Advanced courses were similarly divided into approximately equal periods of theory and practice.

A more detailed listing of the subjects in the radio maintenance course will serve as an example. In the Basic courses, the following subjects were taught in sequence during the first three months: Static electricity, direct current, alternating current, radio circuits, receivers, and transmitters. In the second three months of Basic radio, repair was practiced on six sets, four high frequency and two VHF. In the Advanced course, the same general outline was followed, but was more comprehensive in scope, and with ultimate specialization in one particular set.

No training devices were used at the Fujisawa School other than the elementary type classroom aids already described, and sectioned or cutaway components.

Although the courses in airborne radio and radar maintenance may appear to be adequate, the results, in the opinion of the personnel interrogated, were unsatisfactory, particularly in the radar course. The officers felt that the time allotted was not sufficient for training in enough different types of equipment (one year was felt to be minimum time for the Basic course). In addition, the Fujisawa School was hurriedly planned, and its equipment was usually out of date because the new operational equipment could not be obtained for training.

Part VII

TRAINING OF FLIGHT PERSONNEL IN RADAR AND RADIO OPERATION

Operators for airborne radar and radio were drawn from the flight training program, and therefore, except for certain special post-graduate schools, communications training was an integral part of the flight program.

In order to present adequate background information on the training of communications specialists, the whole flight training process will be reviewed briefly. Fight trainees were taken from three sources: Graduates of the Etajima Naval Academy ("Air Cadets"), college graduates ("Reserve Officers"), and enlisted candidates ("Flight Trainees"). All of these candidates went first into "Basic" training -- consisting of naval indoctrination, academic and scientific subjects, and aviation ground school. This Basic training was conducted at four units of the 19th Combined Air Force: TSUCHIURA, KAGOSHIMA, MIE, and MIHO. The length of time in Basic varied from four months to two years, depending on the educational background of the candidates. The ground school portion included elementary communications training, approximately as follows:

Code	50 hours
Elementary Electrical and Radio Theory	45 hours
Familiarization with Radio Sets	2 to 3 hours

During Basic training, the trainees were classified either as Pilot candidates or Observer candidates, the selection being based on their preferences, as well as the results of medical and psychological examinations. Approximately 50% went into each category. The Observer classification is roughly equivalent to the Aircrewman designation in the U.S. Navy. Observers performed most of the non-piloting flight duties, such as radio operation, bombing, navigation, and gunnery.

Upon completion of the Basic course, the pilot candidates went directly to flight schools, These schools will not be discussed here, since the only communications training was routine and intended only to maintain normal proficiency in radio. Flight courses lasted eight months.

The Observers were further classified as "attack" or "communications" specialists, and sent to Advanced Observers Schools accordingly. The "attack" candidates received some additional communications training, including basic

elements of radar, but concentrated principally on bombing and gunnery. However, the course for the communications specialists (at various Air Forces) stressed radio and radar, and included the following subjects:

Code Practice and Procedure	150 hours
Radio Theory	5 hours
Radar Theory	5 hours
Familiarization with Equipment and Set Operation (on the ground)	50 hours
Familiarization with Equipment and Set Operation (in the air)	5 to 10 hours

This course was normally of eight months duration, but late in the war was shortened to four months. Upon graduation, most of the observers were assigned to tactical air units for operational duty. However, a small number of the most promising of the communications observers were selected for additional training in the Advanced Special School at the Yokosuka Air Force. This course, seven months long, was originally intended to turn out experts in all phases of communications for duty as radio operators in the lead aircraft of bomber formations.

The curriculum included:

Code	300 hours	
Radio and Radar Theory	300 hours	
Radio Operation	130 hours	(40% ground 60% air)
Radar Operation	20 hours	(50% ground 50% air)
Cryptography	10 hours	

After radar equipment had become operational in air units, the demands for trained radar operators necessitated the training of additional observers in the Advanced Special School as radar operators. The course for these men was along the same lines as the above, except that radar operation was stressed more heavily.

