104

RESTRICTED

THE UNITED STATES

STRATEGIC BOMBING SURVEY

(Pacific)

Evaluation of Photographic Intelligence in the Japanese Homeland

PART SEVEN

ELECTRONICS

PHOTOGRAPHIC INTELLIGENCE SECTION

RESTRICTED

OPNAV P23-V2-120-(7)

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Dates of Survey:
7 October 1945 through 15 March 1946

JUNE 1946

FOREWORD

The United States Strategic Bombing Survey was established by the Secretary of War on 3 November 1944, pursuant to a Directive from the late President Roosevelt. Its mission was to conduct an impartial and expert study of the effects of our aerial attack on Germany, to be used in connection with air attacks on Japan and to establish a basis for evaluating the importance and potentialities of air power as an instrument of military strategy, for planning the future development of the United States armed forces, and for determing future economic policies with respect to the national defense. A summary report and some 200 supporting reports containing the findings of the Survey in Germany have been published.

On 15 August 1945, President Truman requested that the Survey conduct a similar study of the effects of all types of air attack in the war against Japan, submitting reports in duplicate to the Secretary of War and to the Secretary of the Navy. The officers of the Survey during its Japanese phase were.

Franklin D'Olier, Chairman.

Paul H. Nitze,

Henry C. Alexander, Vice-Chairmen.

Walter Wilds, Secretary.

Harry L. Bowman,

J. K. Galbraith,

Rensis Likert,

Frank A. McNamee,

Fred Searls, Jr.,

Monroe Spaght,

Dr. Louis R. Thompson,

Theodore P. Wright, Directors.

The Survey's complement provided for 300 civilians, 350 officers, and 500 enlisted men. The military segment of the organization was drawn from the Army to the extent of 60 per cent, and from the Navy to the extent of 40 per cent. Both the Army and the Navy gave the Survey all possible assistance in furnishing men, supplies, transport and information. The Survey operated from headquarters established in Tokyo early in September, 1945, with sub-headquarters in Nagoya, Osaka, Hiroshima and Nagasaki, and with mobile teams operating in other parts of Japan, the islands of the Pacific and the Asiatic mainland.

It was possible to reconstruct much of wartime Japanese military planning and execution, engagement by engagement and campaign by campaign, and to secure reasonably accurate statistics on Japan's economy and war-production, plant by plant and industry by industry. In addition, studies were conducted on Japan's overall strategic plans and the background of her entry into the war, the internal discussions and negotiations leading to her acceptance of unconditional surrender, the course of health and morale among the civilian population, the effectiveness of the Japanese civilian defense organization, and the effects of the atomic bombs. Separate reports will be issued covering each phase of the study.

The Survey interrogated more than 700 Japanese military, government and industrial officials. It also recovered and translated many documents which have not only been useful to the Survey, but will also furnish data valuable for other studies. Arrangements are being made to turn over the Survey's files to a permanent government agency where they will be available for further examination and distribution.

PERSONNEL

Comdr. Richard Reeve, USNR
Chief, G-2

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Lt. Comdr. R. De Lancie, USNR

Deputies

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Sqd. Ldr. Andrew Lyall, RAF

Lieut. W. T. Walsh, USNR

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1st Lieut. D. B. Wrisley, AUS
T/Sgt. J. R. Basso, AUS
T/Sgt. D. P. Rothrock, AUS

Major R. C. Bass, AUS
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1st Lieut. C. H. Schmid, AUS
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Lieut. (jg) R. C. Chaffee, USNR

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W. H. McGowen, Y1c, USN

* Personnel from the U. S. Naval Photographic Intelligence Center gave valuable assistance to USSBS personnel in the preparation and reproduction of Photographic Intelligence Section reports.

TABLE OF CONTENTS

1 INTRODUCTION

1. History

a. The RAF did the first Allied work in interpretation of electronics installations from aerial photographs. The wireless section at CIU Medmenham gathered and distributed electronics intelligence data for Allied use in Europe on location, operational use and characteristics of German electronics installations. The section developed photographic intelligence techniques and employed various methods of coordinating pertinent information from other sources. Intelligence gained by the efforts of the wireless section was used in connection with RCM activities and also for attacks against radar stations by fighters and fighter bombers. The latter were conducted on a large scale during the period immediately prior to the Normandy invasion. The element of surprise and confusion created by RCM activities and strikes against radar stations is considered to have contributed in a large measure to the tactical surprise of the landing operations.

b. The United States Navy was primarily responsible for the early phases of the development of photographic intelligence on Japanese electronics in the Pacific. Later, as Army Air Forces expanded their activity in this area, Army Photographic Interpreters became more active in this phase of the work. In some areas the AAF and Navy collaborated actively. Training material and electronics reports were distributed by both services.

c. During the course of the war against Japan, photographic intelligence in the electronics field was familiar to a considerable part of the armed forces. The following organizations, among others, collaborated with photographic interpretation in electronics work. Information from agencies of this nature was essential to accurate electronics interpretation.

CinCPac-CinCPOA RCM
Counter-Measures Air Analysis Center (Guam)
Director of Naval communications
Operations Section of RCM
Electonics Section
Director of Naval Intelligence
Flakintell
Technical Intelligence
Joint Communication Board (A&N)
RCM Working Committee
Naval Research Laboratory
Operations Analysis Section, FEAF
Section 22, GHQ SWPA
USASTAF Intelligence (Guam)

2. Japanese Electronics

a. The Japanese were firm believers in the military value of electronics. Their use and knowledge of equipment, however, varied considerably with the particular theater or command. Some creditable scientific work was accomplished, and a considerable amount of equipment was produced during the war; but disorganization and inefficiency on the part of the military in utilizing existing knowledge and resources resulted in lessened benefits from this equipment. The "state of war" existing between the Japanese Army and Navy was an important factor contributing to this confusion and lack of efficiency.

b. Most Japanese radar types were copies or adaptations of foreign models. Only one basic design, used in type 22 and type 32 sets which had electro-magnetic horn antennae, was completely original. In their final modifications these sets were fairly efficient.

c. Japanese radio communications had been well developed before the war, particularly in the medium and low frequency bands. Well-constructed permanent stations were numerous. In addition to these there were hundreds of small military stations.

d. The Japanese had great numbers of radio direction finding stations at airfields. These stations were used primarily as aids to navigation.

e. Many experimental types of electronics equipment utilizing higher frequencies were being developed toward the end of

INTRODUCTION

the war. Only a few of the more advanced models had been installed by VJ-Day.

3. Methods of Reporting

a. The following reports and procedures were developed by photographic intelligence to furnish electronics intelligence in a form ready for operational use.

(1) Electronics target photo - Target photos served a dual purpose, first, to provide a means of reporting and disseminating intelligence on installations, and secondly, to provide necessary information for air strikes against these installations. These photographs were made to fit the standard pilots chart board (8 x 8 inches) and marked with the target number, kind of installation (indicating use), type (if known), and elevation above sea level.

(2) Flak maps - All fire control radar, searchlight stations, and searchlight control radar found were plotted, together with AA, on flak maps.

(3) Joint operation with RCM units - Electronics sections worked closely with RCM units. An effort was made to confirm or disaffirm all RCM intercepts on photographs. When identification of a critical installation was doubtful, special RCM intercept planes were dispatched to obtain additional information on the suspected installation. Occasionally low altitude photographic reconnaissance planes were sent to take special photographs of the suspected radar.

(4) Situation maps for landing operations - In areas proposed for amphibious operations, intensive search for electronics installations was facilitated by concentrated photographic coverage. Findings were shown on "situation maps" (1:50,000) of these areas which also showed defenses, airfields, beach information and other related data for use during the operation.

(5) Electronics reports - Electronics reports were usually prepared upon discovery of a new type of electronics installation. Reports included an interpretive drawing, sketched from aerial photographs and existing supplementary intelligence, as well as certain data of a technical nature.

(6) General photographic intelligence reports - Electronics specialists in a PI organization were responsible for the electronics section of routine photographic intelligence reports. Interpreters responsible for routine reports on a given area screened photographs of that area and routed those which were suspected of containing electronics installations to the specialists. The specialists made a careful search and reported back to the area interpreter who incorporated the electronics report in the body of the routine report.

(7) Radar evasion studies - Radar locations and other technical information were made available to RPD teams, and other units making radar evasion maps, for use in air and surface strikes against the Japanese.

4. General Notes on Japanese Radar

a. The importance of radar, the great number of sets, and the difficulty of interpreting small objects made radar interpretation the largest job of the electronics sections. Since land-based equipment was of the greatest interest, other types are but briefly treated here. Only those sets which were in general use during the war are taken into account in the evaluation study. Photographs of a few experimental sets are shown. Table I lists important Japanese Radar types.

b. Japanese radar designations were a difficult problem during the war. US Forces were faced with the problem of deciding which designations to use and which sets they represented. At no time was there general agreement on designations to be used for the known types of Japanese radar.

(1) It is now known that the Japanese themselves had no general agreement on designations. Some sets were known to the Japanese by a variety of names, variations often depending on the location of the theater command. Confusion in designations was greater with Army sets than with Navy.

TABLE I

IMPORTANT JAPANESE RADAR TYPES	
NAVY	
Air Search	Fire Control
Mk 11 and modifications Mk 11k Mk 12 Mk 13 Mk 14	S-3 S-23 S-24 L-1 L-2
ARMY	
Tachi 6 Tachi 7 Tachi 13	Tachi 1 Tachi 2 Tachi 3 Tachi 4

(2) In this report the official naming method set down by the Imperial General Staff will be used.

"TA", derived from "Tamaken", means "experimental phase"

Suffix "CHI" means ground use

Suffix "SE" means shipboard use (not treated here)

Suffix "KI" means airborne use (not treated here)

"TACHI" means radar that has been through the experimental phase and is land-based. The sequence of the number following "TACHI" indicates the relative sequence of the development of the model. Thus, TACHI 1 would be the first Army fire control radar in use.

c. Japanese army and navy officers in Tokyo, Sasebo, Fukuoka and Kure were interrogated and were responsible for the preparation of the maps showing radar locations (Figs 9-11).

d. It is estimated that one-sixth of all Japanese search radar installations in all areas were pin-pointed on aerial photographs during the war. The Japanese are believed to have had over 1000 search radar stations in operation.

II TECHNICAL AND STATISTICAL EVALUATION

1. Introduction

a. This section presents the accuracy of photographic intelligence on Japanese electronics by comparing reports with information gathered by field teams of the USSBS. Since most of the photographic intelligence produced in the latter stages of the war emanated from Interpron Two, most of the material selected for checking, particularly concerning search radar, was from that organization. The combined work of CIC, Interpron Two, JICPOA, and others is checked in the case of fire control radar, searchlights, and sound locators.

b. The evaluation is in two sections. In the first, or Technical Section, each of the major items of electronics equipment is discussed, and selected published technical material is compared with ground data gathered in Japan. The second, or Statistical Evaluation Section, shows the accuracy of interpretation with respect to types of equipment and areas of installation.

2. Technical Evaluation

a. On pages following are descriptions and photographic illustrations of each important type of Japanese equipment, together with discussions of the degree of success achieved in the interpretation of each. In addition, published technical material on several types of equipment is compared with ground data to illustrate the detailed nature and accuracy of technical reports.

b. Most technical electronics interpretation was presented through two media, (1) electronics reports, and (2) a handbook prepared by the Photographic Intelligence Center.

(1) Electronics reports were written in the field when new or unusual types of radar were discovered on aerial photographs. These reports were found to be essentially correct except in one case where evidence is conflicting and no conclusion can be drawn.

(2) "Japanese Electronics" - Photographic Intelligence Center Report #1, published in January 1945, contained train-

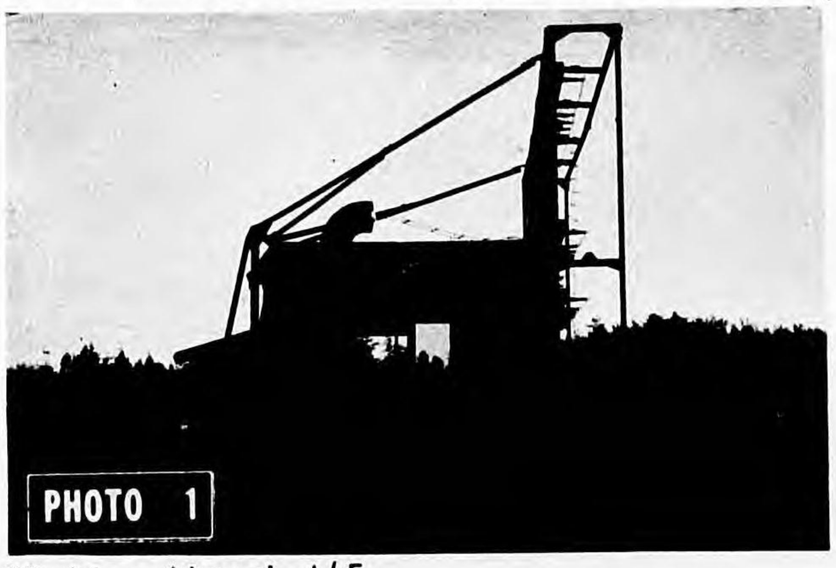
TECHNICAL

ing and reference material on electronics interpretation. To date only one serious error of interpretation has been detected in this report: the configuration of the Tachi 3 Army fire control radar was found to be considerably different from the illustrations in "Japanese Electronics." Inclusion of the section on German Radar correctly anticipated Japanese use of German electronics equipment. At the end of the war, the Japanese Army Tachi 24, which was a copy of the German Giant Wurzburg, had just reached the production stage.

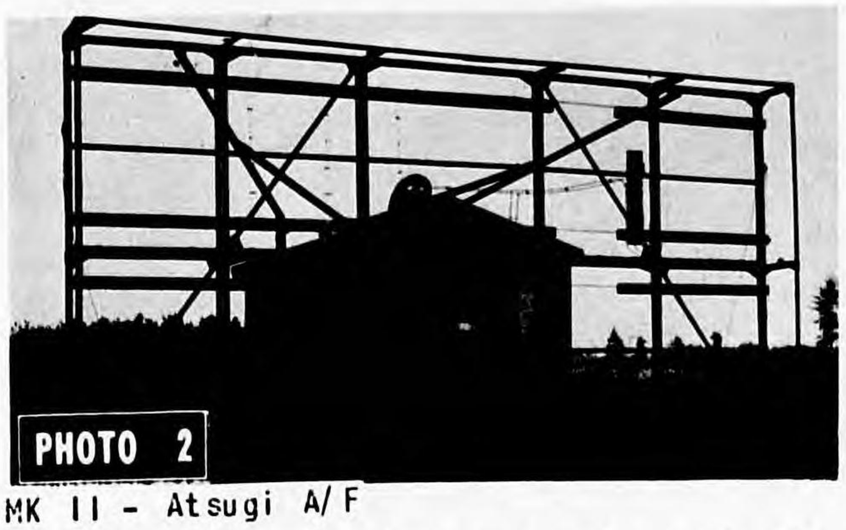
c. Although this report is not a complete treatise on all types of electronics, the radar types shown represent over 95 per cent of all Japanese radar sited during the war. Sections on individual sets follow.

(1) Mark II Navy search radar.

(a) This radar (Photos 1, 2) and modifications thereof, is the best known of all to the US Forces. First found on Guadalcanal, it had undergone three modifications by the end of the war and was still used extensively. The equipment was relatively easy to identify on aerial photographs, due to the standardized construction of its central shack and 28 foot mattress antenna which were joined and rotated together. The set presented a fairly massive appearance on aerial photographs, as compared to other radar types. Hill sitings, ground scars, paths and roads were all helpful clues in recognizing Mark II. Net and natural camouflage were sometimes adopted but seldom prevented recognition. Other designations used by US Forces were Mark I, Model I, "Guadalcanal" type and "Attu" type.



MK II - Atsugi A/F



MK II - Atsugi A/F

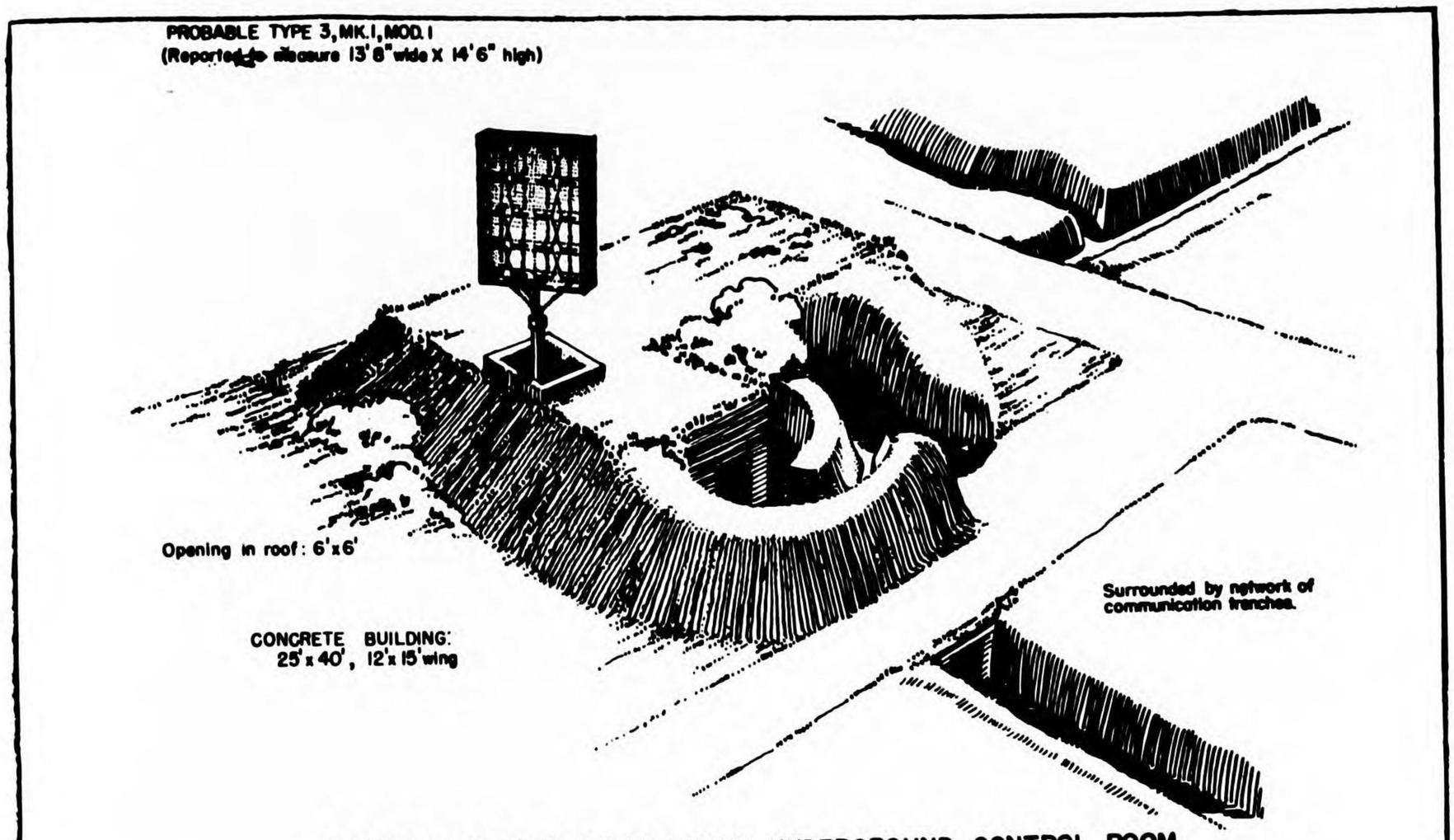
(b) Classification of set: Land-based, fixed, early warning, frequency-100mcs.

(2) Mark IIK Navy search radar.

(a) Used to a very limited extent by the close of the war, this radar was so completely different from the other modifications of Mark II that it is here treated as a separate type. The Mark IIK was first identified on excellent, large scale photographs of Minami Daito Jima. The location and identification was largely fortuitous since only 8 were installed throughout the Japanese Empire and most, perhaps all, of these were sited with underground control rooms (Photo 3, Fig. 1), the small rotating antenna being the only part above ground. This radar was most difficult to interpret on aerial photographs of usual scales. Arrangement of communication trenches were leading clues to final identification. Another designation in use by the US Forces was Type 3, Mark 1, Model 1.

(b) Classification of set: Land-based, fixed, early warning, frequency-150mcs.

Enlarged section of aerial photograph showing MK IIK sited in characteristic manner. Minami Daito Shima. (Photographic Interpretation report #737)



JAPANESE SEARCH RADAR WITH UNDERGROUND CONTROL ROOM
TARGET NO. E-26
SOUTHEAST SHORE, MINAMI DAITO JIMA

FIGURE 1

CV14-C-AB of 9 JUNE 1945

INTERPRON TWO-421.3

Sketch of MK IIK (PI report #737)

(3) Mark 12 Navy Mobile search radar.

(a) This is a land-based adaptation of the Mark 21 ship-borne set. Although the Mark 12 was used much less frequently than the Mark 11 or Mark 13, it has been encountered a number of times since it was first captured on Kwajalein, principally in the islands of the Central Pacific. The set was usually sited in an earthern revetment on a high point of land or on the roof of a concrete building. Despite the fact that it was mobile, it was often used on the same site for long periods. The original Mark 12 (Photo 4) consisted of a small mattress antenna mounted on the side of a trailer. The cabin rotated with the antenna. This model was used throughout the greater part of the war.

(b) Classification of set: Land-based, mobile, early warning, frequency-200mcs.

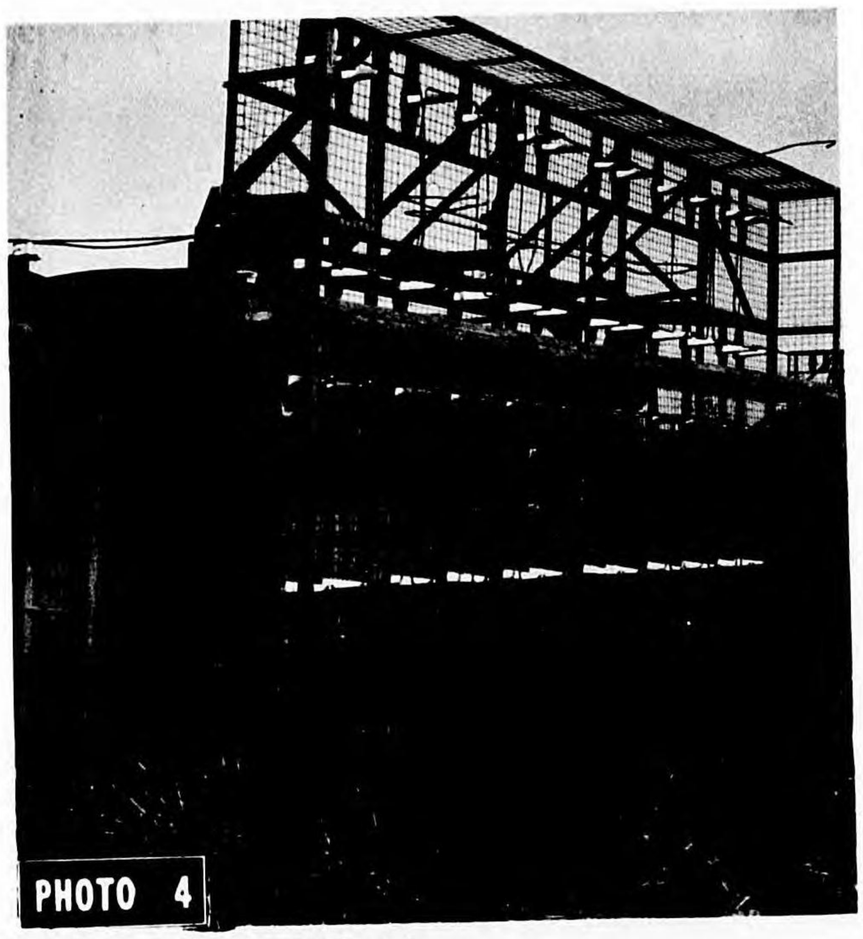


PHOTO 4

MK 12 - Chogo School

TECHNICAL

(4) Mark 21 Navy Ship-borne search radar.

(a) This was the ship-borne prototype of the land-based Mark 12. It was the best equipment in general use by the Japanese Navy afloat until 1944. The Mark 21 (Photo 5) is very similar to the Mark 12. The main difference between the two is in the position of the antenna. In the Mark 21 it is separate from the radar equipment and usually fixed to the top of a mast. Photographic interpreters have frequently identified this set on aerial photographs of naval and, occasionally, merchant vessels. This radar was photographed at the Navy Radar Training School where it was used for training purposes only. Note that the antenna is almost identical to the Mark 12 on page 7.06.