Training procedure was generally similar to other operator's courses. After classroom work on radar theory and set construction, operation was practiced on the ground using random ships and aircraft in the area as practice targets. Then flight operation was practiced, although the drastically curtailed flight time allowed at the end of the war was considered inadequate. About 160 special radar operators were trained per year, and one instructor was provided for each 20 students.

Pilots who were to be assigned to radar-equipped aircraft were also trained at the Yokosuka Air Group. Some of the most promising of the flight school graduates were selected (usually less than 20% of the classes) for seven months advanced flight training (combat training) at YOKOSUKA. This course was designed to train these pilots in a variety of specialized operations, such as precision bombing runs, advanced tactics, and radar, with two to three months devoted to radar. The pilots were not trained to be radar operators, but rather were indoctrinated in the tactical capabilities of radar and taught to cooperate with the observer radar operator. A total of 50 hours of flight time was allotted for radar flights.

The Yokosuka Air Group was also the experimental and research center for Japanese naval aviation, and was, therefore, the location of any informal training for limited groups who were to test and put into operation new airborne equipment which was not yet operational.

Note: Japanese personnel interrogated stated that no work had been done on the problem of reducing pilot fatigue in listening to signals at high

altitudes. (See NavTechJap Report "Aero, Surface and Submarine Medicine and Research in the Japanese Navy", Index No. M-06).

Part VIII

MAGNETIC AIRBORNE DETECTOR TRAINING

Magnetic Airborne Detection equipment was first installed in aircraft in October 1943, and became operational in the spring of 1944, the first anti-submarine attack having been made in June. (See NavTechJap Report, "Japanese Magnetic Airborne Detectors", Index No. E-14). Training for aircrews was begun in June 1944 at the Saeki Air Group, KYUSHU, and training for ground maintenance men was started at the Sunosaki Air Force at about the same time. Both courses continued until the end of the war.

Flight personnel for MAD training were selected from two sources: anti-submarine squadrons and the Flight Observer schools, with about 50% of the personnel from each source. The crews of aircraft engaged in ASW were ordered back for MAD training as a unit. These remained as a unit throughout training and were returned to their squadrons. The observers went through the MAD course as individuals, and were subsequently detailed to ASW air units for duty in patrol aircraft. There were no special entrance requirements or tests. However, observer candidates were selected who were considered to be of a quiet, patient nature, rather than forward and aggressive.

Almost all the instructors at SAEKI were selected from operating units and had had anti-submarine experience. A few were pilots, but most were observers.

The training period lasted three months, being divided into three sections of one month each. A summary of the course follows. (It should be noted that this course was designed to teach not only operation of the equipment and tactical ASW doctrines, but also enough construction and maintenance to enable the flight personnel to perform minor repairs in the air when necessary.)

The first month was devoted to ground training in the following subjects: Construction and operation of the equipment, anti-submarine doctrines and patrol tactics, and the use of radar in ASW. Training films and operating models of various components of the MAD equipment were used to supplement the lectures. No means of operating the MAD realistically in the classroom was available, although a plan had been devised by which a submarine contact could be simulated by modifying the MAD and using a movable miniature "target" at about five meters range. This device had not been constructed at the end of the war. Radar, particularly its use in anti-submarine attacks, was included because many of the students had had no previous instruction.

The second month was devoted to flight training, practicing MAD attacks on stationary targets such as abandoned submarines or sunken ships. In the third month, flight training was continued, but with either tame submarines or escort ships as moving targets. Near the end of the course, operational anti-submarine patrols were flown in home waters. (No Allied submarines were sunk during these training flights). No training flights were made at night, as the Japanese did not use MAD at night because of the hazard involved in flying at the very low altitudes necessary. When submarines were not available, coast defense vessels (600 tons) were used as targets. To obtain MAD contact, the planes flew alongside at low altitude rather than directly overhead.

A total of 60 to 80 hours of flight time was given each student, although this figure was cut in half near the end of the war because of fuel shortage. All aircraft used in training were operational types. The following types were MAD equipped: 96 land based bomber, TOKAI anti-submarine patrol, ZERO (seaplane reconnaissance), 97 torpedo bomber, and TENZAN torpedo bomber.

The peak rate of output of the Saeki School was reached in November 1944, at which time 140 operators (50 observers and 30 crews of three men) were being trained every three months. From that date until the end of the war the output rate declined, primarily because of operational losses of flight personnel in ASW squadrons, and secondarily because of shortages of fuel and aircraft.

The MAD training program appears to have been well-organized, and well-carried out until flying was drastically curtailed. The officers connected with the school felt that their personnel were trained adequately upon graduation, and were capable of making the best use of the MAD. Apparently, however, difficulties were encountered in the operation of the school, particularly in obtaining supplies and equipment, because of a lack of recognition by high ranking naval officers of the importance of anti-submarine warfare. The lack of interest stemmed from the fact that ASW was viewed by these officers as essentially a defensive operation, and therefore was considered less important than operations of an "attack" nature.

The training of MAD ground technicians was conducted at the Sunosaki Maintenance School, and the course was of six months duration. Preliminary information indicated that this course was similar to the radar and radio technicians' courses which have been described already, so a detailed investigation was not made.

Part IX

TRAINING FOR SPECIAL APPLICATIONS OF RADAR

A search was made for training and utilization information concerning any special applications of radar equipment. The following is a summary of this investigation:

Navigation by Radar. The use of radar for navigation was still in a comparatively elementary stage. Since only the "A" scope was available to operational ships and aircraft, the uses for navigation were restricted to taking ranges and bearings on islands, channel navigation in fog, etc. The only known training was the inclusion in a new radar handbook of scope pictures correlated with locations on a chart.

Radar Countermeasures. Electronic jamming and homing equipment was still under development at the end of the war, so no training in counter-measures was included in the radar courses. Research personnel visited operational units from time to time to disseminate available countermeasure information.

Aircraft Radar Interception. The first successful intercept radar set for fighter aircraft had just been completed at the end of the war; thus the program was not far enough advanced to warrant any formal training.

Fighter Direction. One elaborate fighter direction system had just been put in operation at the end of the war, the first development in this field. However, the use of the system was still experimental and no training plan had been considered.

Siting of Land Based Radar. The investigation did not disclose any new or special methods for determining sites for land based early warning radar sets. The technique in use was, after determination of the general location, to survey the area visually and then use the highest practical point of land. Training consisted only of a lecture at the Chogo School, setting forth this technique.

ENCLOSURE (A)

RELATED REPORTS OF OTHER INTELLIGENCE AGENCIES

1. Air Technical Intelligence Group Report #110, dated 15 December 1945, Subject: "Magnetic Airborne Detectors". (Covers MAD equipment and tactical use in anti-submarine warfare).

2. Far Eastern Air Force Intelligence Memorandum #14, dated 29 September 1945, subject: "Japanese Agencies for Naval Air Training". (Brief outline of Japanese Navy Ministry organization for naval air training).

3. Far Eastern Air Force Intelligence Memorandum #19, dated 31 October 1945, Subject: "Training Plan for Japanese Naval Air Force". (Presents in some detail the Japanese naval aviation training plan of 1944).

4. Far Eastern Air Force Intelligence Memorandum #33, dated 1 January 1946, Subject: "Training". (A comprehensive study of Army Air training, which references and transmits those few training documents which were captured. Includes section on training organization, pilot training with curricula, specialist aircrew training programs, glider and troop carrier training, tow target training (not formal course), communications and radar training, aviation engineer and quartermaster training, photographic training, training films, and recognition training. The training film program was quite comprehensive until the acute film shortage developed. Recognition training was restricted to models and photographs, and consisted principally of teaching recognition of Japanese equipment, and assuming all others enemy. Navy communications is also discussed).

5. Air Technical Intelligence Group Report #115, dated 10 December 1945, Subject: "A Short Survey of Japanese Radar". (A comprehensive review of Japanese radar, in eight sections, as follows:

   I. Foreword and History of Japanese Radar Development and Employment
   II. Electronics Research
   III. Manufacture of Radar
   IV. The Japanese Army Radar Book
   V. The Japanese Navy Radar Book
   VI. The Japanese Radar Training Program
   VII. Radar Equipment Performance in the Field
   VIII. The Japanese Air Defense System

   (Part VI covers briefly the Army radar training program, which was inadequate, and the Navy radar school at CHOGO for surface radar. A detailed description of the Chogo School, which is considered very good, including maps and photographs of the classrooms, training aids, and training radar installations, is presented).