(b) Classification of set: Ship-borne, early warning, frequency-200mcs.

(5) Mark 12 Navy search radar - new type.

(a) A recent modification of the Mark 12 (Photo 6) utilized 2 stacks of dipoles on top of the trailer (similar to the construction of Mark 13) instead of the mattress antenna. The trailer was the same as that used with the original model. The frequency, however, as in the case of the Mark 11K, was changed without a change of the mark number. Such changes created much confusion where RCM intercepts were being used as evidence. The equipment shown below utilizes an antenna design which resembles the Mark 13 Navy radar (page 7.07) more than it does the original Mark 12. The control shack and trailer are the same, however.

(b) Classification of set: Land-based, mobile, early warning, frequency-150mcs.

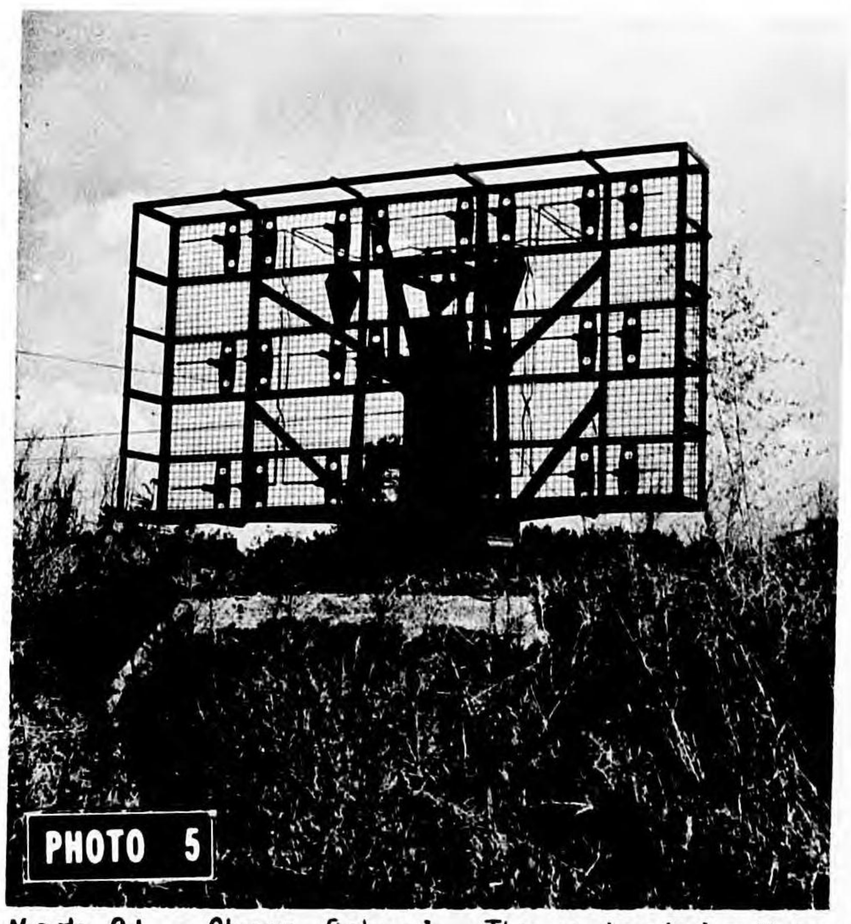


PHOTO 5

Mark 21 - Chogo School. The principle Navy Radar Training School was at Chogo, near Atsugi Airfield. This school was correctly interpreted on aerial photographs in April 1945. In this report the equipment sited at the Chogo School for training purposes is used to illustrate certain types of Navy radar.

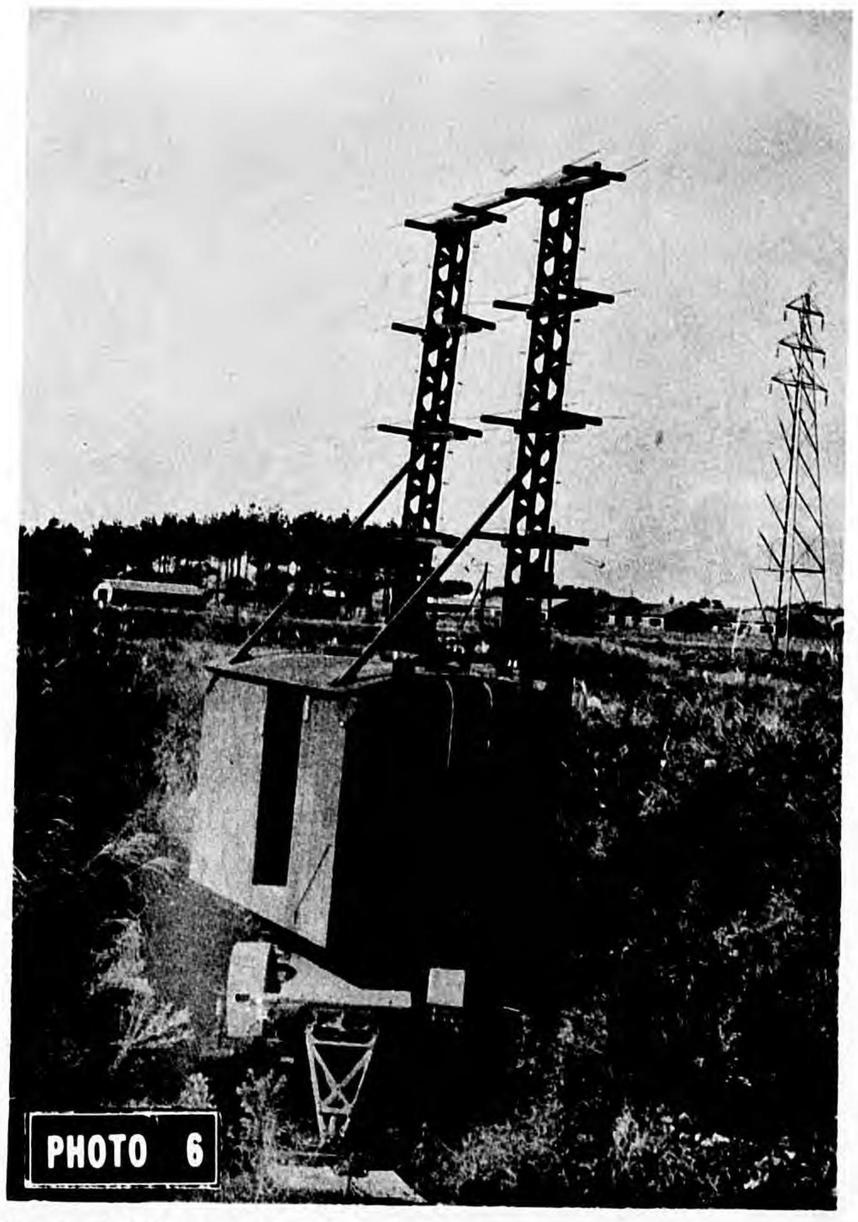


PHOTO 6

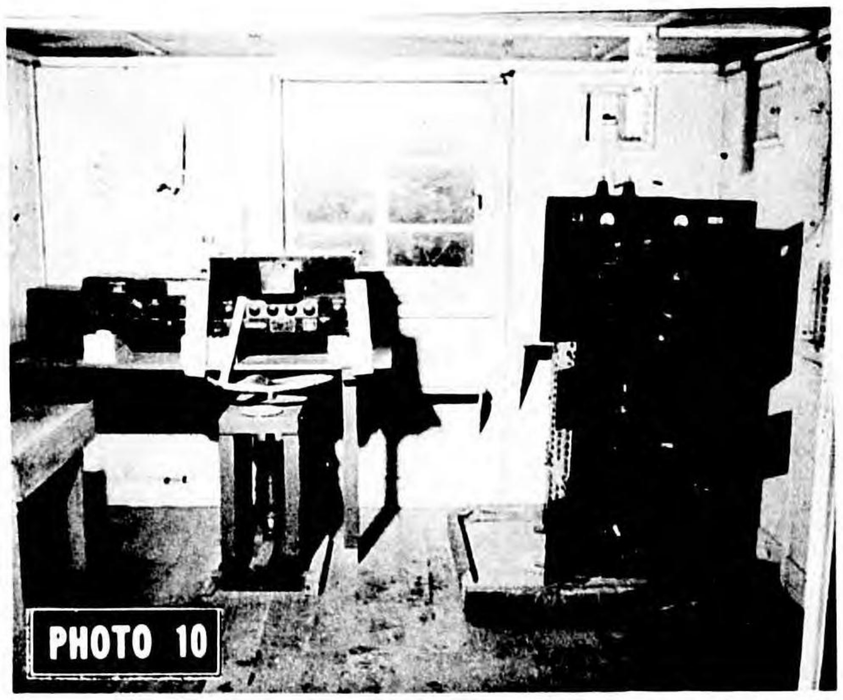
Mark 12 Navy Search Radar - New Type.

(6) Mark 13 Navy search radar.

(a) This was used in greater numbers toward the end of the war than any other type. Like the Mark 12, it was used on ships as well as on land. The antenna (Photos 7, 8) consisted of a stack of dipoles mounted on a rotating vertical mast which, when land-based, was installed on the roof of the control shack (Photos 9, 10) or next to it and supported by guy wires. The mast was usually manufactured in prefabricated sections which were assembled on the site. In some areas, however, jerry-built masts were used to support the antenna.

MK 13 Control shack, Hakodate

MK 13 Antenna - Damaged by Japs



MK 13 Interior-control shack, Hakodate

MK 13 Sections of antenna mounting

(b) The Mark 13 proved to be the most difficult of the well-known types to identify on aerial photographs. At the usual scales of 1:7500 to 1:10,000 the shadow thrown by the mast was usually indistinct and, therefore, often not observed. In clear pictures, however, the "ragged" nature of the shadow was helpful in identification. Leading clues were the type of building construction and general arrangement on the site. Photo 11 shows an example of a camouflaged generator shack used with Mark 13 radar. When so camouflaged the generator shack was difficult to identify.

(c) Classification of set: Land-based, fixed, early warning, frequency-150mcs.

TECHNICAL

MK 13 Generator shack, Hakodate

(7) Mark 13 Navy Ship-borne search radar.

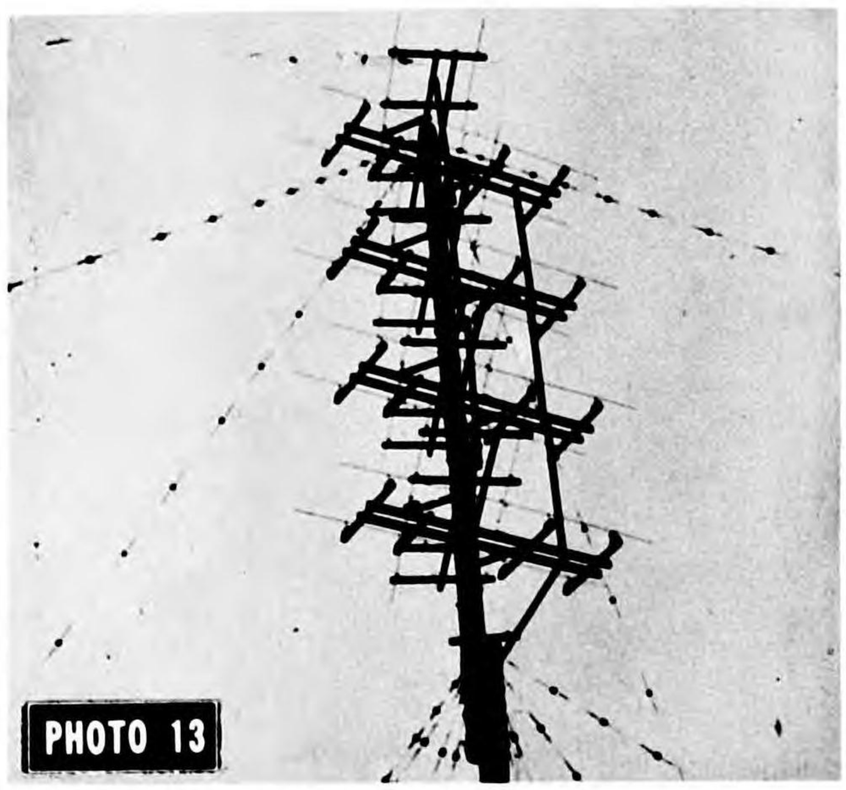
(a) Also called Mark 24, this had the same frequency and characteristics as the land-based model but utilized a lighter antenna. This type of radar was occasionally identified on shipping photographs but only with the aid of low-level obliques. In Photo 12 it is shown emplaced on land for training purposes.

(b) Classification of set: Ship-borne, early warning, frequency-150mcs.

MK 13 Ship-borne antenna, Chogo School, also called MK 24

(8) Tachi 6 Army search radar.

(a) The Tachi 6 was the only fixed Army early warning radar and constituted the most important part of the Army early warning system at the close of the war. It was generally used in multiple receiver form, i.e., one transmitter (Photo 13) operated with 2 or more receivers which were located near the transmitter. Each receiver crew was responsible for one sector of search. A standardized type of building was used with the antenna mounted on a vertical shaft projecting from the roof at the ridge line (Photo 14). Large numbers of the Tachi 6 were constructed during 1945.



TACHI 6 Transmitting antenna

(b) The Tachi 6 was the final multiple receiver version derived from a basic Army set which had existed since 1943 in a more or less portable form, utilizing tents and temporary structures for housing the equipment. The standard type of building with the antenna on the roof did not come into general use until 1945. Interpretation of the new form of the set was not difficult after it was first recognized on aerial photographs. Standard buildings, usually revetted, distribution of buildings, typical sites (usually high places near water and on bare land) and paths and roads were leading clues.

(c) Use of natural camouflage (Photos 14, 15) was standard practice but seldom prevented recognition. Identification of the camouflaged antenna, although not easy, was never as difficult as the identification of well camouflaged buildings. When such buildings were placed in a heavily wooded area, as they often were, the station was extremely difficult to find. Other common designations used by the US Forces for this radar were: Mark 154, Multiple Receiver Radar Station, Mark 231.

TACHI 6 Receiving antenna - Fukuoka region

(d) Classification of set: Land-based, fixed, early warning, frequency-60-80mcs.

(e) Excerpts from an Interpron Two Report (Figs 2,3, Sample Report, and Photo 16) are presented to show the detailed analysis possible when adequate photography is interpreted by competent personnel. The report was prepared at the time the Tachi 6 (Mk154) multiple receiver stations were first discovered on photographs taken at 20,000 foot altitudes. A captured document showing a Japanese diagram of a proposed system for using more than one receiver with each transmitter, but showing no details of the method of siting or appearance of the set, was the only ground intelligence available on this set at the time. Post-war check shows that the report was essentially correct in all details. The large building (23x30 feet) shown in some of the ground photos is used for training purposes and was not typical. The standard building for operational use was 23 x 30 feet, as indicated in the report.

SAMPLE REPORT

EXCERPTS FROM AN INTERPRON TWO REPORT

ELECTRONICS REPORT: PERMANENT "CHI" MULTIPLE-RECEIVER RADAR STATIONS, SHIMO KOSHIKI SHIMA, KOSHIKI RETTO, 31°38' N., 129°41' E. TSUTSU, TSUSHIMA, 34°07' N., 129°10'E

Based on: VD5 149B, 13 May 1945, Koshiki Retto and 3PR5M147-3L, 16 April 1945, Tsushima.

Supplements: Interpron Two Special P.I. Report No. 32 (Electronics) of 14 May 1945.

Map References:
(a) H.O. Chart 5677 (Koshiki).
(b) H.O. Chart 2574 (Tsushima).

Reference:
(a) Captured radar document issued March 1944 by Hamamatsu Army Flying School.

Enclosures:
(A) Stereogram of Koshiki multiple-receiver radar station, (Photo 16).
(B) Overlay of Koshiki multiple-receiver radar station, (Fig 3).
(C) Drawing of typical radar receiver building (Fig 2).

TECHNICAL

SUMMARY

NEWLY ERECTED MULTIPLE-RECEIVER RADAR STATIONS AT SHIMO KOSHIKI SHIMA, KOSHIKI RETTO, AND AT TSUTSU, TSUSHIMA, CONSTITUTE PART OF PRIMARY EARLY WARNING NET. STATIONS USE ARMY "CHI" EQUIPMENT, PROBABLY MODIFICATION OF MARK 154, OPERATING FREQUENCY 60-80 MCS.

STANDARDIZED CONSTRUCTION NOTED AT THESE TWO STATIONS MAY ASSIST RECOGNITION AND DEVELOPMENT OF FURTHER INTELLIGENCE ON THIS EARLY WARNING SYSTEM.

DESCRIPTION

Both Koshiki and Tsushima installations believed to operate on principle requiring one transmitting set with several dispersed receiving sets. Receiver usually installed in standard type wood building - 23' x 30', one story, pitched roof, often revetted. 28' rotating antenna mounted directly on roof probably similar to "Wewak" type. Transmitter probably contained in 23' x 30' building, transmitting antenna being mounted on 60-75' free-standing mast located within 50' of transmitter building.

SITING

Koshiki:

Installations stretched out 4/5 mile along high ridge (1,000' ± above sea level) at south tip of Shimo Koshiki Shima. Transmitter in center of group. Six receiver buildings sited so that entire group may be used to search required coverage with overlaps of search sectors. Station under construction. Two receiver buildings not yet equipped with antennae at time of photography (scaffolding on roofs indicates construction activity). All receivers within 1,000 yards of transmitting mast.

Tsushima:

Installations arranged near southwest tip of island west of Tsutsu. Transmitting mast (60' ± high) and transmitter building in center of group on high point. Base of mast 580' ± above sea level. Three definite and two probable receiver buildings observed, dispersed at selected positions of varying elevations advantageous for accomplishing required group coverage. Station probably under construction at time of photography. All receivers within 1,000 yards of transmitting mast.

ANALYSIS

It is believed, from a study of these photos, and from analysis of existing intelligence on Japanese radar, that the following conclusions may be drawn:

1. That these installations represent the primary phase of the Japanese Army early warning system.
2. That the building types and general arrangement of other stations of the army early warning system are likely to conform to general standards as outlined in this report.
3. That the radar equipment, army search gear or "CHI", is probably a modification or variation of Mark 154, for permanent siting, and operates at frequencies between 60 and 80 mcs.

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Encl. (C)

INTERPRON TWO 402.5

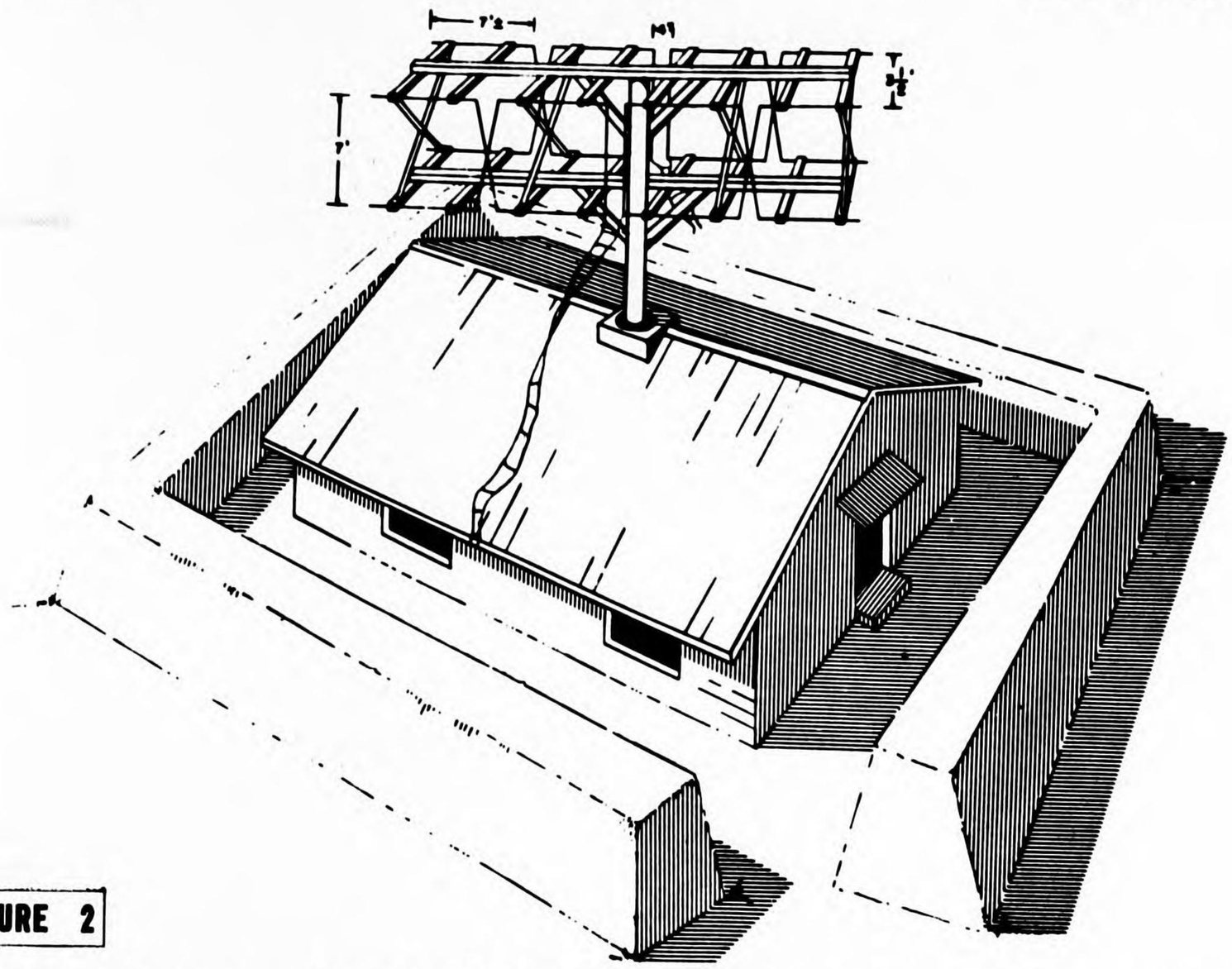


FIGURE 2

Probable appearance of revetted standard 23 x 30 feet building with 28 foot antenna.
Antenna appearance partly conjecture
Interpretive perspective sketch from aerial photograph (Photo 15).