6. "Pilot Training in the Japanese Navy". Air Technical Intelligence Group Report #20, dated 31 October 1945. (A detailed account of Navy pilot training. Covers sources of personnel, training schools, formation of squadrons, and appendices showing physical requirements, curricula outlines, and personnel statistics. The report traces the history of Navy pilot training since well before the war, and concludes that the flight training programs were well conceived and well executed).

7. "Flexible Gunnery Training in the Japanese Army and Navy Air Forces". ATIG report #165. (This report outlines the training programs for free gunners for both Army and Navy, and transmits captured Army documents. All Navy records were destroyed. Both programs lacked organization and centralization, since the individual Air Group commanders were in complete

charge of training schedules, proficiency requirements, etc., even though the Air Headquarters laid down overall plans. The Navy had no "career" gunners, gunnery being collateral to some other flight duty. A few devices are reported which are described elsewhere in this report. The training programs include theory of sighting, ballistics, ground firing, and air firing. The Navy emphasis on flexible gunnery was increasing at the end of the war, because of cut-back in carrier types, whereas the Army's emphasis was decreasing, since the major effort was in fighter aircraft for home defense).

8. "Horizontal and Dive Bombing Training Equipment and Devices - Japanese Navy". ATIG Report #48, dated 7 November 1945. (Outlines the eight-month training program for bombardiers and the six-month advanced course for pilots and bombardiers. The training devices used were described, and are included later in this report. The Navy considered dive bombing a very effective weapon and the training consisted of dry dives and then dropping of practice bombs on stationary and moving targets. Prizes were offered for the development of a dive-bombing training device, but none were completed).

9. "Japanese Navy Training Equipment and Devices". ATIG Report #50, dated 8 November 1945. (Outlines Navy organization for handling of training equipment, and lists devices in use. Descriptions are included in this report).

10. "Training Methods and Equipment in the Japanese Air Force". ATIG Report #86, dated 15 November 1945. (Presents Army organization for handling of training equipment, and lists the devices in use).

11. "Training Aids and Devices Used in the Japanese Air Force". ATIG Report #240, dated 7 December 1945. (A further discussion of the Army Training Aids Branch. All records of the branch were destroyed. Lists and describes 14 Army Devices).

12. "Anti-Aircraft Training and Education". Anti-Aircraft Officer, GHQ report dated 1 October 1945. (An interrogation in which the organization for anti-aircraft training was discussed. No training devices are known, and anti-aircraft training was confused by the fact that air units trained their own AA personnel for defense of air installations).

13. "Japanese Army Air Force Use of Aviation Psychology". ATIG Report #176. (Presents tests and standards used with flight personnel).

ENCLOSURE (B)

A SUMMARY OF ALL KNOWN JAPANESE TRAINING DEVICES

1. Landing Trainer. This device was intended to train pilots in landing techniques, and was put into use at Yatabe Naval Air Base and Toyooka Army Air Field (Primary Flight Training Stations) in late 1944 or early 1945. It consisted of two steel towers, 65 ft. and 20 ft. high, about 250 yards apart, and connected by cables. A glider was suspended from the cables, hoisted to the top with a winch, and upon release, the glider and student pilot descended by gravity, landing on a concrete strip at the low end. Approximately 10 to 15 hours was given each student before commencing flight training, and occasionally more time was given during flight training. The Navy reported that no decrease in training time resulted from its use. A description of this device, with a rough sketch, is included in ATIG report #50, reference (g). This device was inspected at the Yatabe base, but was inoperative. The towers and cables were in place, but the aircraft had been removed, and no literature was located. It is believed that the limitations on speeds, ranges of movements, and student capacity (one) were responsible for the failure of the device.