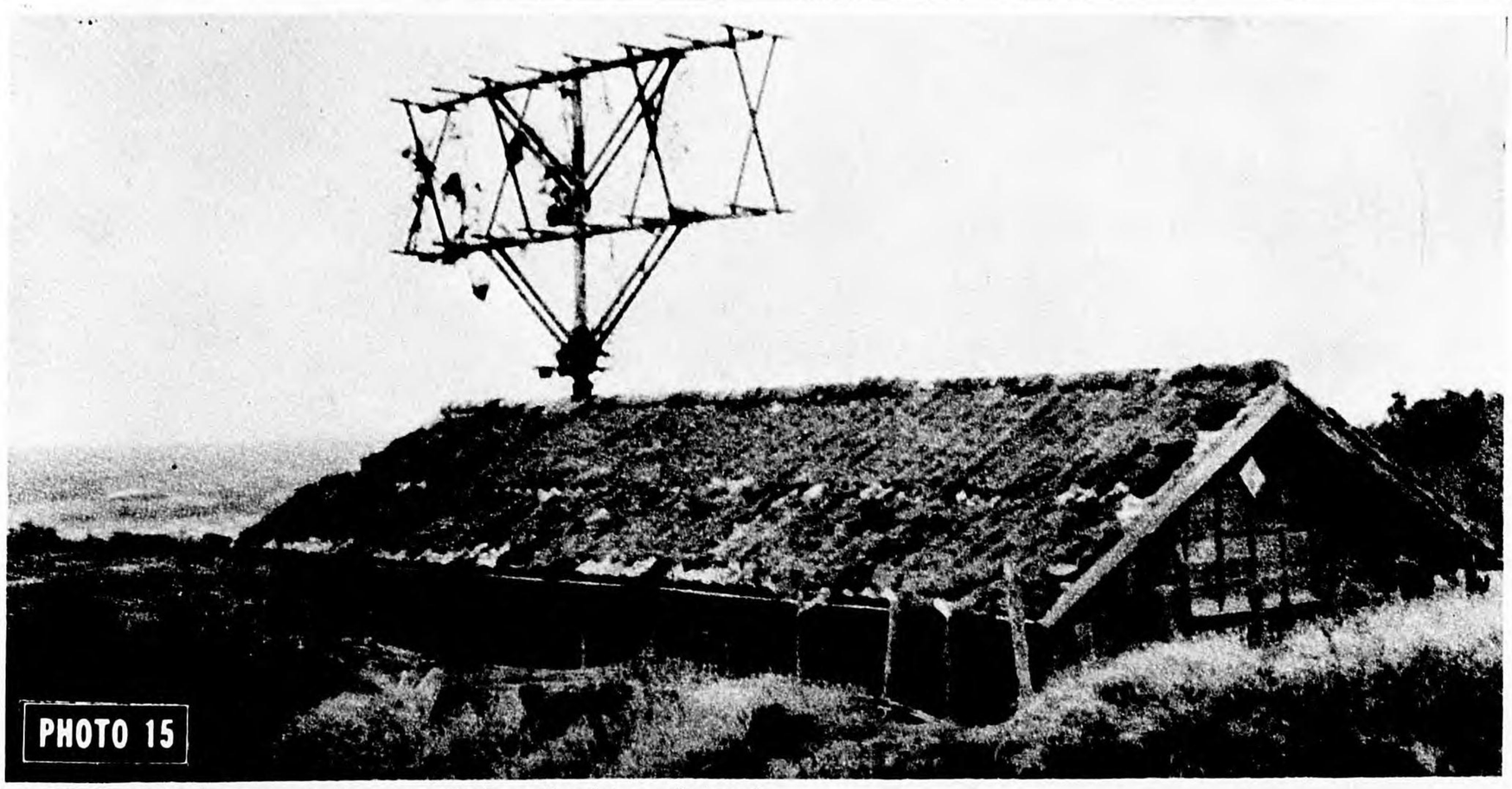


PHOTO 15

TACHI 3 Receiving antenna, Omika Eushiyo School

TECHNICAL

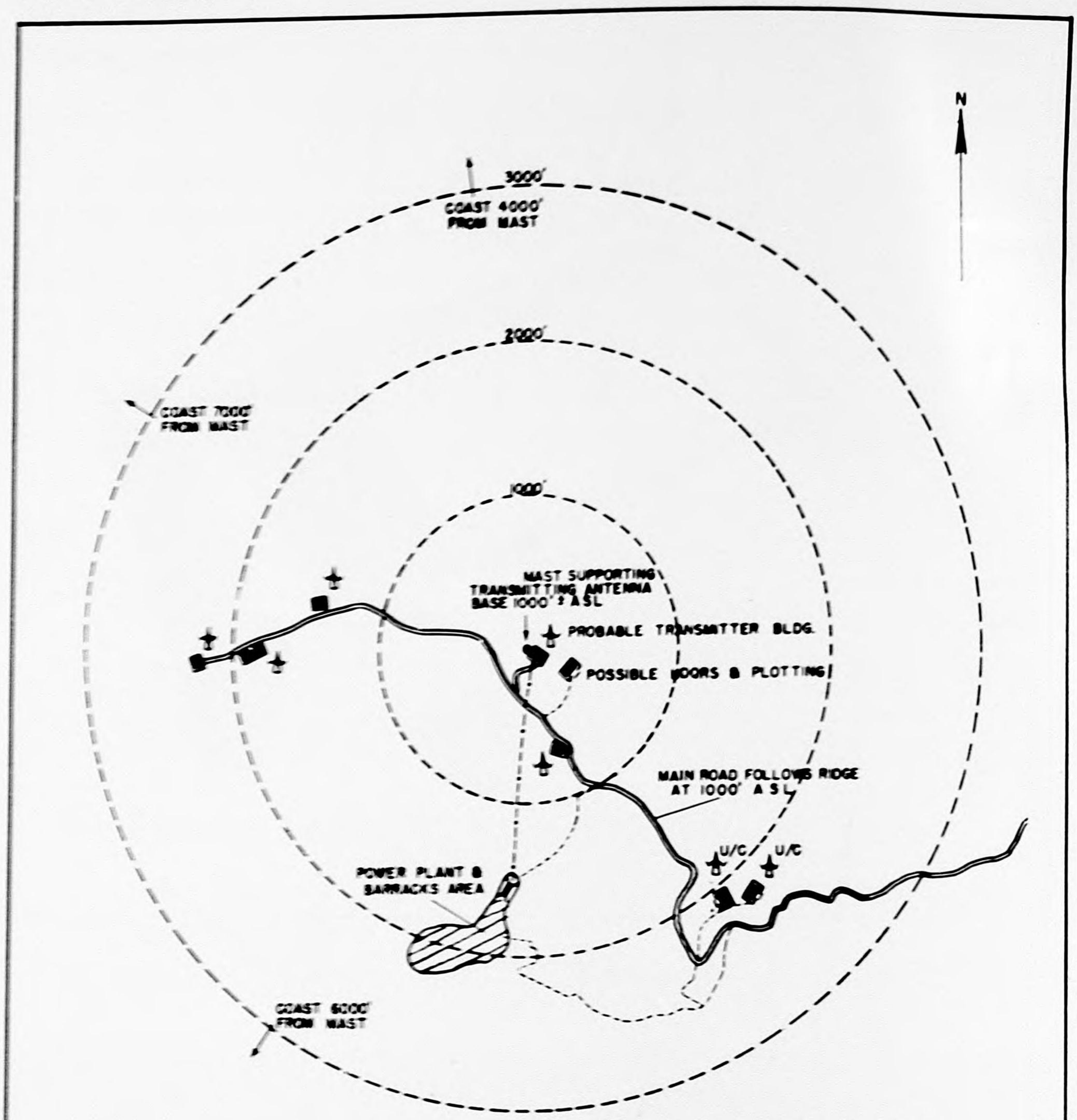


FIGURE 3

Disposition of radar sets at typical TACHI-6 radar station.

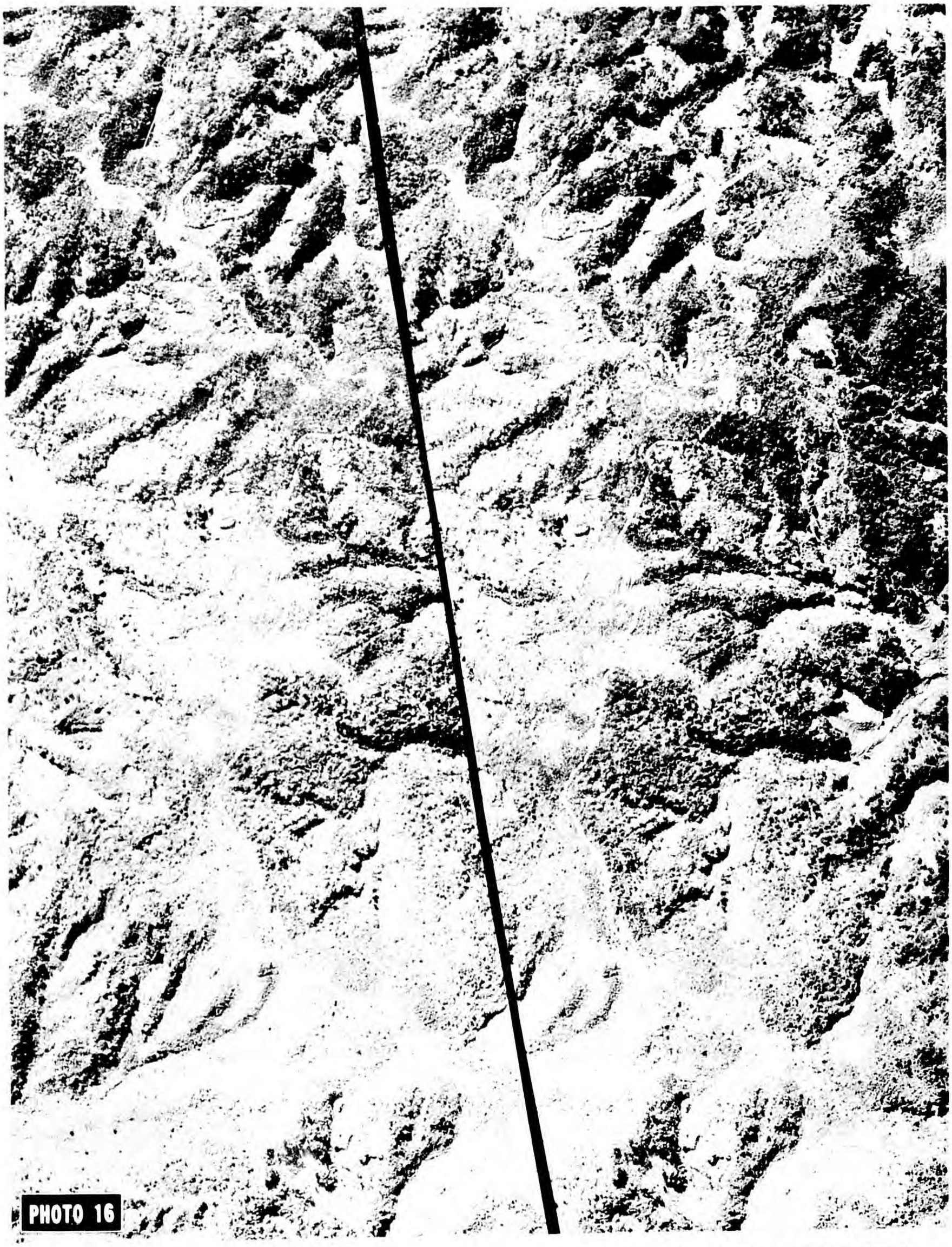


PHOTO 16

TACHI 6 Receiving antenna - Fukuoka region from aerial photograph on which TACHI 6 multiple receiver was first discovered.

TECHNICAL

(9) Tachi 7 and Tachi 18 Army search radars.

(a) These are treated together because the Japanese Army made no distinction between them on its radar location maps, listing both as mobile early warning stations. Both sets were designed to be transported on trucks which carried all equipment including power generators (Photo 17). They operated at the same frequency. Except for size of antenna the sets are very similar. Tachi 18 antenna resembles Tachi 7 in form but has six horizontal elements as compared with the latter's three (Photo 19). Tachi 7 has been identified on aerial photographs in the Nanpo and Nansei Shotos. Some difficulties were encountered due to the lack of familiarity with the set and extensive use of natural camouflage. The equipment was sometimes placed in covered revetments (Photo 18). As far as is known, the Tachi 18 has not been seen in aerial photographs. It is known, however, that very few were installed.

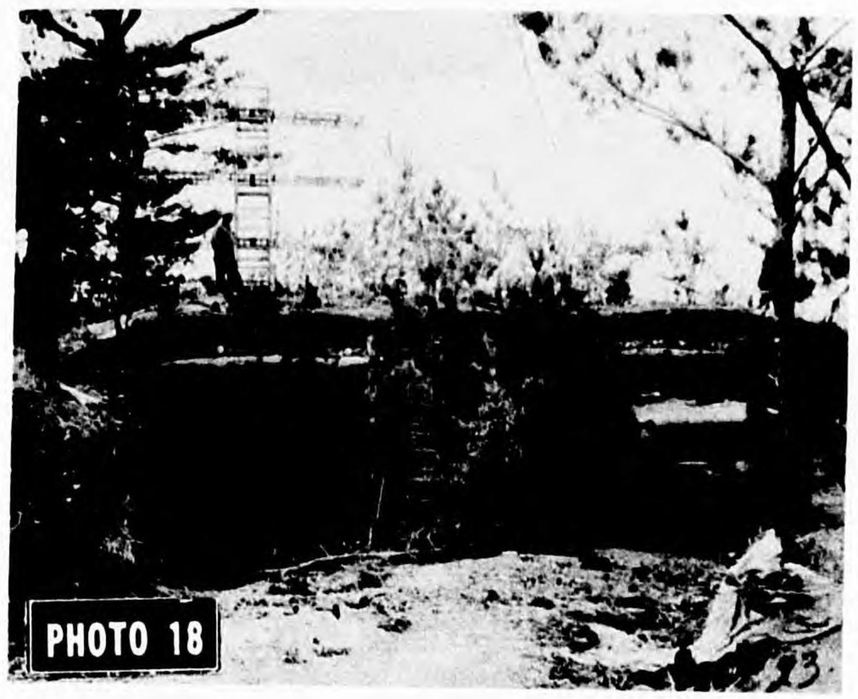


PHOTO 18

TACHI 7 Emplaced

(b) Classification of sets: Land-based, mobile, early warning, frequency-100mcs.

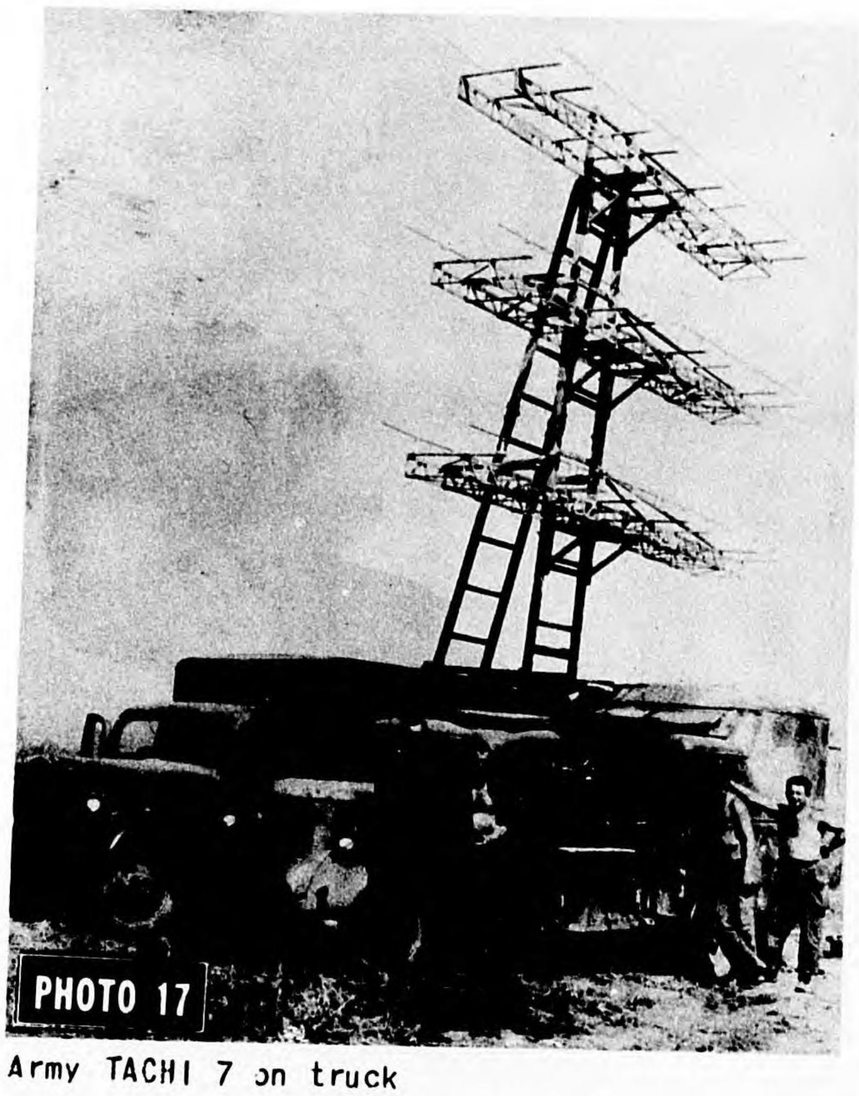


PHOTO 17

Army TACHI 7 on truck

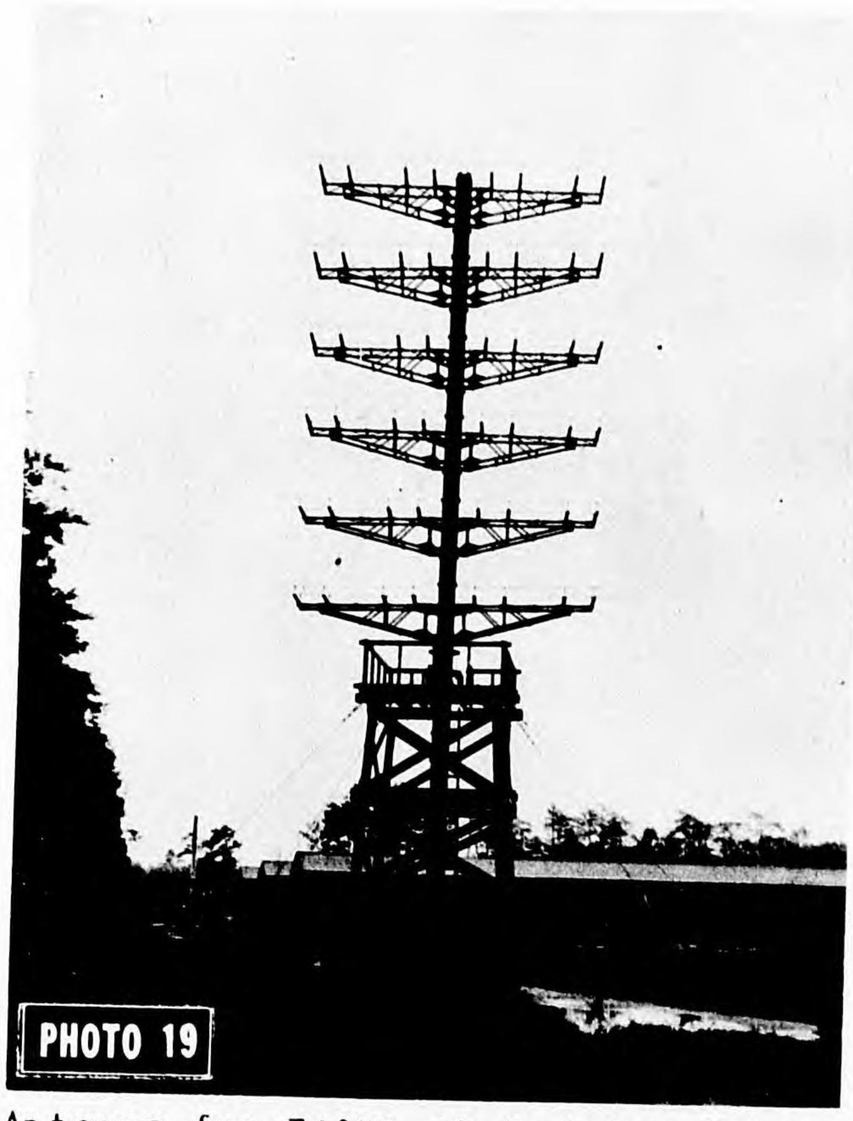
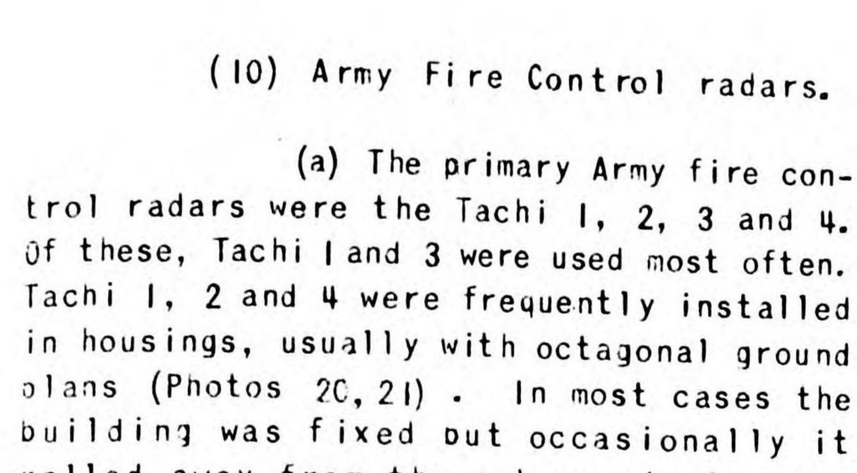


PHOTO 19

Antenna for TACHI 18, Kodaira School

(10) Army Fire Control radars.

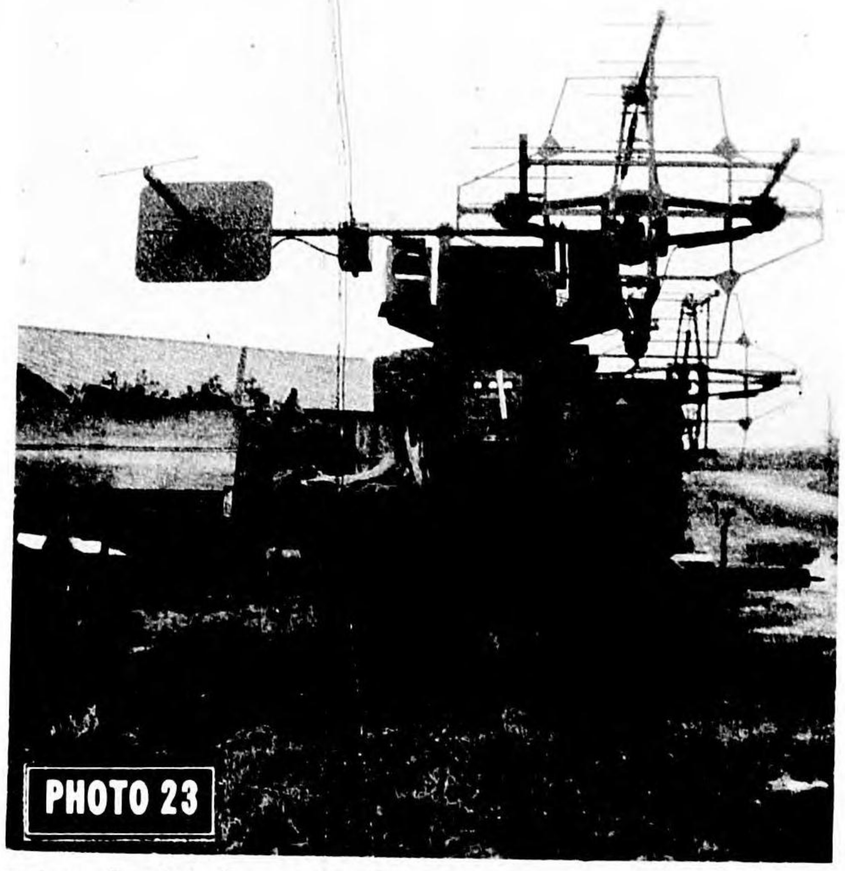
(a) The primary Army fire control radars were the Tachi 1, 2, 3 and 4. Of these, Tachi 1 and 3 were used most often. Tachi 1, 2 and 4 were frequently installed in housings, usually with octagonal ground plans (Photos 20, 21) . In most cases the building was fixed but occasionally it rolled away from the set on steel rails (Photos 22, 24) This standardized building design was correctly interpreted as containing fire control radar. Tachi 1, 2 and 4 are all 200mcs. and capable of being used as mobile sets when placed on trailers (Photos 23, 25) .



Army TACHI housing. Muroran

Housing for army TACHI 2, Kawasaki

Army TACHI housing. Muroran



Army TACHI 1, Muroran

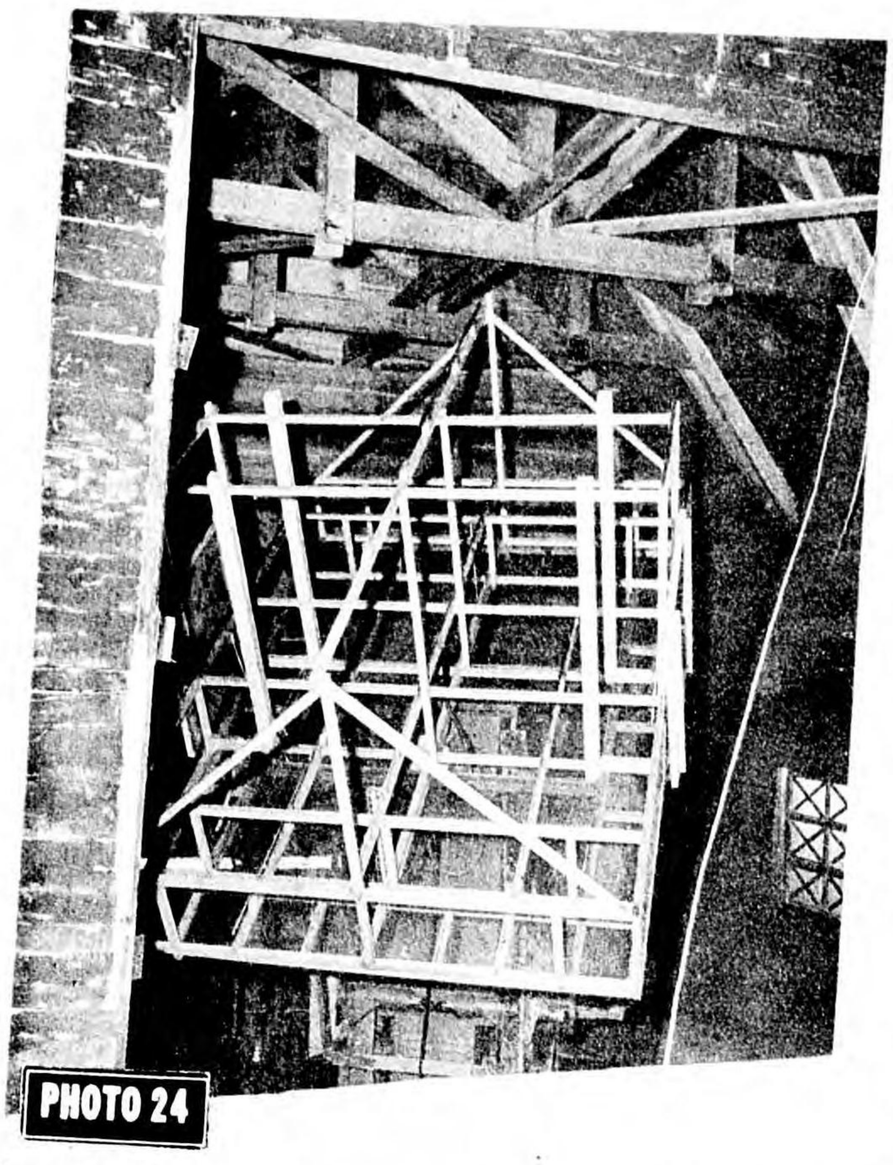


PHOTO 24

Army TACHI 2 with modified antenna , Kawasaki

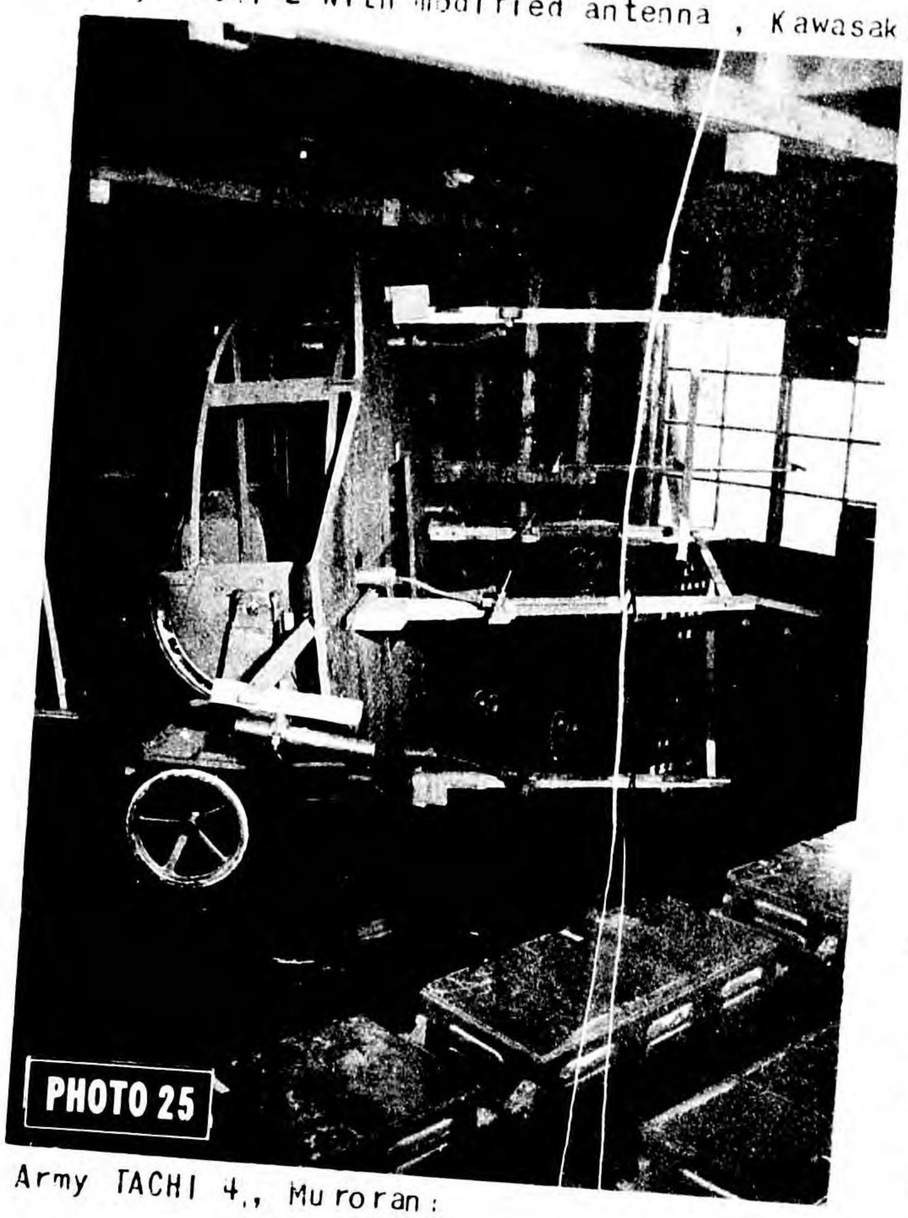


PHOTO 25

Army TACHI 4,, Muroran:

(b) Tachi 3 was probably the most commonly used Army fire control radar at the end of the war. It utilized a separate transmitter (Photo 26) and receiver (Photo 27) and was based on an English design used early in the war. Field check in Japan revealed that the physical appearance of the antenna was quite different from its prototype, a British set. The Tachi 3 was usually characterized by a circular flat clearing surrounding the receiver. The transmitter was always placed outside the circle about 150 feet away when this method of installation was used. No difficulties were encountered in recognizing this set on aerial photographs when a circular clearing was made. Occasionally, when the site was not cleared, the set was not identified. Other designations used by US Forces for Tachi 3 were Mark TA, Model 3 and TA-3.

(c) Classification of sets: Tachi 1, 2 and 4 land-based, fixed or mobile, for fire control, frequency-200mcs. Tachi 3 land-based, fixed, for fire control, frequency-75mcs.

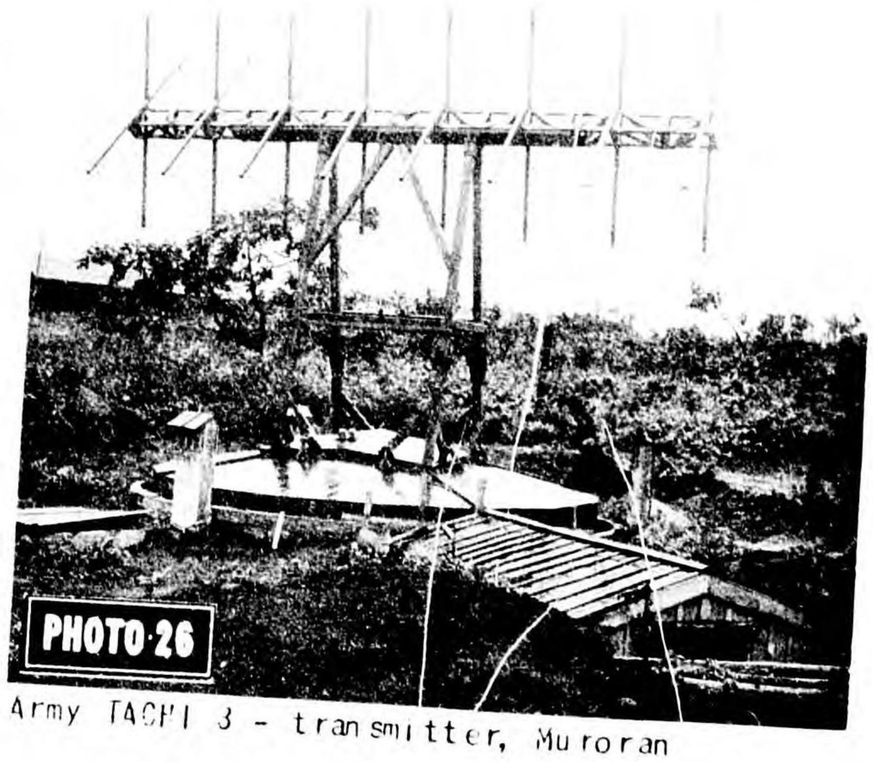


PHOTO 26

Army TACHI 3 - transmitter, Muroran

PHOTO 27

Army TACHI 3 - receiver, Kawasaki

(d) An excernt from "Japanese Electronics" (PIC Report I, January 1945) on Tachi 3 is included here for comparison with post-war information. A significant error was made in interpreting its physical appearance particularly with respect to the antenna. This was due in large part to an assumption that the Japanese adaptation of the British original would have a similar appearance. All photographic coverage which contained Tachi 3 was flown at 30,000 feet which, although providing adequate quality of photography for identification (circular clearing, siting methods, general form indicating presence of antenna), was not sufficiently clear for a reliable detailed analysis such as was attempted. (Fig. 4, 5, 6)

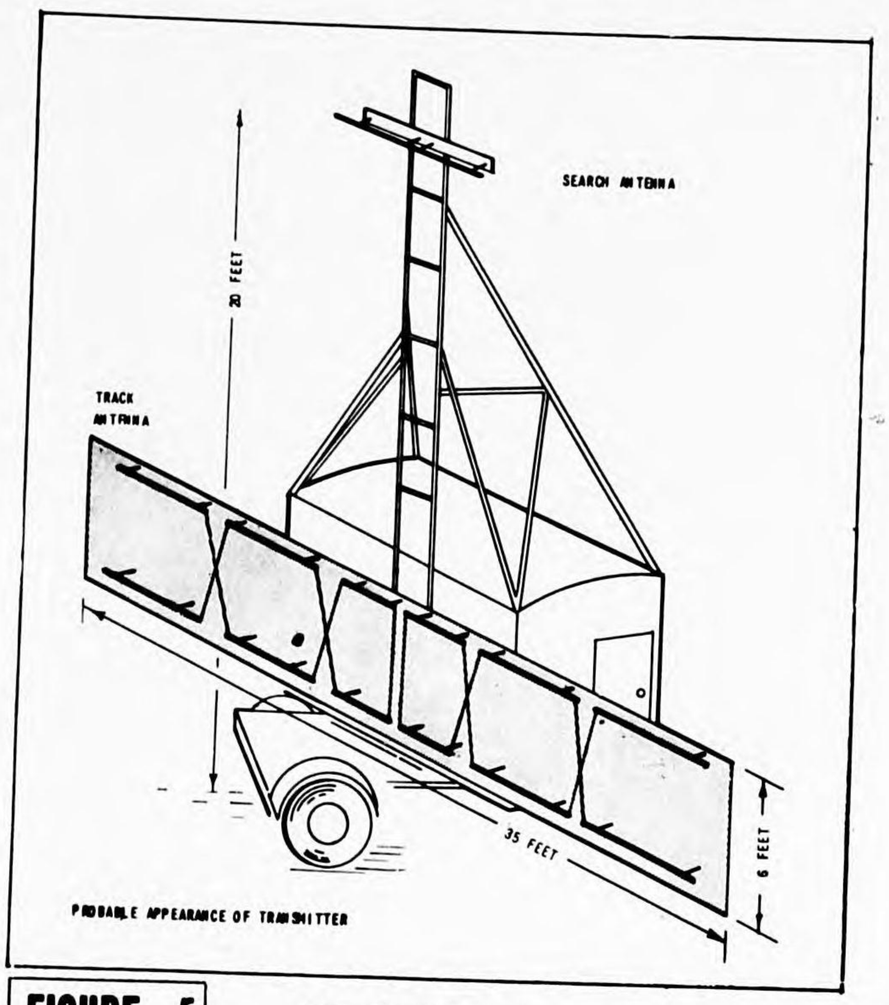


FIGURE 5 TRANSMITTER

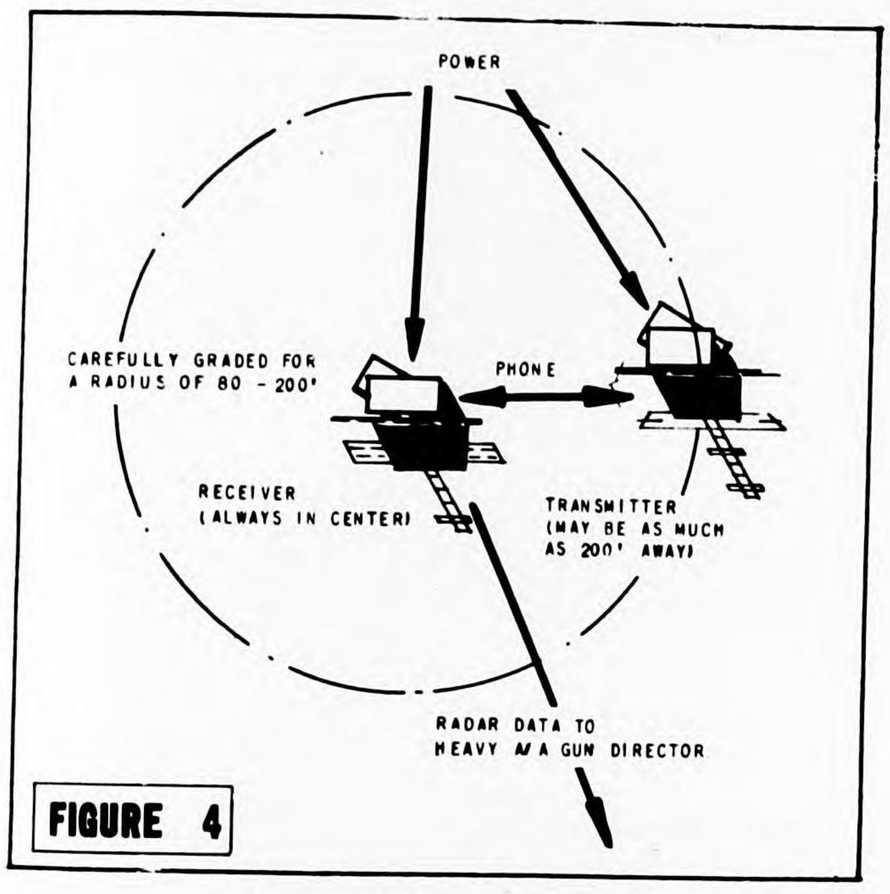


FIGURE 4

HYPOTHETICAL PLAN

The above sketch represents an hypothetical arrangement of the Mark "TA", Model 3, as seen in plan view. However, the circular clearing and graded area may vary considerable in size. Ground mats may be used instead of clearing and grading.

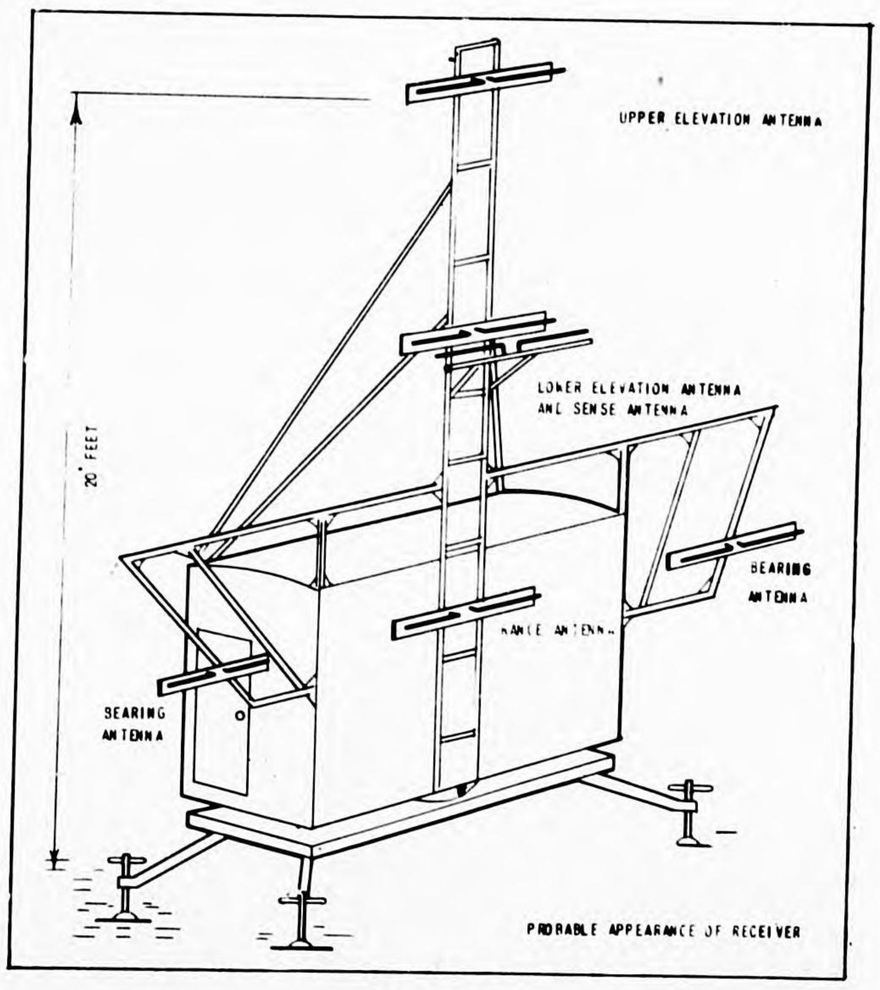


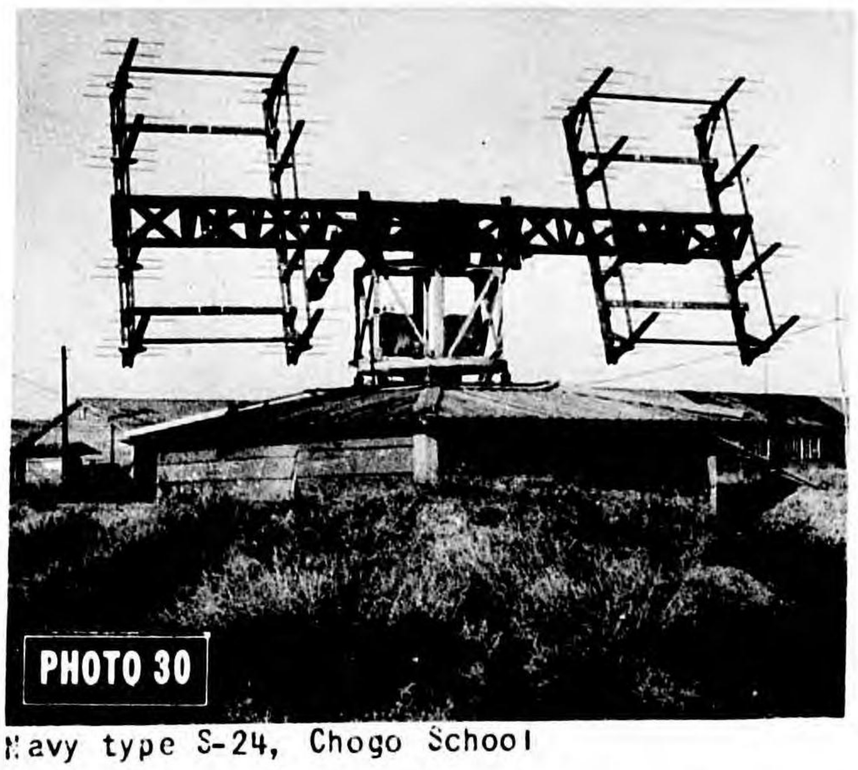
FIGURE 6 RECEIVER

TECHNICAL

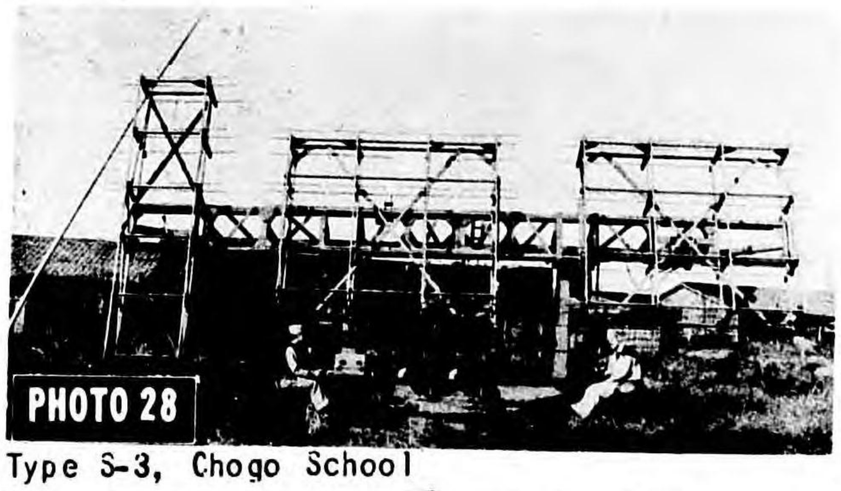
(11) Navy Fire Control radars.

(a) The primary Navy fire control radars were the S-3 (Photo 28), S-23 (Photo 29), and S-24 (Photo's 30, 31, 32). Of these the S-3 and S-24 were most commonly used. All three sets are quite similar in appearance and performance. S-3, the first developed, was a close copy of the US Army SCR 268 which was captured by the Japanese in the Philippines. Navy fire control radar was sited in a variety of ways; most sets, however, were installed in the center of a saucer-like circular emplacement. This fact was recognized by most photographic interpreters late in 1944 and sets emplaced in such manner were correctly interpreted. The base for S-24 (Photo 32), was, for example, correctly interpreted as fire control radar under construction. Nevertheless, some interpreters erroneously interpreted sound locator revetments used with army searchlight stations as fire control radar. These latter revetments, although similar in shape, were much smaller.

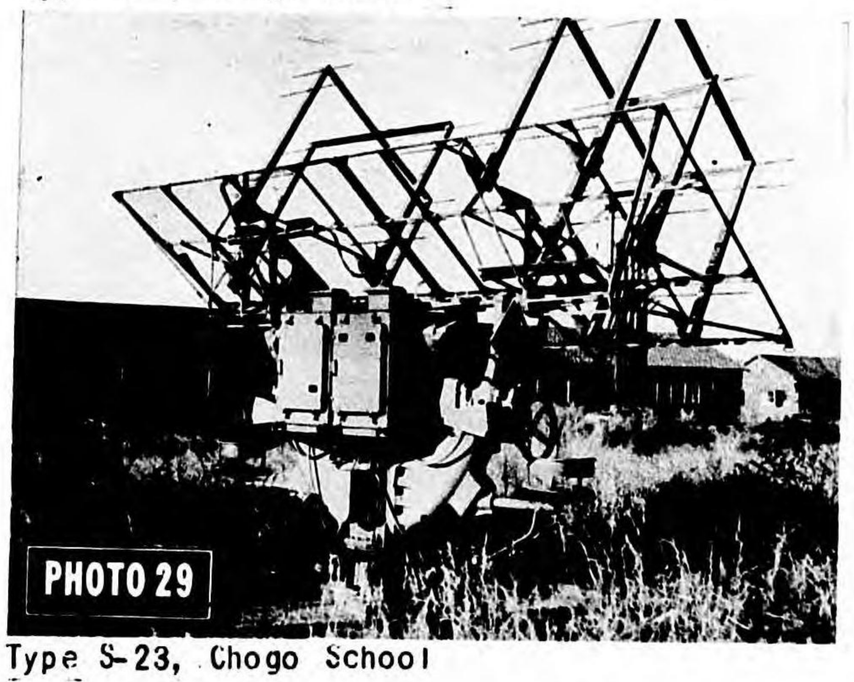
(b) Classification of sets: Land-based, fixed, fire control, frequency - 200mcs.