2. Night Carrier Approach Trainer. This device was designed to teach proper use of the throttle in making night landings on carriers or fields using landing path lights. It consisted of a wood tower about 30 feet high, a mockup cockpit which moved vertically on the side of the tower, and a small truck which moved horizontally on the ground. The carriage mounted appropriate electric light combinations, and the lights moved horizontally relative to each other (simulating change in range), and angularly (simulating plane moving in or out of the fixed landing path). In action, the carriage moved in toward the tower, and the lights changed relative position (through pantagraph mechanisms) by means of a compressed air system controlled by the cockpit throttle. The cockpit itself moved steadily downward during the "approach." An instructor rode in the cockpit with the student. This trainer was located at Yatabe Naval Air Base, but was not located, and personnel interrogated stated that it had been destroyed and all descriptive literature burned. Pilot trainees were given limited training in the device, but the results obtained are not known. No device was limited to a fixed glide angle (6 degrees). It is described in ATIG report #50, reference (g).

3. Torpedo Trainer. This device was one of the few produced in any quantity, and was essentially a tactics game built around aircraft and ship models. Two "teams" competed, each team having models arranged to represent a given tactical situation and separated by a screen. At intervals, the screen was lifted and a quick view of the other team's disposition was given, and then the new attack was planned. An instructor observed both sides and evaluated the results. This was the only training device used aboard carriers. It is described in ATIG report #50, reference (g), and a sample has been sent by ATIG to TAIC, Anacostia.

4. "Link" Type Trainer. This device was located at TOYOOKA Army Air Base, and at several Navy Air Bases. It is similar in construction and use to the early models of the Link trainer used in the U.S., and is one of the very few devices in use prior to the war. The trainer was also used with the hood removed, for pilot selection. Pilot candidates were required to "fly" predetermined patterns visually, and it was stated that about 10% of the candidates were rejected as a result of these tests.

5. Vehicle for Training in Maintaining Direction. A dummy fuselage and rudder bar mounted on a bicycle, the device was intended to teach rudder control in landings and takeoffs.

6. Ground Training Apparatus. Hoop-shaped frames, in which a student sat or stood, were rolled around to demonstrate the efforts of looping and banking (for banking, the hoop section was a truncated cone).

7. Training Device for Coordination of Hands and Feet. This device consisted of a seat, stick, and rudder pedals. The stick and pedals were connected to a chart which recorded the pressure applied to each, in an attempt to demonstrate proper coordination of stick and rudder. The device was stationary and crudely constructed.

8. Ground Navigation Trainer. A "platform" was installed over a moving map. The map was movable through a limited angle to change the "drift." Drift sights or bombsights were installed in the platform and were used to train operators in their use. Two sizes were constructed, - one for eleven drift sights and the smaller for six. The device is believed to be large and cumbersome for the purpose, although its 11-man capacity is good. A rough sketch and description are included in ATIG Report #240, reference (i).

9. Apparatus for Training in Simple Navigation. A small, table size version of #8 above.

10. Ground Training Apparatus for Bombardiers. This device, considered by the Japanese as their "most successful device", consisted of a large moving cart, about 10 feet high, and a small moving target (ship model). The bombardier on the top platform viewed the moving target through the bombsight, and gave flight dirctions to the "pilot" inside the cart, who controlled its movements. Speeds were to scale, and auxiliary bombsight locations were provided for additional bombardier students. Sixty of these devices were built prior to the war, but were abandoned with the curtailment of training for horizontal bombing on moving targets in 1942. They are considered to be of value principally in promoting coordination between bombardier and pilot, since the Japanese had no automatic flight equipment for bombing runs. A sketch of this trainer is included in ATIG Report #240, reference (i).

11. Communications Training Devices. For communications training, the following equipment was used: Code sending machines with loudspeaker systems connected between classrooms, for voice and code intercommunications, and models of operational sets. These items are all simple and for elementary training.

12. Sleeve Targets. Towed sleeves used in air gunnery training. No automatic devices for recording hits were used.

13. Pilot Seat Operational Training Stands. These were wood mockups of various aircraft types for ground familiarization with the cockpits.