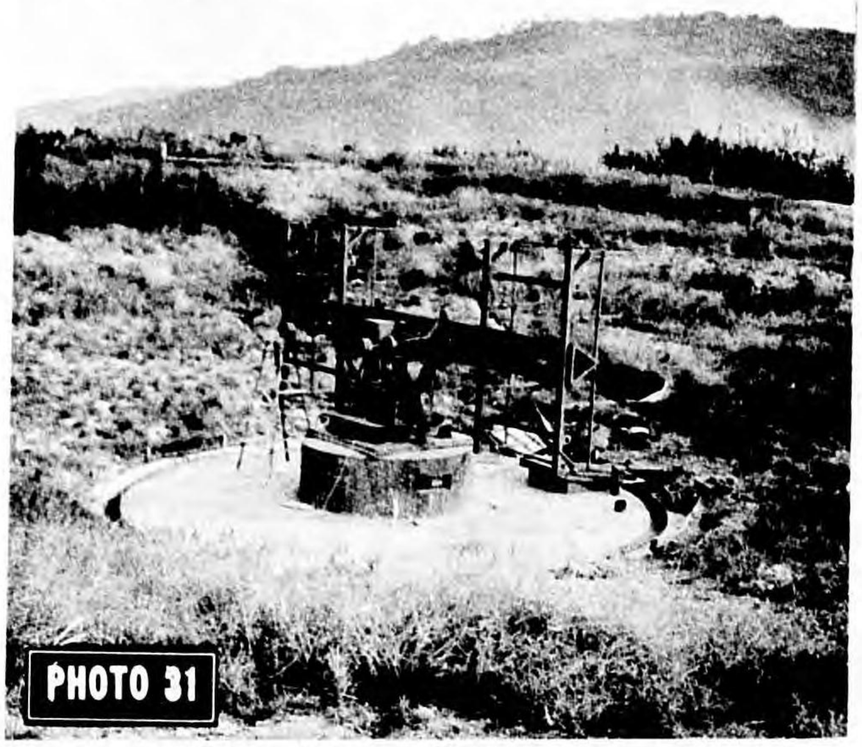
Navy type S-24, Chogo School



Type S-3, Chogo School



Type S-23, Chogo School



Navy type S-24, Omura A/F

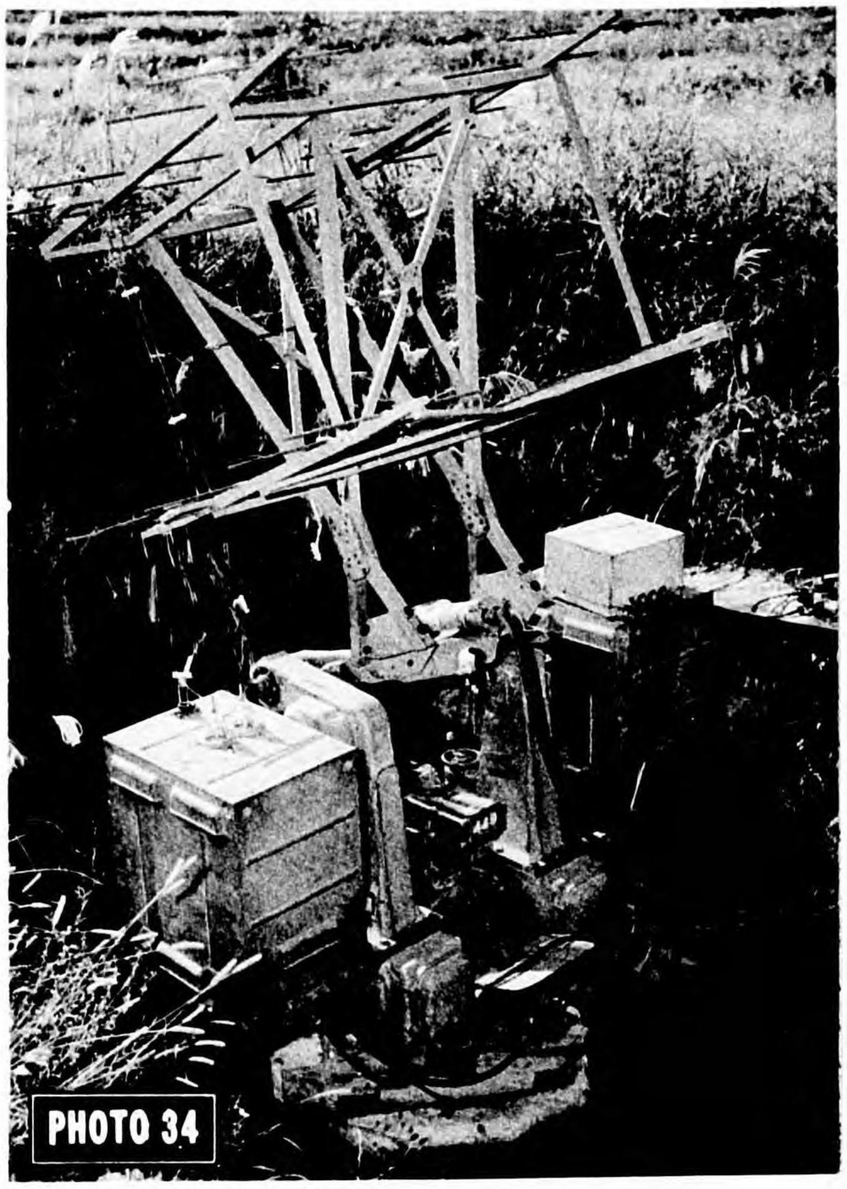
Base for navy type S-24 under construction, Omura A/F

(12) Searchlight Control radar.

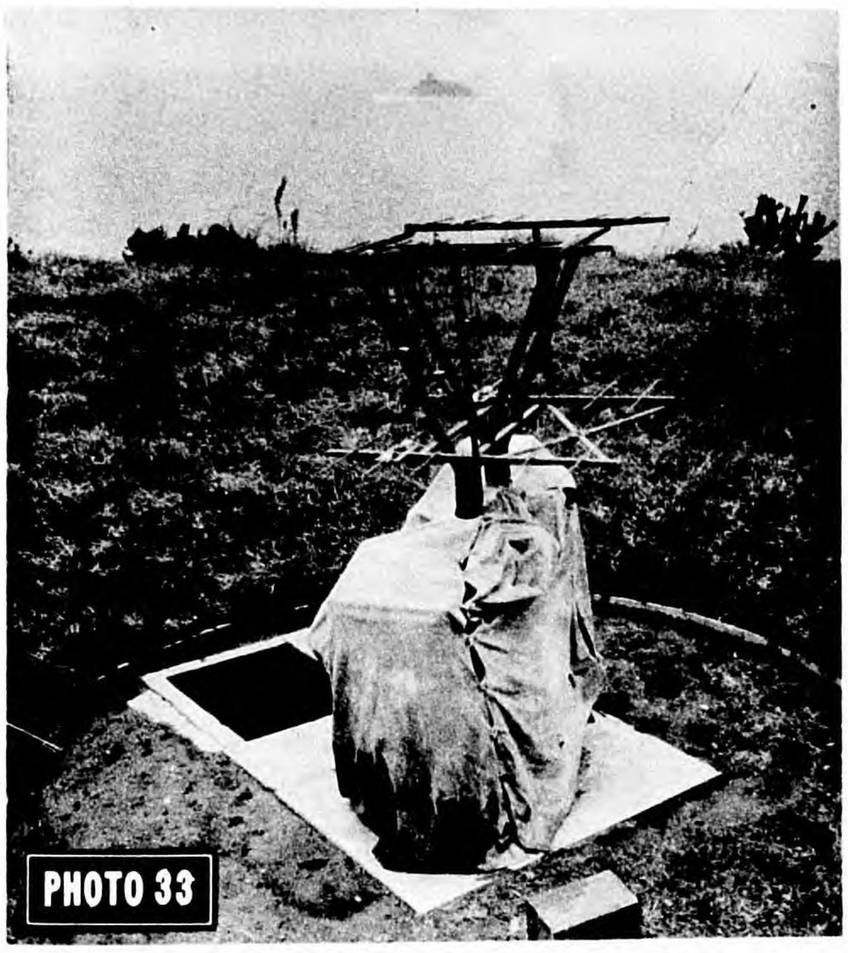
(a) Photographic interpreters experienced very little success in finding searchlight control radar. The Army had no special equipment for control of lights, using sound locators and Tachi 1, 2, 3 and 4 but the Navy used types L-1 and L-2. The L-2 was used in greater number toward the end of the war. This type operated at 200 mcs and required use of a separate transmitter, the receiving antenna being mounted on the searchlight itself. Type L-1 was very similar, the main difference being the method of mounting the Yagi antenna.

(b) The small size of this equipment is believed to be the primary cause of the inability of photographic interpreters to recognize it on aerial photographs. Photos 33, 34 and 35 illustrate examples of type L-2 Navy radar. Note underground construction.

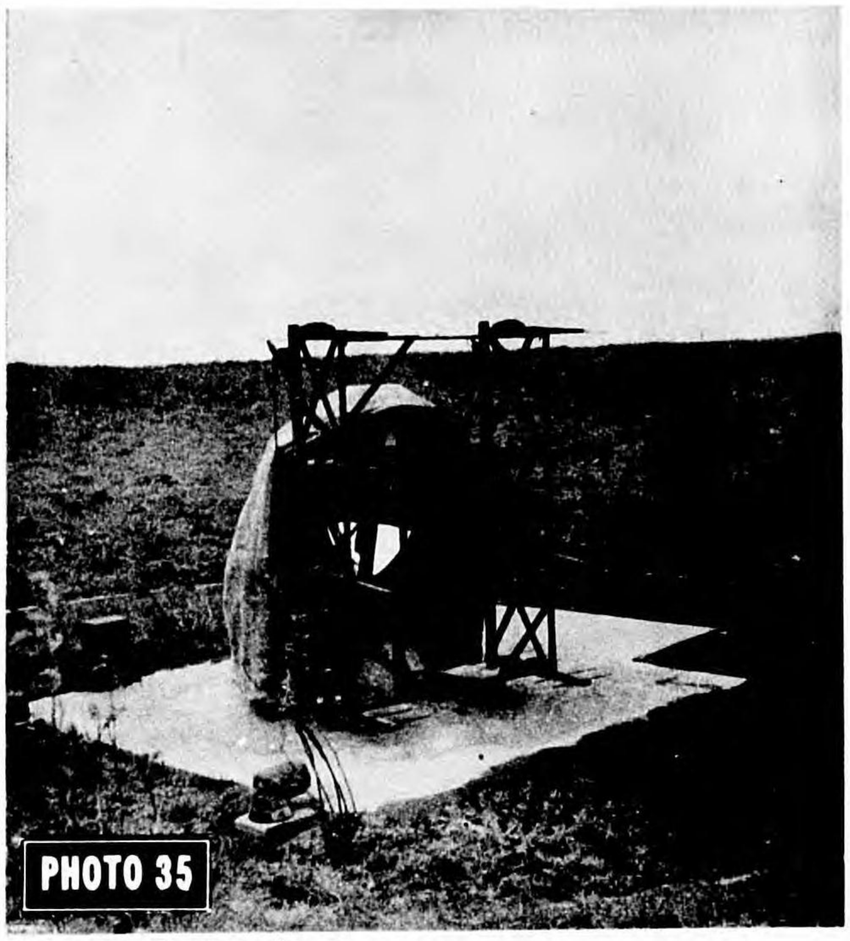
(c) Classification of sets: Land-based, fixed, searchlight control, frequency - 200 mcs.



Type L-2 transmitter



Type L-2 transmitter



Type L-2 receiver

TECHNICAL

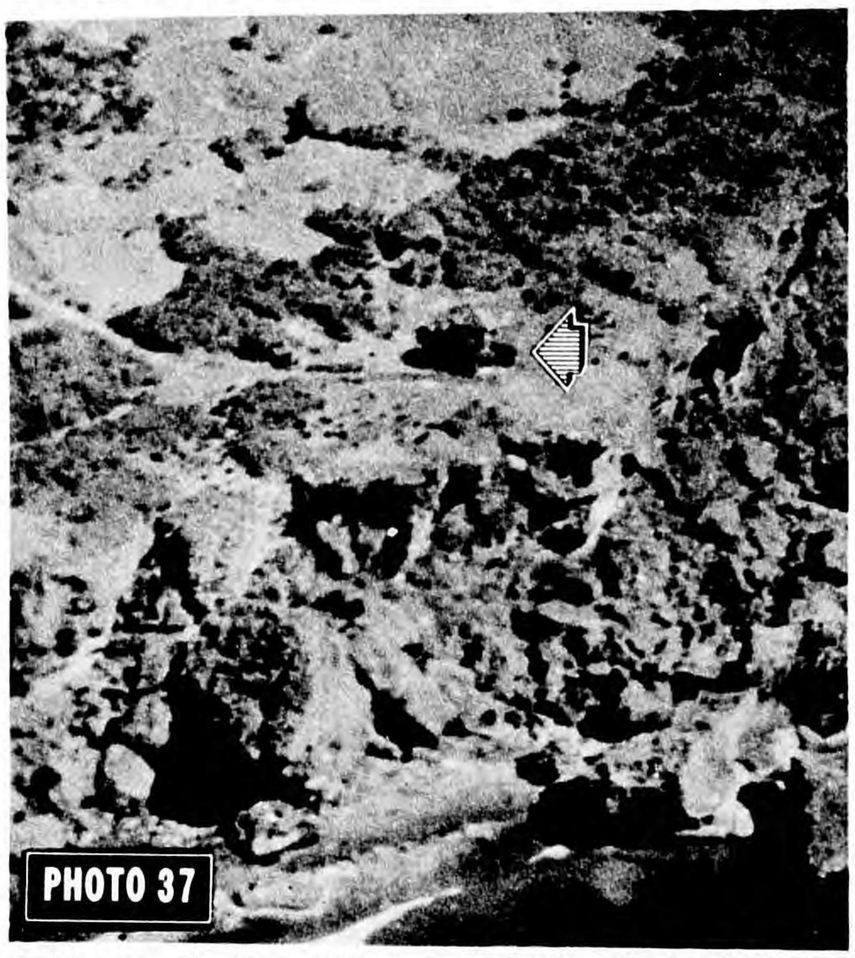
(13) Housed radar installations.

(a) Two standard wooden building types having octagonal plan were frequently reported as housing radar.

(b) Photo 36 a selected portion of an aerial photograph taken during the war, shows a vertical view of one type of octagonal building - the standard housing for Army fire control radars (Tachi 1, 2 and 4) discussed on the previous pages. This standard building was 10 - 15 feet high and was always sited in a circular revetment near heavy AA batteries. Ground check proved that it was correctly interpreted as containing fire control radar.

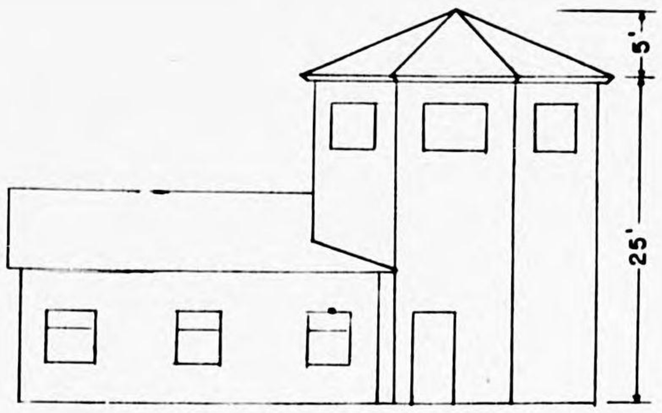
Vertical photograph of fire control radar housed in octagonal building, Uma Shima

(c) Photo 37 is an enlarged portion of an aerial oblique shot of the other standardized octagonal building, observed several times in the Nansei Shoto. This building was reported as containing search radar. All such installations ground checked had been completely destroyed prior to the arrival of the investigators and, consequently, no positive evidence regarding the accuracy of the interpretation could be obtained from field examination. Japanese officials interrogated in Tokyo and Kyushu reported unanimously that they knew of no such buildings housing search radar. When asked what such structures might be the Japanese suggested that they might have been used for lookout stations. The Japanese are known to have had numerous lookout stations which usually contained radio communications equipment. No conclusive proof, therefore, has been forthcoming up to the present time to establish definitely the use of these towers. Other evidence supports the photographic intelligence analysis reports, namely that the towers occupied typical radar sites and, that RCM intercepts were recorded from the general vicinity of the reported towers. Fig 7 is an interpretive sketch of the tower made from aerial photographs.

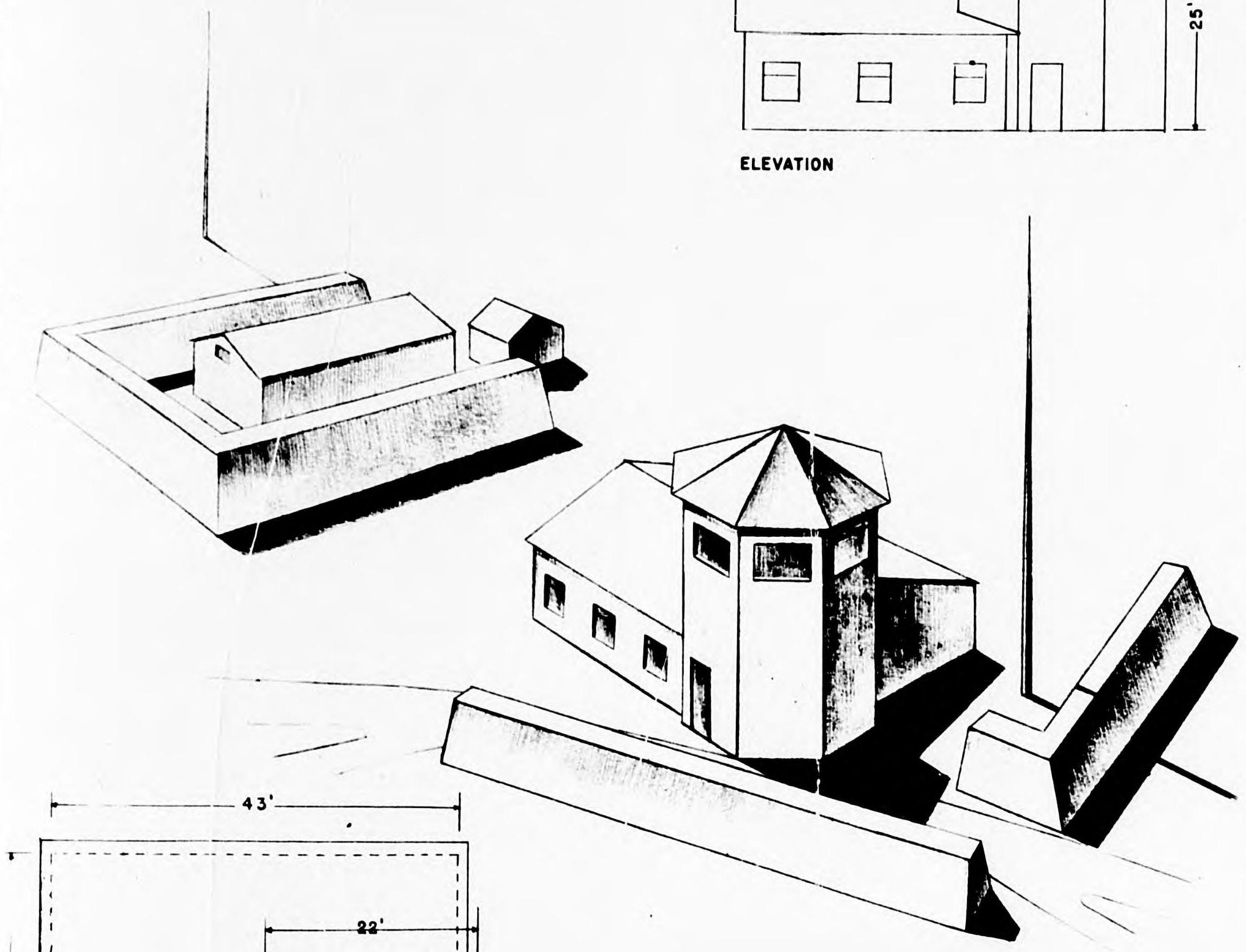


Oblique photograph of octagonal building, suspected of containing search radar, Okinawa

RESTRICTED



ELEVATION



PLAN VIEW

POSSIBLE RADAR INSTALLATION

On Okino Daito Jima
NANSEI SHOTO
LAT. 24° 28'N LONG. 131° 11'E

INTERPRON TWO - 557

FIGURE 7

Interpretation sketch taken from Interpron Two report showing appearance of suspected "housed radar" installation made from aerial photographs.

TECHNICAL

(14) New types of radar.

(a) On 15 August 1945, several new designs had passed the experimental phase and were ready for mass production.

(b) The Navy sets type 22 and 32 (Photos 38, 39) were being installed on land sites toward the close of the war but relatively few were completed. This radar design, the most advanced the Japanese used, was in the microwave band for surface search (22) and for surface fire control (32). They were originally used on shipboard and were known as experimental ship-borne radars by US Intelligence since 1944. The Japanese Navy planned to use type 32 for control of coastal defense batteries but had only begun to execute these plans at the close of the war. Equipment of such small size would have been very difficult, perhaps impossible, to identify on aerial photographs at the usual scales.

PHOTO 38

Navy type 22 for surface search, Chogo School

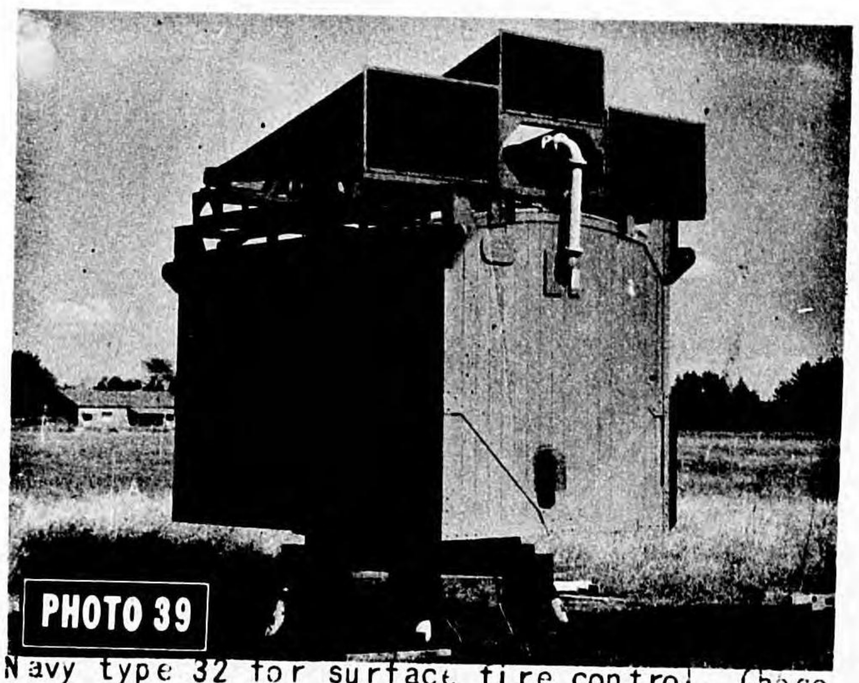


PHOTO 39

Navy type 32 for surface fire control, Chogo School

(c) The Navy Mark 14 search radar (Fig 8) was considered by the Japanese to be a very advanced set for long range aircraft reporting, but construction had begun on only three sites when the war ended (Irozaki, Toi Misaki and Shiono Misaki). Very little information could be obtained and the sets had been destroyed.

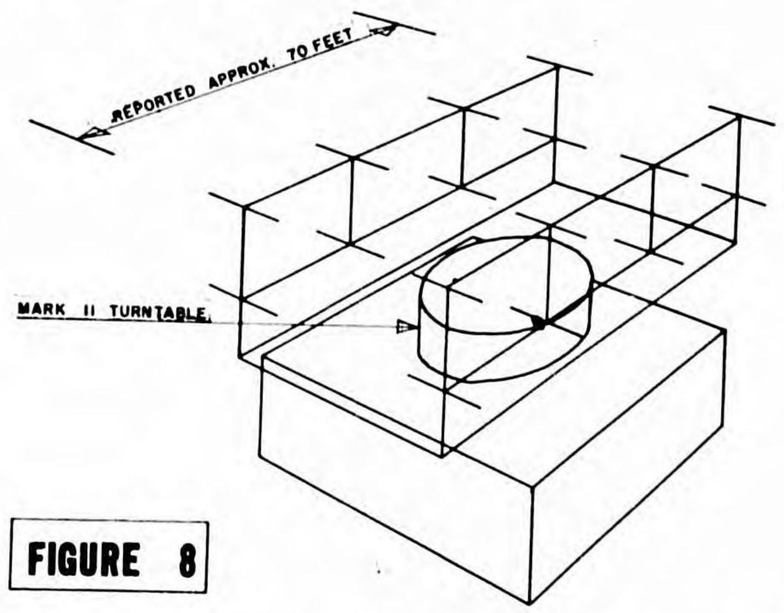


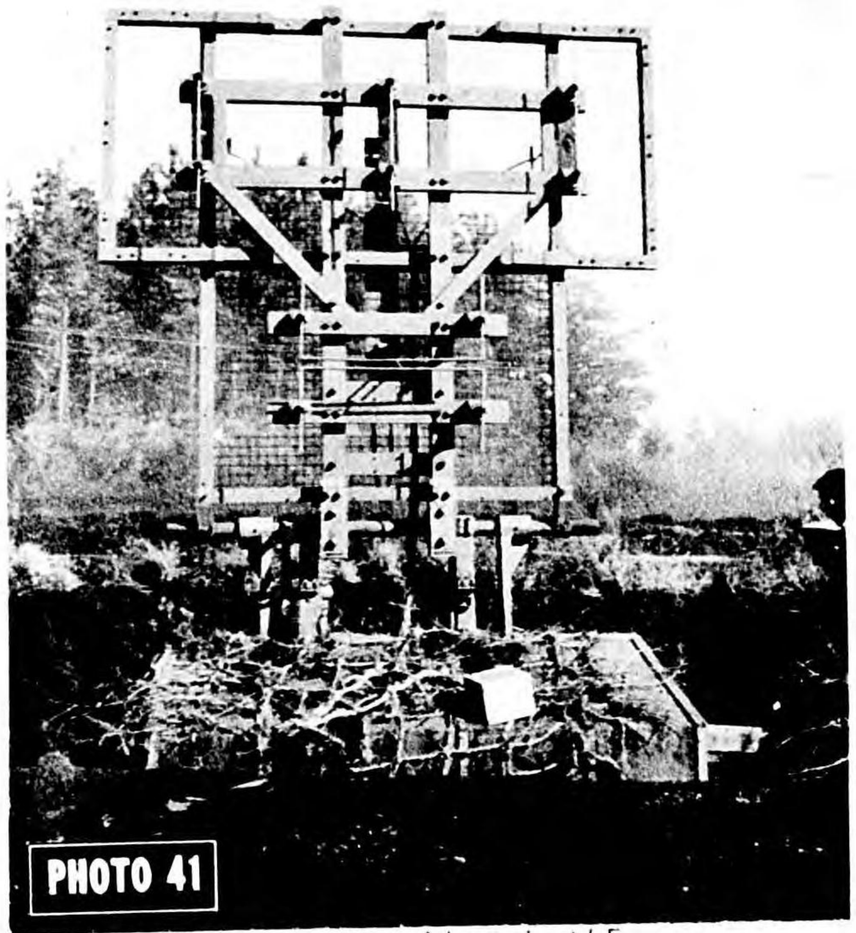
FIGURE 8

(d) Photo 40 is a view of the first and only model (adapted) of the German Wurzburg constructed by the Japanese. This set, called Tachi 24, was finished shortly before the war ended and was being tested prior to entering the production stage. It is interesting to note that plans for this set were received eighteen months prior to the war's end.

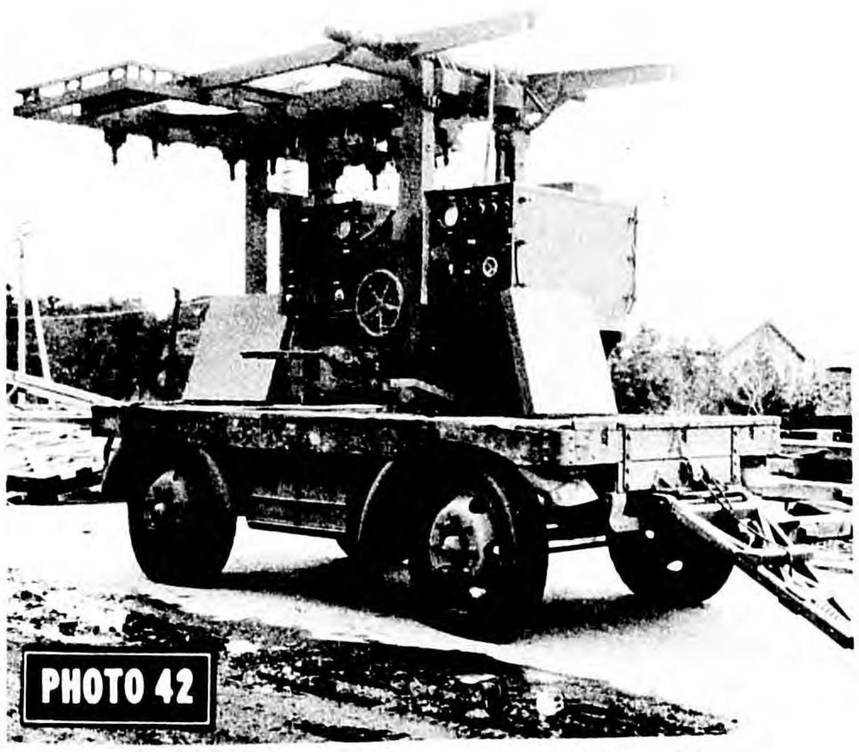
PHOTO 40

Army TACHI 24 copy of German Wurzburg, Tokyo area

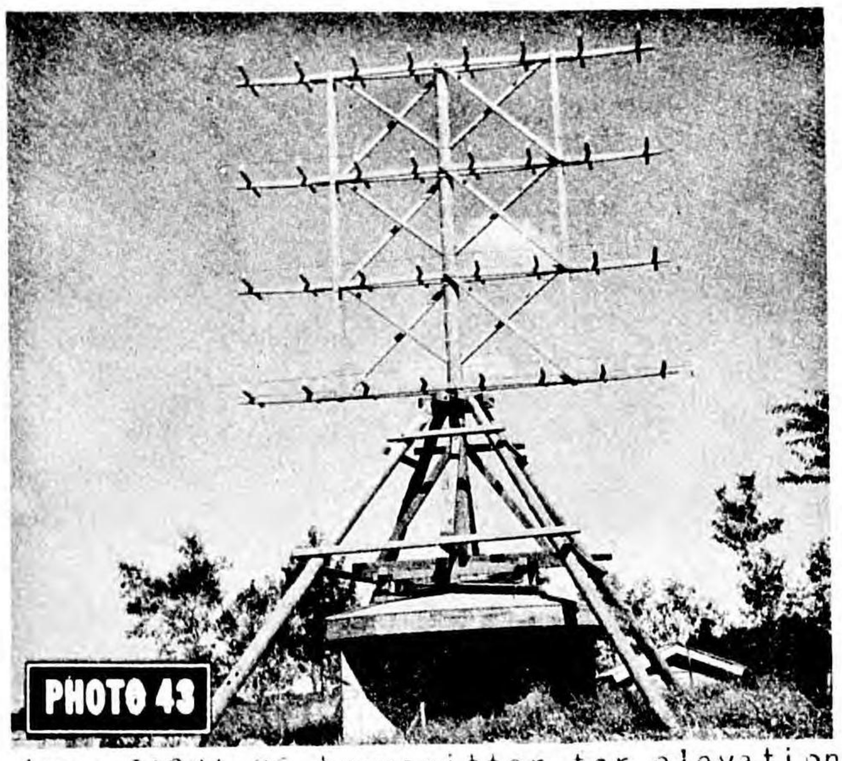
(e) Other new types, which had been used to a limited extent, were Tachi 17 (Photos 41, 42), Army IFF: Tachi 35 (Photos 43, 44) a supplementary "elevation measuring radar" for use with Army fire control radar; and Hama 62, (Photo 45) a probable Navy "friendly fighter locator."



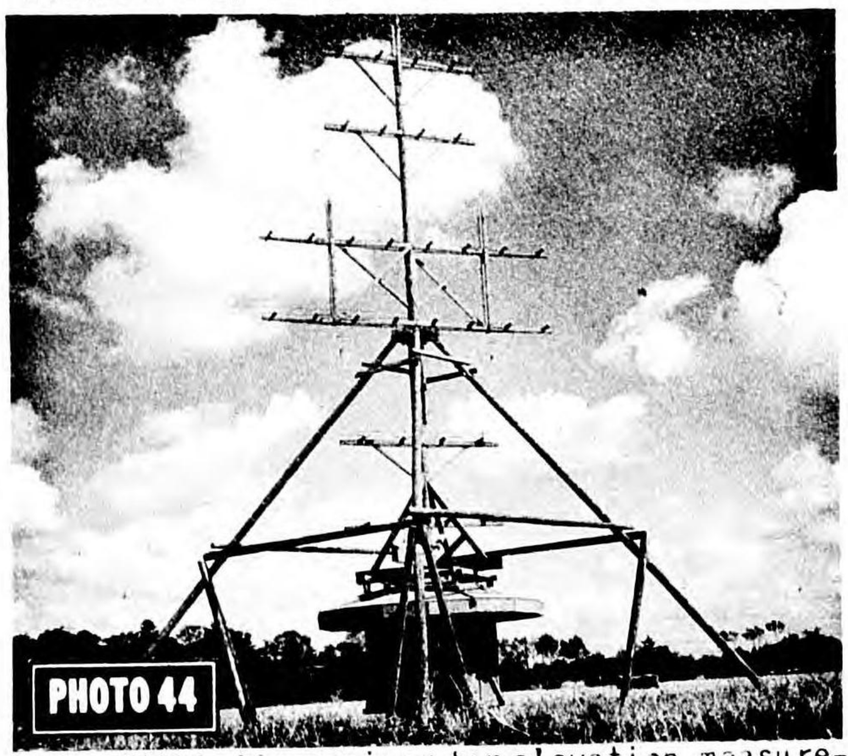
Army TACHI 17, IFF, Atsugi A/F



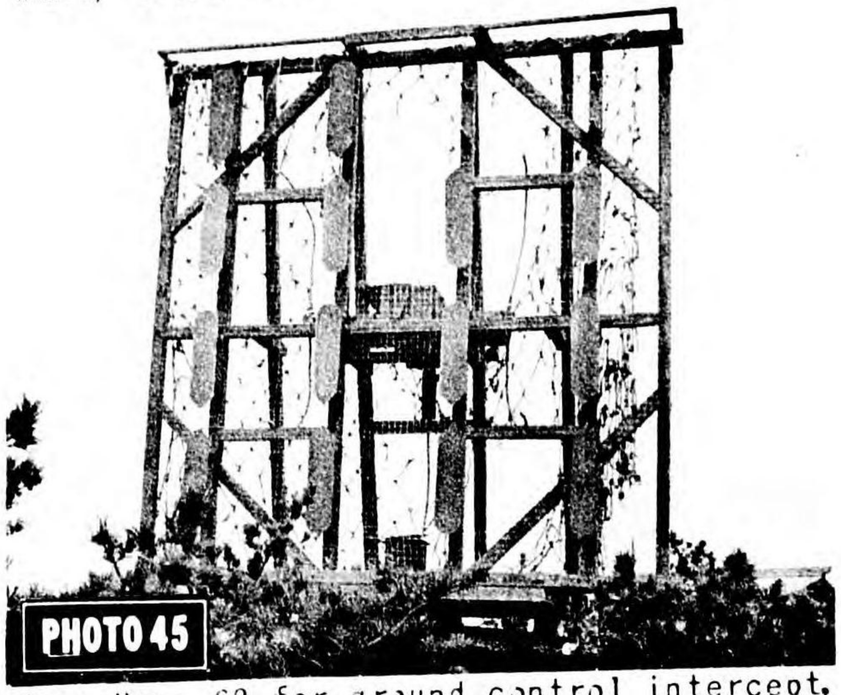
Army TACHI 17, IFF, Mito South A/F



Army TACHI 35 transmitter for elevation measurement, Tokyo area



Army TACHI 35 receiver for elevation measurement, Tokyo area

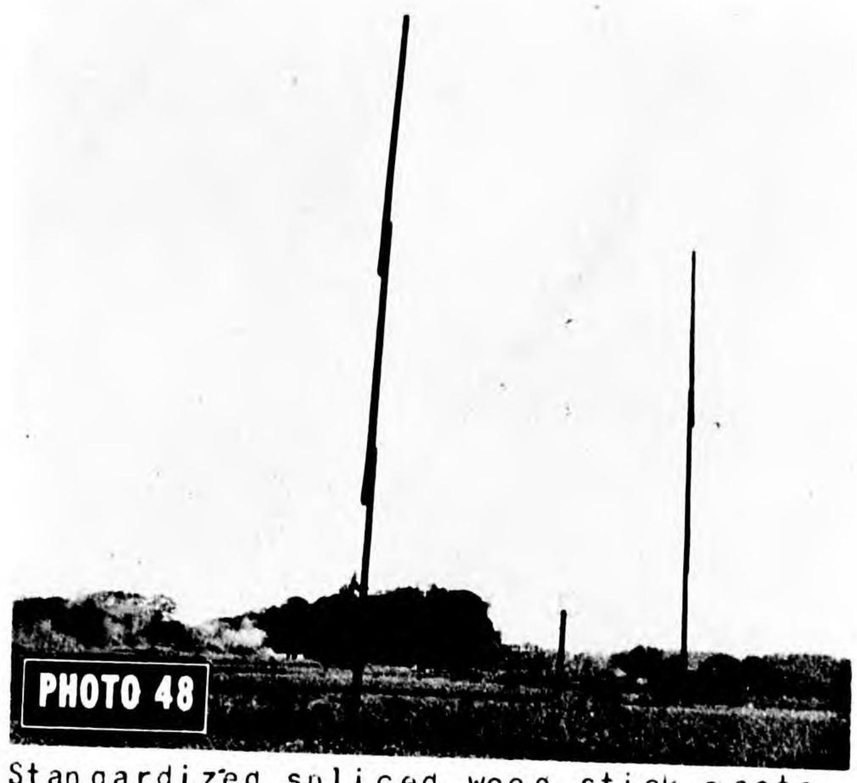


Navy Hama 62 for ground control interceot, Tokyo area

(15) Radio Communication stations.

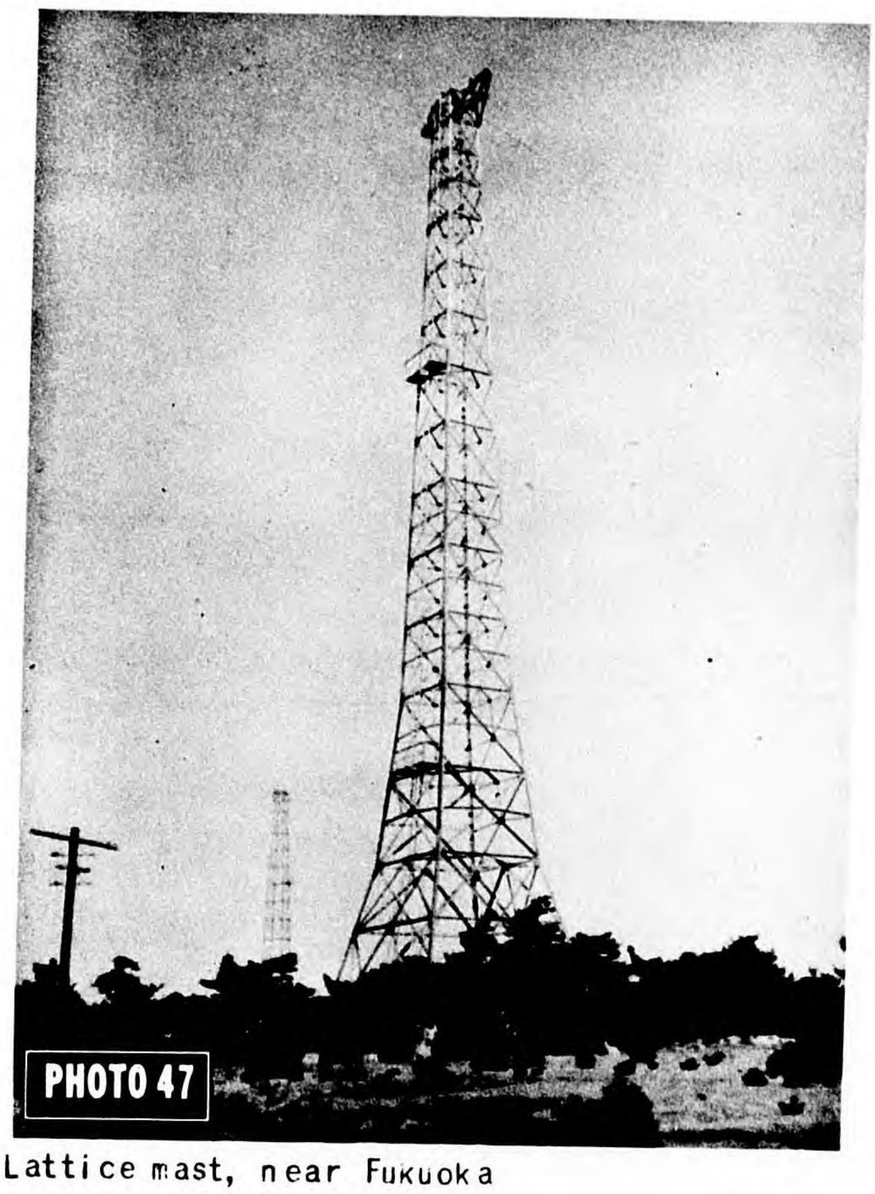
(a) Japanese radio stations were easily identified on aerial photographs. Masts as well as many transmitter buildings were of standard design. Lattice masts (Photos 46, 47) were used in the more important stations and usually had built-in platforms for lookouts and signalling purposes. Spliced wooden stick masts (Photo 48) were standard construction and characteristic of most smaller military stations.

Twelve lattice masts, near Fukuoka

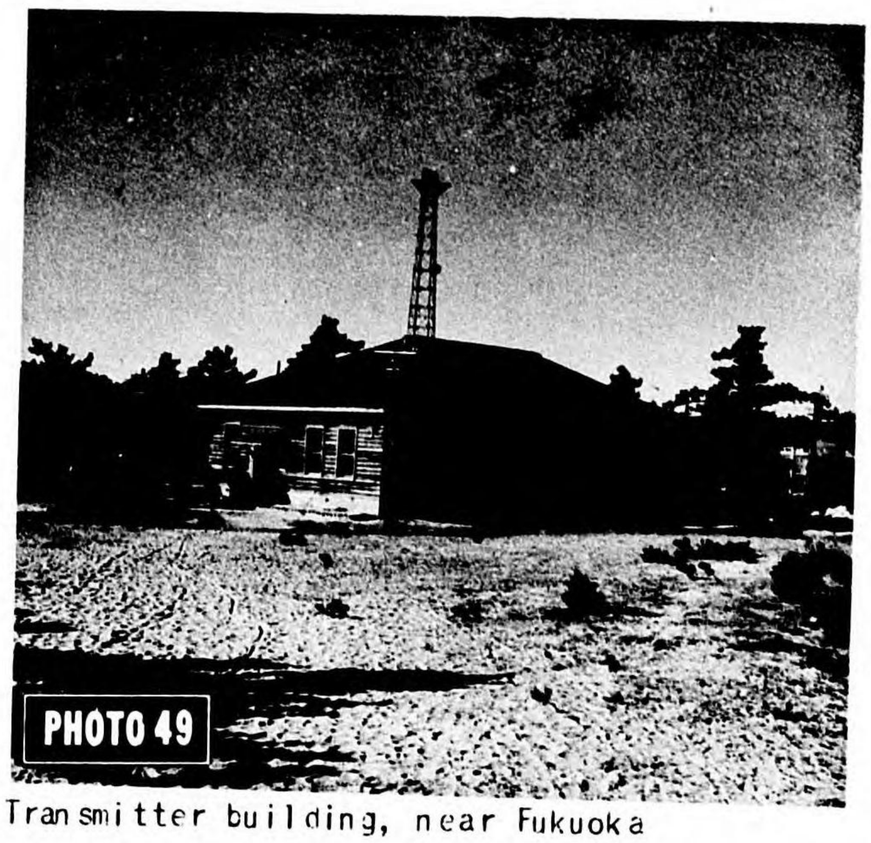


Standardized spliced wood stick masts, Hitachi area

(b) Transmitter buildings were constructed of wood (Photo 49) or concrete. Although the concrete buildings were not completely standardized, they were usually as easy to identify as the masts.



Lattice mast, near Fukuoka



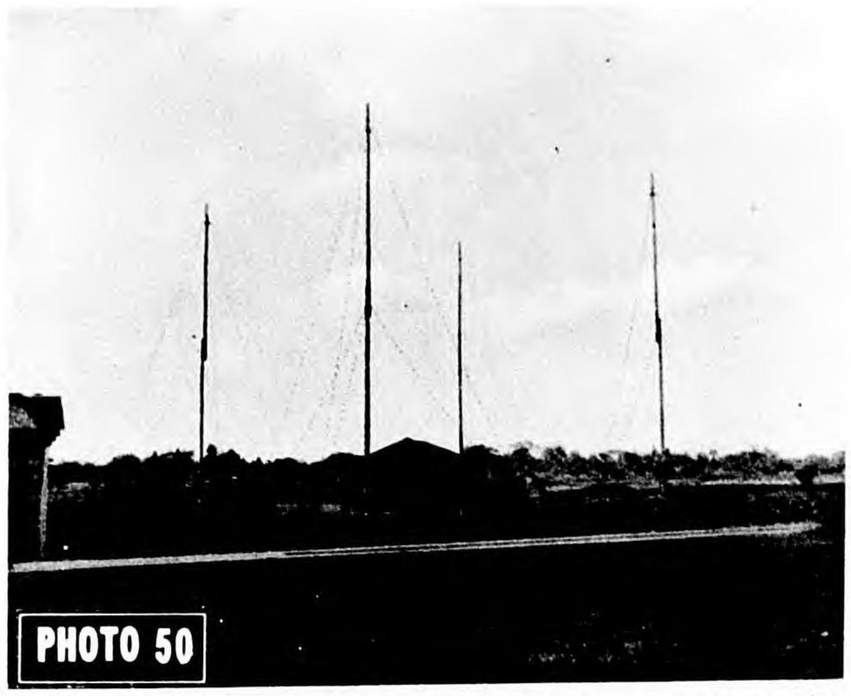
Transmitter building, near Fukuoka

(c) Classification of stations by use, i.e., "weather reporting" and "shore to ship communication", was correct in most cases.

(15) Radio Direction Finding stations.

(a) RDF stations were located on or near practically all Japanese airfields. They became easy to spot after the initial identification was made and training and reference material distributed. It was sometimes possible to recognize RDF at photographic scales as small as 1:25,000. Analysis of the frequency bands used by the equipment housed in various types of buildings associated with RDF proved to be 100 per cent correct.

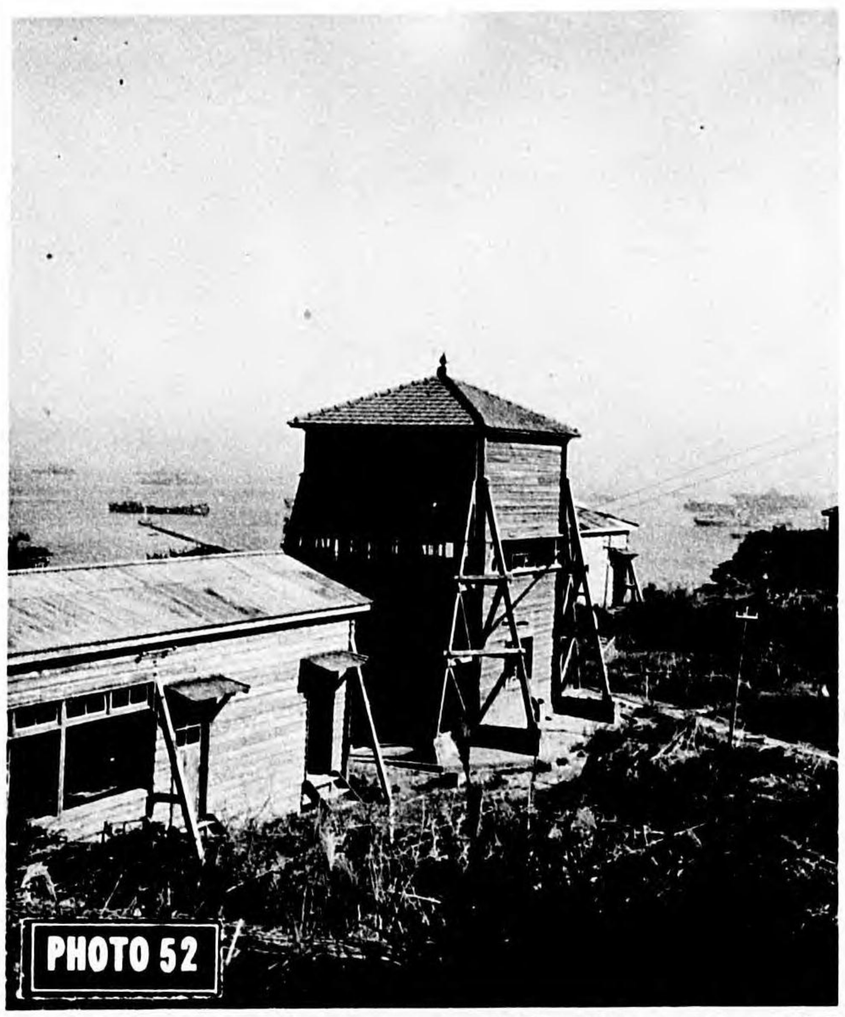
(b) Photo 50 shows a typical medium frequency Adcock type RDF which became the easiest of all electronics installations to identify due to the symmetrical plan, standardized dimensions and circular clearing around the entire station.