14. Astronomical Charts. For classroom use in celestial navigation training.

15. Target Sighting Range. A moving miniature aircraft target for live machine gun ground firing.

16. Sighting Trainer. Wooden guns with sights mounted, for elementary sighting and tracking training.

17. Sectioned Machine Guns. For demonstration of machine gun construction.

18. Devices for Elementary Technical Training. The following items were used for elementary technical training: Enlarged micrometer, "lock nut training stand," pipe and tubing assemblies, and sectioned electric motors.

19. Acrobatic Trainer. Two references were made to the existence or contemplation of such a trainer, but no additional information has been located.

20. Gun Cameras. Standard camera gunnery was used, but to a very limited extent because of the acute shortage of film.

21. Range Finder Trainer. A device for viewing a model aircraft through an optical sight. The model moved in range, and the student called out his estimated range, which was then compared with the scale range. It is similar in function to U.S. Navy range estimation trainers.

22. Training Films. Training films were used in many of the training programs, although the film shortage restricted their use. Samples were collected by ATIG and sent to Wright Field.

23. Model Aircraft and Ships. Model aircraft and ships were produced, and were the principal means of recognition training.

24. Slides, Diagrams, and Charts. These were used in a variety of applications for classroom aids, particularly in recognition training.

25. Aspect Angle Trainer. This device, for air gunnery training, was designed and constructed at the OI (Navy) Air Force and was still experimental at the end of the war. A model airplane is mounted in front of a cloth background and is controllable in altitude. Live firing is done with a machine gun, and the "hits," or holes in the cloth, are evaluated according to the deflection. No satisfactory means of quick assessment of hits had been worked out.

26. Ground Firing Device for 7.7 mm. Gun. This device was under development by the Army, and was to be similar to #25, above.

27. Gunnery Tracking Trainer. This device was under development at the end of the war, and was intended to provide turret gunners with automatically scored tracking training. A spotlight target and photocell recorder were planned. If completed, it would have closely resembled in function the U.S. Navy spotlight animator.

28. Mirror Trainer. A simple flat mirror (about 2 feet diameter) and post sight arrangement was used outdoors for ground observation of aircraft in bombing runs, to determine deviations from a straight run. No information could be obtained on exactly how it was used, and how the information was relayed to the pilot.

29. Shore Bombing Targets. Concrete targets 30 meters in diameter were generally used.

30. Sea Bombing Targets - Stationary. In shallow water, circular platforms of 10 meters were used as bombing targets. In deep water, it was found that visibility was greatly improved by the addition of a pyramid roof.

31. Sea Bombing Targets - Mobile. A few small ships were modified to serve as bombing targets, and were armored against light practice bombs. A small sled target was developed by the Navy which could be towed at 30 knots and was claimed to be visible from 13,000 feet altitude. However, these were not used after 1942, because the Japanese considered horizontal bombing of mobile targets so unsuccessful that all advaneed training was abandoned.

32. Practice Bombs. A wide variety of practice bombs was used.

33. Technical Training Devices. A variety of mocked up and sectioned components was used in instruction, particularly in aircraft maintenance training.

ENCLOSURE (B), continued

34. Electrical Models. A number of "wiring boards," demonstrating various electrical principles, were used in electronics training.

35. Electronics Training Devices. In the radio and radar courses, the operational sets were sometimes broken down into components and separately mounted, to illustrate construction of the sets.

36. Radar Panorama. The CHOGO Navy radar school used a crude panorama of model aircraft and model radar antennae to demonstrate air defense systems.

37. Radar Training Sets. Operational surface radar sets were arranged with the set in the classroom, and the antenna just outside and controlled mechanically from the class. In addition, some radars were connected to "information centers" for plotting and filtering practice. In one instance, a mockup ship's fire control room was connected to operational radar sets. No equipment for simulating radar targets was available.

38. Radar Target Balloons. When aircraft were not available as radar targets, free balloons carrying metal reflectors were used. The balloons were of 1 1/2 meters diameter and hydrogen filled, and were released at ranges up to 40 km. They were considered satisfactory for tracking training, but were subject to wind conditions. Fixed calibration targets were also used to a limited extent in training, but were not practical because they were fixed.