Typical medium frequency RDF, Tokarazawa A/F

(c) Photo 52 illustrates a typical high frequency "housed adcock" which was identified by the standard size and shape of the wooden tower which enclosed the equipment. This installation puzzled interpreters when first observed but it was finally recognized as an RDF installation because of its proximity to an "open Adcock", a basic design well known throughout the world. The experimental station shown in Photo 51 was correctly identified even though it was of unusual design.

Experimental high frequency RDF, Tokarazawa A/F



Typical high frequency RDF, Yokosuka A/F

TECHNICAL

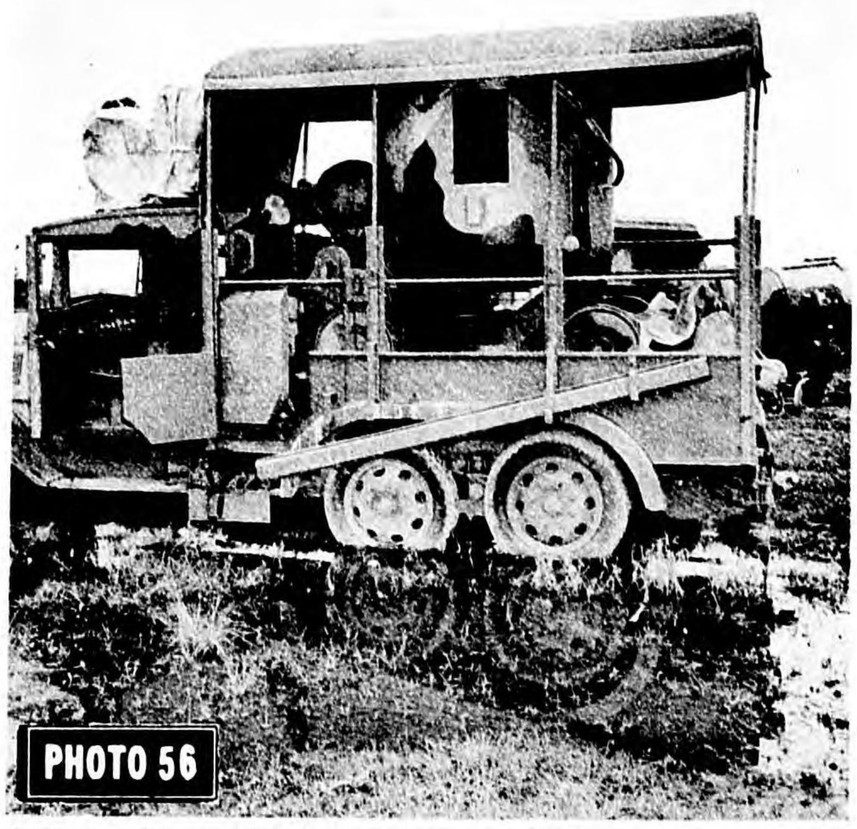
(17) Searchlights.

(a) Because of their small size and mobility, searchlights were frequently not observed; when reported, however, the identification usually proved to be correct. When emplaced in circular revetments (Photo 53, 54) searchlights were easily interpreted. When used as mobile lights (Photo 55) and on covered trucks (Photo 56), the problem was almost beyond the scope of photographic interpretation with usual quality and scale of photographs.

(b) Knowledge of Japanese doctrine such as flanking twin 127mm guns with a pair of 150mm lights, and general patterns of lights on the perimeters of defense areas, proved to be most helpful in searchlight interpretation.

Motile Searchlight, Palace A/F

Searchlight position, Muroran



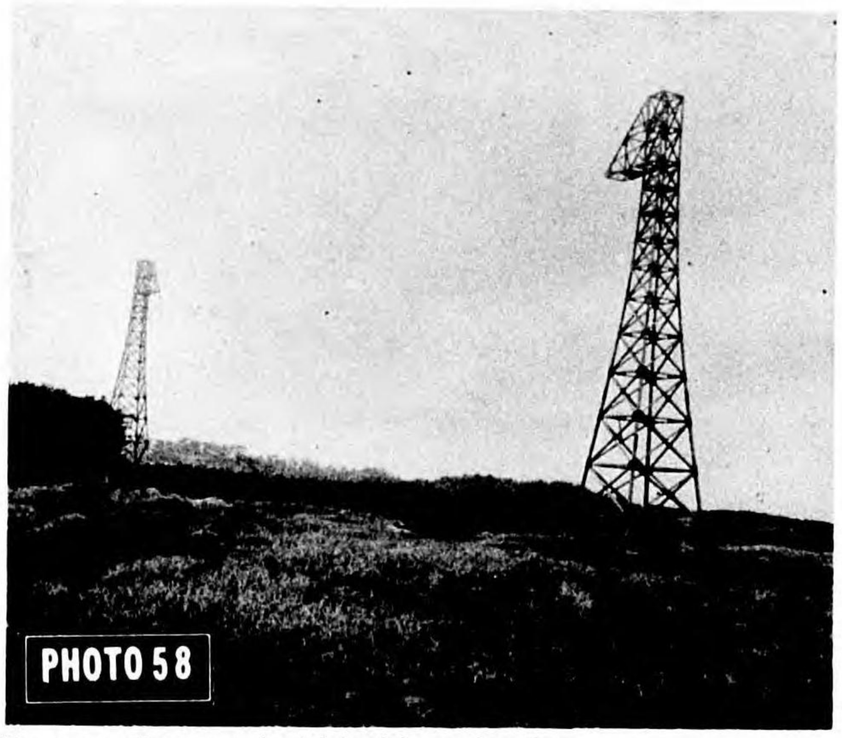
Mobile Searchlight, Palace A/F

Searchlight position, Muroran

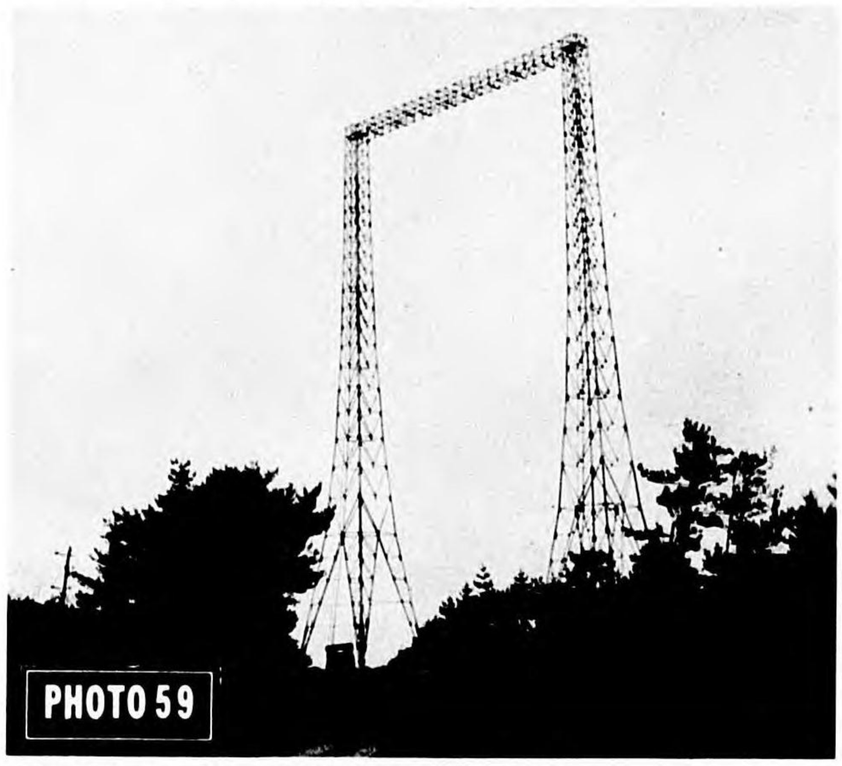
(18) Misleading Non-Electronic installations.

(a) Photos 57 - 62 are examples of objects which created confusion and might have misled the interpreter working on electronics. These objects and others equally misleading were noted on aerial photographs during the war and were suspected of being electronics installations but, when repeated examination failed to reveal adequate evidence, were not reported as such.

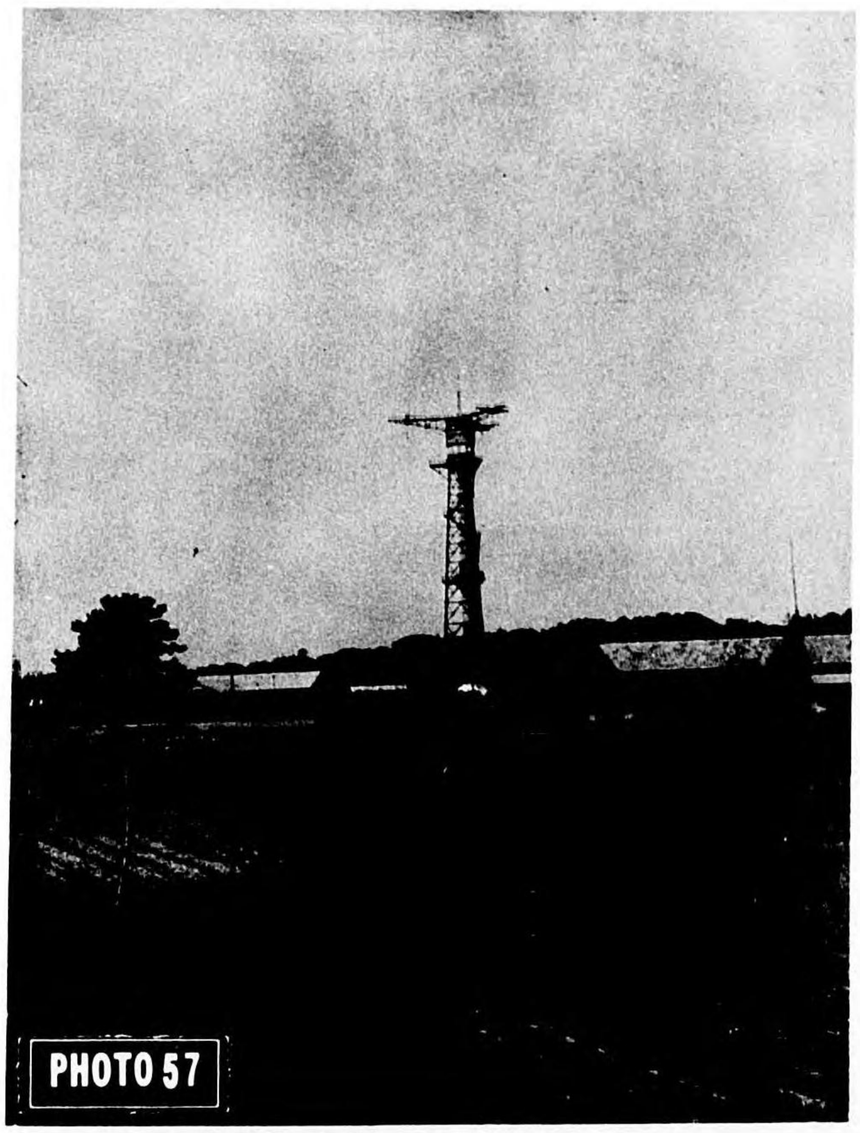
(b) The most bizarre of installations of this type is illustrated in Photos 60 and 61. It was used in flight training to demonstrate, without the use of gasoline, the correct glide angle for landing a plane. By the end of the war this gadget" was being used on numerous airfields. A few of the many interpreters who puzzled over it correctly guessed its use, but unfortunately no one was bold enough to publish such a guess.



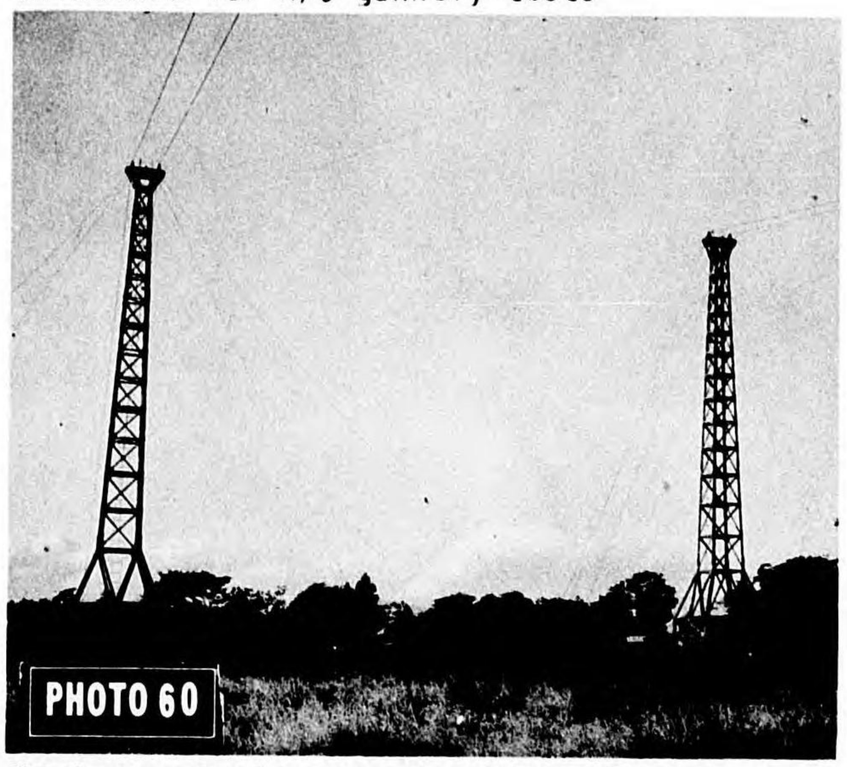
Towers for AA ballistics tests



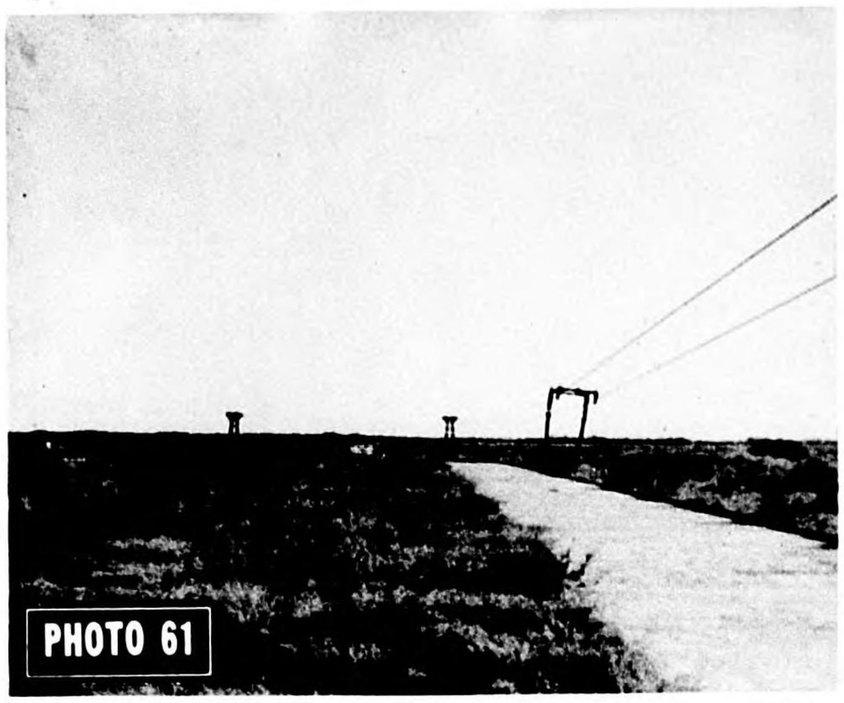
Structure for A/C gunnery tests



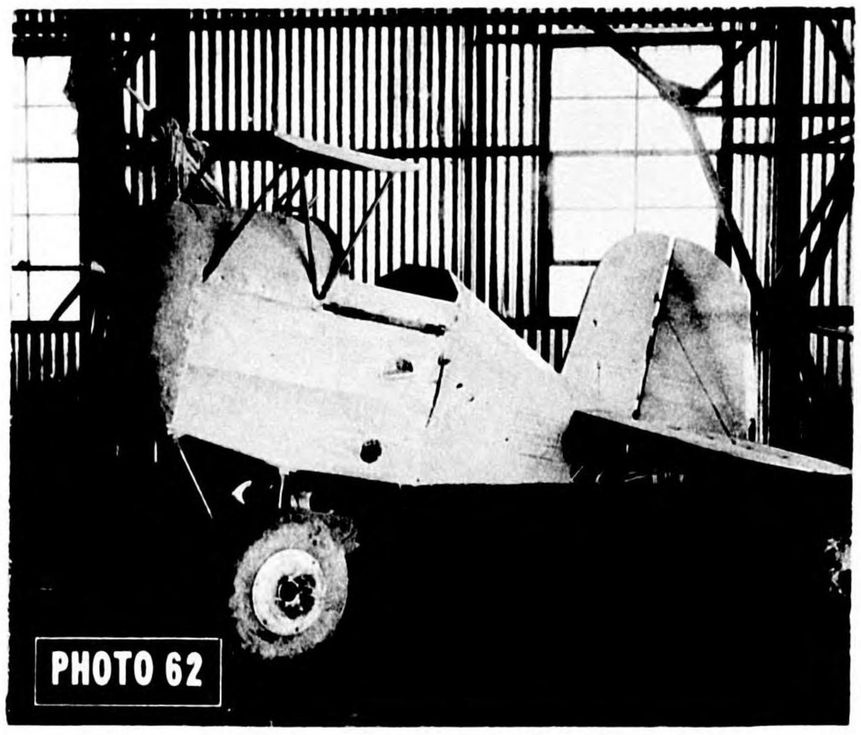
Amusement park parachute jump device



Training device for landing planes. View showing high towers and inclined cables.



Training device for landing planes. View showing low towers, inclined cables, and end of runway.



Training plane which ran on inclined cables of device for landing planes.

(19) Camouflaged installations Japanese efforts at concealment as well as their use of dummy installations often made identification difficult but seldom made it impossible. The most effective camouflaged sets were those sited in groves of trees and those in buried or earth-covered buildings (Photo 63).

Camouflaged radar building (antenna is destroyed)

3. Statistical Evaluation

a. Tables 2 - 6 show the accuracy of interpretation of various types of radar equipment in three sample areas. The location of the sets listed in the statistical tables are shown in Figs 9, 10 and 11. Where available, dates of construction of sets are indicated. Estimated dates of construction of other sets may be found in Exhibit A. Table 5, based on a much less complete check than Table 2-4, while not a precise indication of the accuracy of interpretation of fire control radar, searchlight control radar, searchlights, and sound locators, is believed to indicate the general order of accuracy.

b. Unfortunately a number of factors not associated with photographic intelligence affect the accuracy of figures shown in the various statistical tables. It is important that they be understood and borne in mind at the time the tables are examined.

(1) Photographic coverage was not available in certain areas where sets were reported. Other coverage was poor in quality. Occasionally, photographs of an area pre-dated the construction of the set on the site indicated by the Japanese.

(2) Most radar sites were not visited by field teams, and many installations visited had been destroyed or removed prior to the visits.

(3) Radar locations on outlying islands (not visited) constituted a primary part of the early warning set, and were treated as such during the war. It was necessary to rely on maps prepared by the Japanese for all radar locations in these areas.

(4) Japanese reports were found to be partially inaccurate.

(a) More sets at certain defense points were listed than were constructed. Some actual sites may have been omitted because information on their location was not transmitted to the proper Japanese authorities.

(b) The Japanese assumed that all sets shipped to the field were installed. Many never reached their original destination. Some sets listed as "under construction" were in reality merely "planned." This condition was aggravated by a policy of certain officers of falsifying the completion date of work in the field in order to impress superiors in Tokyo.

(c) Information on Army and Navy radar was obtained separately. It was observed that no collaboration beyond certain aircraft reporting procedures was in effect between radar officers of the two branches of service even though their respective radar positions were physically adjacent. It was impossible to obtain correct records on the status of Army radar sets on islands under Navy command and vice versa.

(5) Since that part of Table 6 showing the accuracy of radar identification by type includes only those sets on which a definite check was available, the percentages therein are affected to a much lesser extent by the factors mentioned above.

STATISTICAL

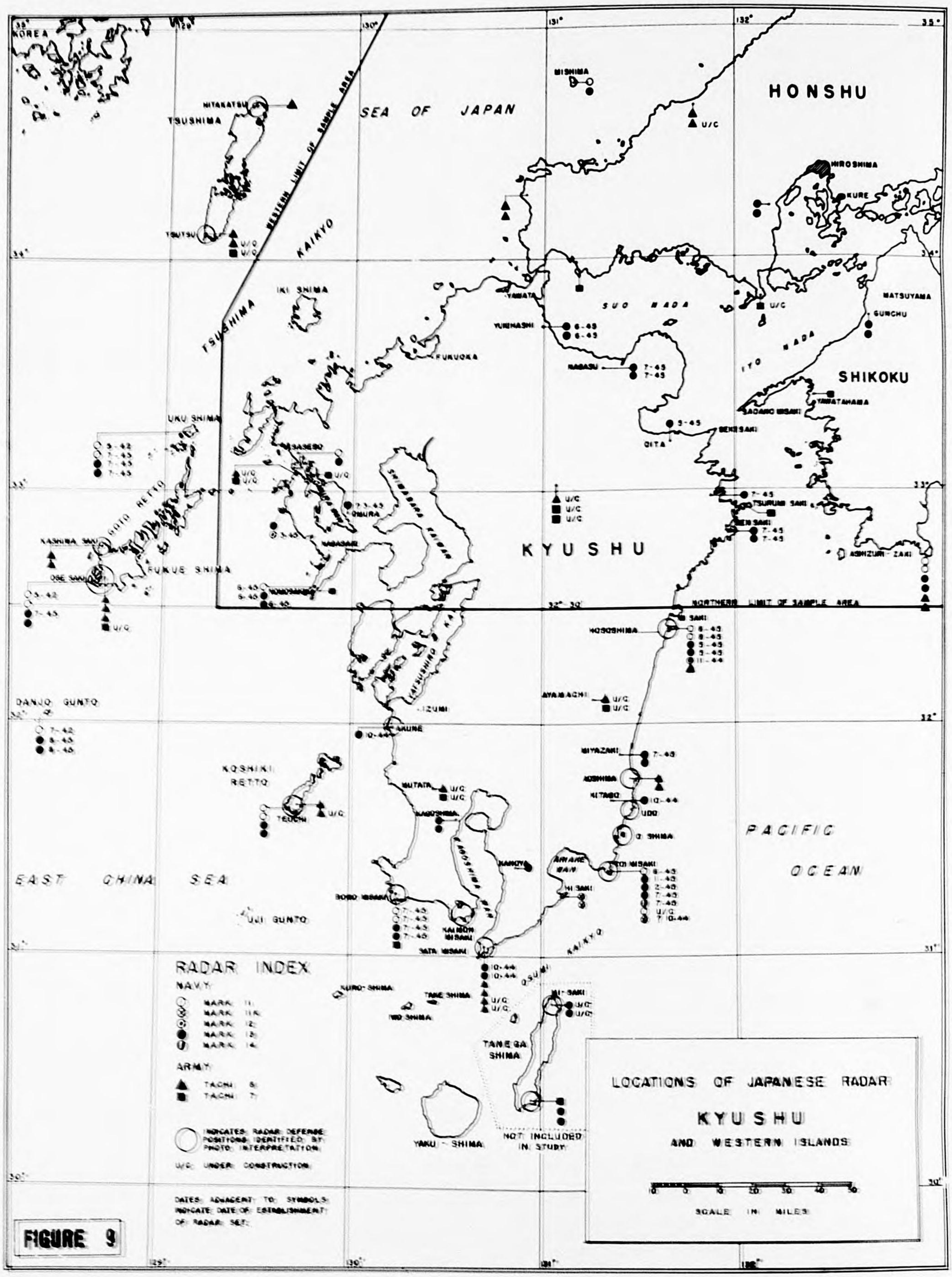


FIGURE 9

COMPARISON OF INTERPRON TWO SEARCH RADAR INTERPRETATION WITH RADAR LOCATIONS REPORTED BY JAPANESE (1)

SOUTHERN KYUSHU & WESTERN ISLANDS

Location of Japanese Radar Defense Points	Reported by Japanese		Reported by Interpron Two	
	Type	No. of Sets	Type	No. of Sets (2)
HOSOSHIMA	Mk. 11	2	Mk. 11	2
	Mk. 12	1	Mk. 12	1
	Mk. 13	2		
	Tachi 6	1	Tachi 6	1 (1T) 6R
AYAMACHI	Tachi 6	1 u/c(3)		
	Tachi 7	1 u/c		
MIYAZAKI	Mk. 13	2		
AOSHIMA	Tachi 6	2	Tachi 6	2 (2T) 5R
KITAGO	Mk. 13	1		
TOI MISAKI	Mk. 11	1	Mk. 11	1
	Mk. 11	1 u/c		
	Mk. 13	3	Mk. 13	1
	Mk. 14	1		
	Mk. 11K?	1		
HI SAKI	Mk. 11K	2		
KANOYA	Mk. 13	1		
SATA MISAKI	Mk. 13	2		
	Tachi 6	2	Tachi 6	2 (1T) 6R
	Tachi 6	2 u/c	Tachi 6?(4)	1 ?u/c
BONO MISAKI	Mk. 11	2		
	Mk. 13	2		
	Tachi 7	1	Tachi 6?	1
KAGOSHIMA	Mk. 13	2		
MUTATA	Tachi 6	1 u/c		
	Tachi 7	1 u/c		
AKUNE	Mk. 13	1	T.N.I. (5)	1
TEUCHI, Koshiki Retto	Mk. 11	2		
	Mk. 13	2		
	Tachi 6	1	Tachi 6	1 (1T) 6R
	Tachi 6	1 u/c		
DANJO GUNTO	Mk. 11	1		
	Mk. 13	2		
OSE SAKI, Fukue Shima	Mk. 11	2	Mk. 11	1
	Mk. 13	2		
	Tachi 6	3	Tachi 6	3 (1T) 6R
	Tachi 7	1 u/c		
KASHIWA SAKI, Fukue Shima	Tachi 6	2		
UKU SHIMA	Mk. 11	2		
	Mk. 13	2		
TSUTSU, Tsushima	Tachi 6	1	Tachi 6	1 (1T) 5R
	Tachi 6	1 u/c		
	Tachi 7	1 u/c		
HITAKATSU, Tsushima	Tachi 6	1	T.N.I.	1
Total Sets		55 Complete		19 Complete
		11 u/c		1 ?u/c
TABLE 2 TOTAL RADAR DEFENSE POINTS		18 Complete		10
		2 u/c		-

(1) Consult page 7.29 for evaluation of table.
(2) In cases of Tachi 6, 1st figure indicates number of sets reported by Japanese; the 2nd, in parentheses, and 3rd indicate, respectively, the number of transmitters, "T", and receivers, "R", reported by Interpron TWO.
(3) u/c indicates under construction.
(4) ? indicates probable.
(5) T.N.I. indicates "Type Not Identified".

STATISTICAL

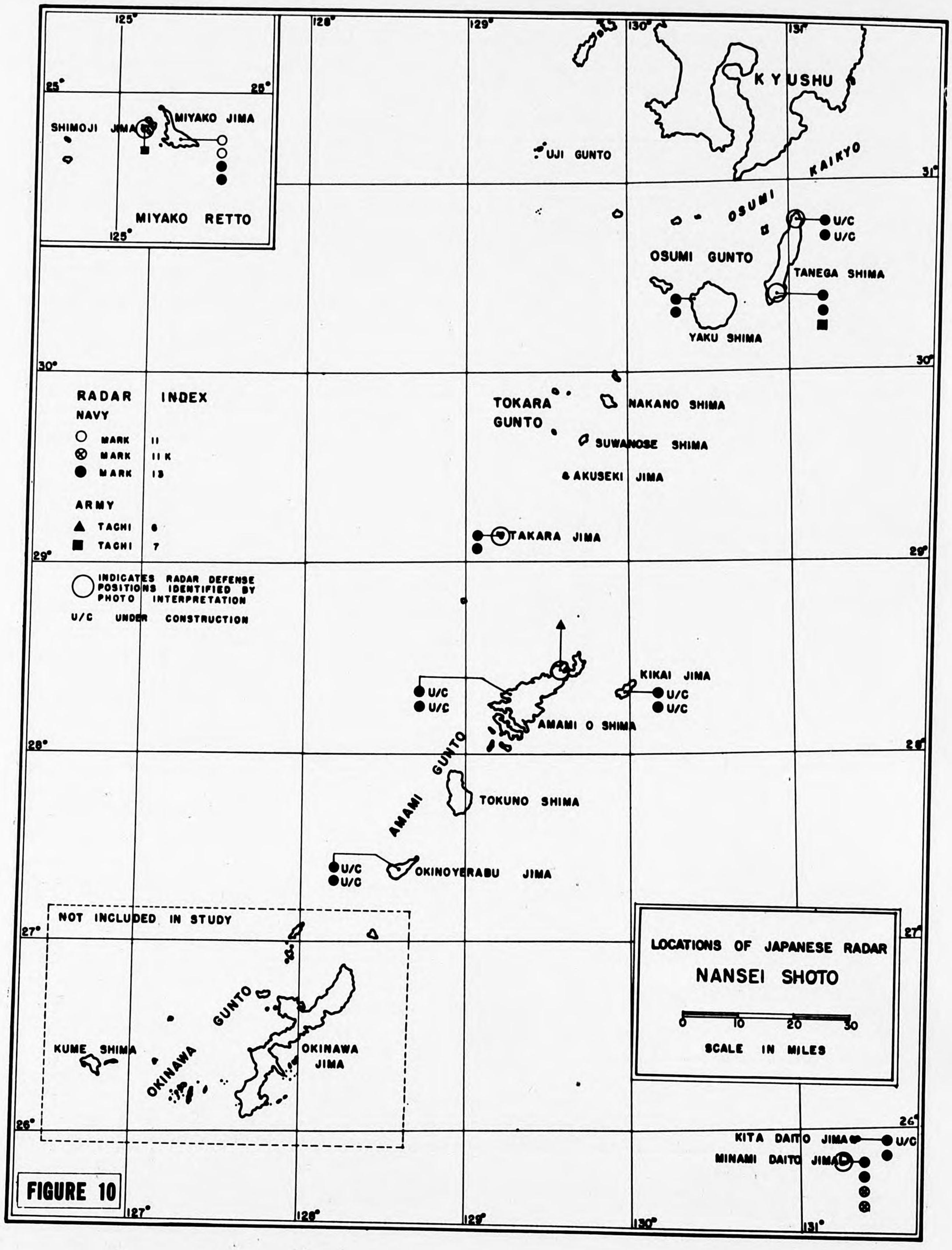


FIGURE 10

COMPARISON OF INTERPRON TWO RADAR INTERPRETATION WITH RADAR LOCATIONS REPORTED BY JAPANESE (5)
NANSEI SHOTO

Location of Japanese Radar Defense Points	SEARCH RADAR				FIRE CONTROL RADAR			
	Reported by Japanese (1)		Reported by Interpron Two		Reported by Japanese (1)		Reported by Interpron Two	
	Type	No. of Sets	Type	No. of sets	Type	No. of Sets	Type	No. of Sets
TANEGA SHIMA	Mk. 13	2u/c(2)	Mk 13	1				
	Mk. 13	2	Mk 13	1				
	Tachi 7	1		0				
YAKU SHIMA	Mk. 13	2		0				
TAKARA SHIMA	Mk. 13	2	Mk 13	2				
ANAMI-O SHIMA	Mk. 13	2u/c		0				
	Tachi 6	1	Tachi 6	1				
KIKAI JIMA	Mk. 13	2u/c		0				
OKINOYERABU JIMA	Mk. 13	2u/c		0				
KITA DAITO JIMA	Mk. 13	2u/c		0				
MINAMI DAITO JIMA	Mk. 11K	2	Mk 11K	2	S(3)	1	S	1
	Mk. 13	2		0	L(4)	1		0
MIYAKO JIMA	Mk. 11	2		0	S	1		0
	Mk. 13	2		0	L	1		0
SHIMOJI JIMA	Tachi 7	1	Tachi 7	1				
Total Sets		17complete		8		4		1
		10u/c						
TOTAL RADAR DEFENSE POINTS		10		6				

(1) As of August 20, 1944.
(2) u/c indicates "under construction".
(3) S indicates Fire Control Radar for AA guns.
(4) L indicates Searchlight Control Radar.

(5) Consult page 7.29 for evaluation of table.

TABLE 3

STATISTICAL

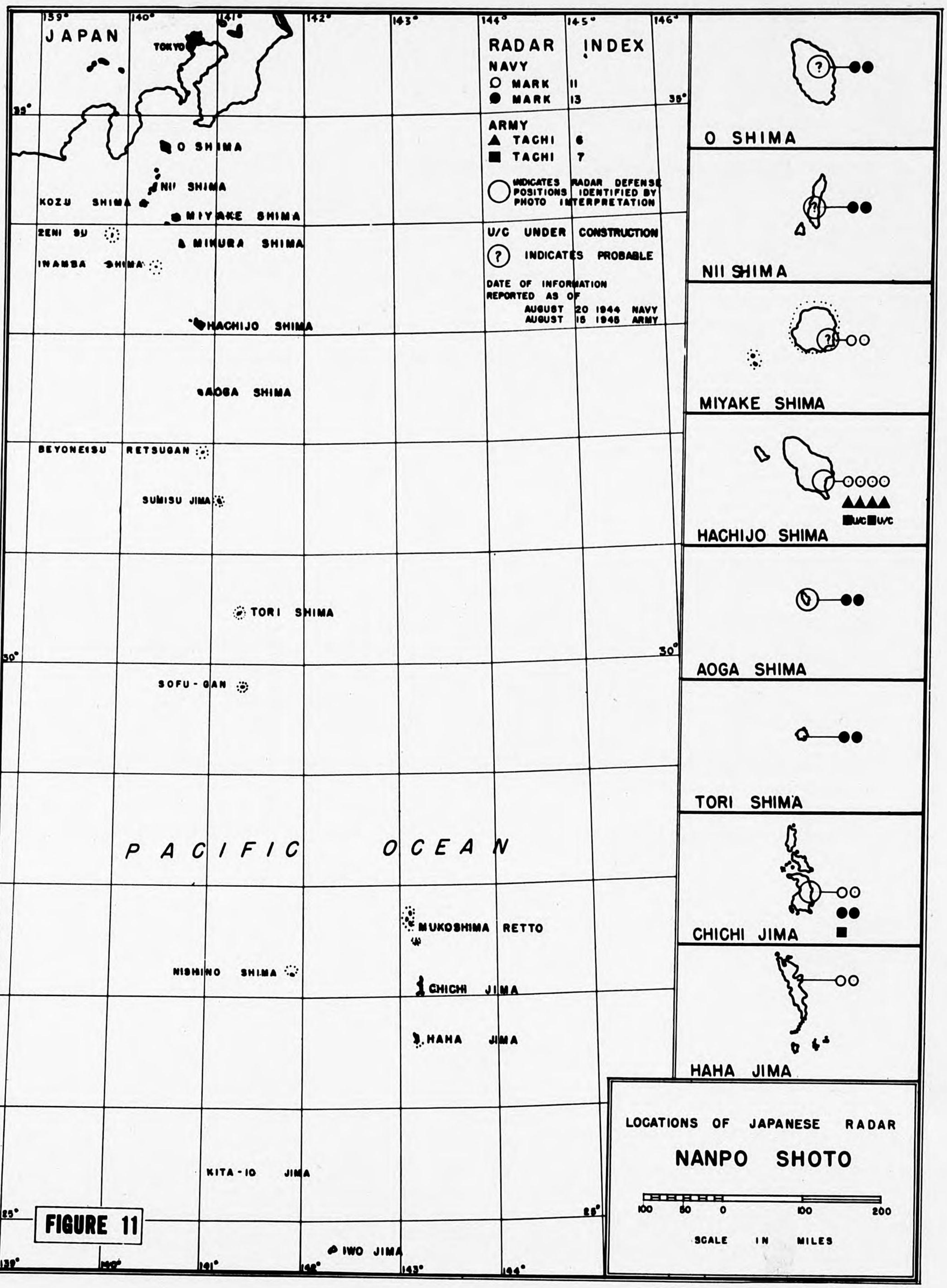


FIGURE 11

COMPARISON OF INTERPRON TWO RADAR INTERPRETATION WITH RADAR LOCATIONS REPORTED BY JAPANESE (8)
NANPO SHOTO

Location of Japanese Radar Defense Points	SEARCH RADAR				FIRE CONTROL RADAR.			
	Reported by Japanese (1)		Reported by Interpron Two		Reported by Japanese (1)		Reported by Interpron Two	
	Type	No. of Sets	Type	No.of Sets	Type.	No.of Sets	Type	No.of Sets
O SHIMA	Mk. 13	2	T.N.I. (2)	1? (3)				
NII SHIMA	Mk. 13	2	T.N.I.	2?				
MIYAKE SHIMA	Mk. 11	2	T.N.I.	1?				
HACHIJO SHIMA	Tachi 6	4	Tachi 6	2	S(4)	1	0	0
	Tachi 7	2u/c(5)	-	0				
	Mk. 11	2	Mk. 11	1?				
	Mk. 11	2	T.N.I.	1?				
AOGA SHIMA	Mk. 13	2	Mk. 13	1				
TORI SHIMA	Mk. 13	2	-	0				
CHICHI JIMA	Mk. 11	2	Mk. 11	2	S	1	S	2
	Mk. 13	2	-	0	L(6)	1	-	0
			Tachi 7	1(7)				
HAHA JIMA	Mk. 11	2	T.N.I.	1?				
Total Sets		24 complete		5 Definite		3		1
		2u/c		7 Probable				1(7)
				1(7)				
TOTAL RADAR DEFENSE POINTS		8		3 Definite				
				4 Prpoable				

(1) As of August 20, 1944.
(2) T.N.I. indicates "Type Not Identified".
(3) ? indicates "probable."
(4) S indicates Fire Control Radar for AA guns.
(5) u/c indicates "Under Construction"
(6) L indicates Searchlight Control Radar.
(7) Not listed by Japanese but photo evidence shows positive presence.
(8) Consult page 7.29 for evaluation of table.

TABLE 4

GENERAL ACCURACY OF INTERPRETATION

	Interpreted Correctly	Not Located	Interpreted Incorrectly
Fire Control Radar	69%	30%	1%
Searchlight Control Radar	1%	98%	1%
Searchlights	36%	60%	4%
Sound Locators	80%	20%	0%

TABLE 5

STATISTICAL

SUMMARY

COMPARISON OF INTERPRON TWO SEARCH RADAR INTERPRETATION WITH RADAR LOCATIONS REPORTED BY JAPANESE (1)

TEST AREA	NUMBER OF RADAR SETS		
	Reported by Japanese	Reported by Interpron Two	
		Number	Percent of Jap.
NANPO SHOTO	24	13	54.2%
NANSEI SHOTO	17	8	47.0%
SOUTHERN KYUSHU & WESTERN ISLANDS	55	19	34.5%
TOTAL	96	40	41.7%

TEST AREA	NUMBER OF RADAR DEFENSE POINTS		
	Reported by Japanese	Reported by Interpron Two	
		Number	Percent of Jap.
NANPO SHOTO	8	7	87.5%
NANSEI SHOTO	10	6	60.0%
SOUTHERN KYUSHU & WESTERN ISLANDS	18	10	55.5%
TOTAL	36	23	63.9%

EVALUATION OF RADAR INTERPRETATION BY TYPE OF SET			
TEST AREA	Total Sets Reported By Type	Sets for which Type Classification was correct	
		Number	Percent
NANPO SHOTO	6	6	100.0%
NANSEI SHOTO	8	8	100.0%
SOUTHERN KYUSHU & WESTERN ISLANDS	17	16	94.1%
TOTAL	31	30	96.8%

TABLE 6

(1) Summary does not include radar sets under construction. Sets reported as "probable" are included in Interpron 2 totals.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS AND RECOMMENDATIONS

1. General Conclusions

a. It is conceivable that electronics installations similar in appearance to the Japanese equipment used during the war will never again be the subject of photographic interpretation. Nevertheless, because they would be valuable in the future location, classification, and cataloging of all kinds of small installations it is believed that the techniques and procedures employed in electronics interpretation are worthy of study and perpetuation.

b. During the Pacific phase of the war photography was inadequate to do a complete job of identifying electronics installations.

(1) Coverage - Photographic missions were seldom requested for the purpose of finding radar installations, and unfortunately regular photography taken for damage assessment, airfield studies, etc., often omitted points on the coast line, and areas of comparatively rough or uninhabited land which frequently contained early warning radar installations.

(2) Scale - Photography of the scale usually available (1:9,000 - 1: 15,000), was adequate for interpretation of most radar types only when it was sharp and clear. Larger scale photographs are necessary for consistently accurate interpretation, especially for certain types of camouflaged radar, and for new types about which there is no knowledge from other sources. The usual scales, therefore, should be supplemented by special photographic runs whenever necessary.

(3) Quality - In general the quality of aerial photography was good. There were many instances, however, in which better quality photographs would have permitted a positive instead of a "probable" or "possible" interpretation.

c. In addition to the limitations of photography, the organization of electronics work was inadequate to perform a complete job.

(1) Coordination of effort - Activities of various units working on the electronics phases of intelligence were not sufficiently coordinated. Until near the end of the war many were not aware of the contributions which photographic intelligence was able to make to electronics intelligence. Before work on the sample area (Figs 9-11) was started as a definite project, only haphazard efforts toward locating electronics installations in Japanese held territory were made. Greater efficiency would have resulted had work been concentrated, when required in specific areas, by coordinating photographic coverage with RCM reconnaissance.

(2) Insufficient personnel - Because interpreters trained in electronics interpretation were not present in sufficient numbers, the volume of photographs taken during the last three months of the war was much greater than could be adequately screened by available personnel.

2. Factors which Improved the Efficiency of Electronics Interpretation

a. Distribution of training and reference material - A noticeably increased efficiency in electronics interpretation was observed by the spring of 1944. Prior to that time, information on the appearance of Japanese radar, and other radar features was scanty. The capture of sets on Kiska, Guadalcanal and Tarawa provided a basis for the development of intelligence material, and subsequently electronics training and reference reports were made available to all interpreters in useful form. This resulted in a considerable increase in the discovery rate of radar sets and suspected new types.

b. Collaboration with defense section - Close collaboration existed between the electronics section and the defense section. All fire control radar, searchlights, searchlight control radar, and sound locators were reported on flak maps. Photography was exchanged with the defense section and frequent conferences were held. Such collaboration was very helpful because of the resulting additional screening and double checking.

CONCLUSIONS AND RECOMMENDATIONS

c. Central electronics files - An orderly filing system was developed for all electronics reports, magazines, documents, photographs of typical installations, and other information related to electronics. Suspected radar locations were plotted on maps which were displayed prominently for the use of all interpreters. This system increased the number of sets confirmed because it encouraged all interpreters to check areas containing suspected installations.

d. Research - Research was conducted concurrently with reporting. The wide distribution given electronics target photographs and reports, developed from the research phase, resulted in speeding the acquisition of intelligence from other sources, and encouraged coordination of radar intelligence work.

3. Recommendations

a. Stereo-oblique photographs - The use of two cameras for taking simultaneously exposed stereo-oblique photographs from fast, low-flying planes is recommended to aid in the interpretation of electronics installations.

b. Dissemination - Electronics target photographs, or a similar method of standard presentation, is recommended for reporting electronics intelligence for operational use. An overall system for providing target numbers, target lists, briefing information, and methods for distributing and cataloging electronics intelligence is of great value and should be a part of any future program.

c. Coordination - Coordination of efforts in all electronics intelligence work is strongly recommended. This was never fully realized during the war against Japan. Although the uncertainties of the future make it impossible to recommend any program of work flow that will be applicable in all cases, the basic principles of coordination with other intelligence agencies, and organization of photographic interpreters along geographic and specialist lines should be embodied in future work flow procedures.

EXHIBIT A

CHRONOLOGICAL SUMMARIES OF INSTALLATION OF JAPANESE RADAR

1. At the request of the Photographic Intelligence Section, USSBS, the Japanese Army and Navy each submitted a chronological summary of the geographical distribution of various types of radar. While all the information contained is not directly applicable to an evaluation of photographic intelligence, it is felt that it will be of general interest to those concerned with Japanese radar. In addition to the summaries included here, the Japanese Navy listed dates of construction of sets sited in Kyushu. These are shown on location map Fig 9. The Japanese Army could not provide any definite dates for any area.

2. The information furnished is known to be inexact as to some details since conditions on the remote islands were generally unknown to Tokyo officials. An example of this is the fact that although no radar is listed for the Gilbert Islands, two Mark IIs were found on Tarawa. Despite these shortcomings the general trends in radar development are believed to be correct. Paragraphs 3, 4 and 5 are free translations of the subject summaries.

3. *"Periods of Establishment of Japanese Navy Radar outside Japan Proper."* Prepared by Lt. Cmdr. Mori - Japanese Imperial Navy.

July 1943 .....Rabaul area installations established. Intention was to establish more stations in Solomons but operations of war prevented accomplishment. Prior to this time, only experimental sets were in use.

November 1943.....Installations started in Marshalls, Carolines and Marianas with emphasis on the Marshalls These were all Mk11s and Mk12s and, with the exception of captured islands, were completed in March 1944.

March 1944.....All Mk11 and Mk13 equipment intended for Solomons was redirected to the central Pacific islands and installed there. After March 1944 Mk11 and Mk12 equipment went to Malaya, Java and the Phillipines.

After July 1944.Mk13 equipment went to Phillipines and Malaya. Supply to former interrupted by U.S. invasion.

Early 1944.....S3 sets sent to Rabaul, Hainan and Nichols Field. Of the many sent out, only these three sets were placed in operation. After the U.S. occupation of the Marshalls, much of the equipment destined for those islands went to Wake Island.

August 1944...Intensive effort made in Okinawa, Kyushu, Formosa and Japan proper. Prior to this time there had been only 4 installations in Kanto area.

Formosa.....40 percent of equipment by January 1945. 100 percent by May 1945.

Okinawa-Ryukyus..50 percent by January 1945. 100 percent by April 1945.

Mainland.....70 percent to January 1945 (including off-shore islands). 100 percent by August 1945.

Kuriles.....Mark 11, only, started November 1943. 100 percent by January 1945.

PHOTOGRAPHIC INTELLIGENCE — ELECTRONICS

EXHIBIT A

Gilberts.....No radar establishments. Probably used H-6 airborne, adapted locally to land-based use. **(Ed. note: this is known to be an error).**

4. Periods of Establishment of Army Search Radar on Mainland of Japan. **Prepared by Lt. Colonel Tominaga, Imperial General Staff.**

1st Period...A fixed "radio detector" was installed at Choshi but was in an experimental stage and could not be put to practical use.

2nd Period...In summer of 1942, tools and materials became available for construction of "radio detectors" to defend Kyushu. The installations were almost completed by the summer of 1943.

3rd Period...Since the summer of 1943 "radio detectors" were installed in places not included in the 2nd period. By April 1944 installations were almost completed.

4th Period...In July 1944 "radio detectors" were installed in Korea and Okinawa.

5th Period...In May 1945 the second watch-line of the mainland and the Japan Sea coast were strengthened.

5. Periods of Establishment of Army Fire Control Radar on Mainland of Japan. **Prepared by Lt. Colonel Tominaga, Imperial General Staff.**

"Radio-locators" on the mainland of Japan were delivered to anti-aircraft units of ground forces in the east, central and west areas. Production of radio-locators to be installed in the above mentioned areas was started in the beginning of 1944 but did not get into full swing until the fall of 1944.

UNITED STATES STRATEGIC BOMBING SURVEY

European War

LIST OF REPORTS

The following list of studies is a bibliography of completed reports resulting from the German survey. Reports numbers 1, 2, and 3 can be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. Permission to examine the remaining reports may be had by writing to the headquarters of the Survey at Gravelly Point, Washington 25, D. C.

1 The United States Strategic Bombing Survey: Summary Report (European War)
2 The United States Strategic Bombing Survey: Over-all Report (European War)
3 The Effects of Strategic Bombing on the German War Economy

AIRCRAFT DIVISION

(By Division and Branch)

4 Aircraft Division Industry Report
5 Inspection Visits to Various Targets (Special Report)

Airframes Branch

6 Junkers Aircraft and Aero Engine Works, Dessau, Germany
7 Erla Maschinenwerke G m b H, Heiterblick, Germany
8 A T G Maschinenbau, G m b H, Leipzig (Mockau), Germany
9 Gothaer Waggonfabrik, A G, Gotha, Germany
10 Focke Wulf Aircraft Plant, Bremen, Germany
11. Messerschmitt A G, Augsburg, Germany — Over-all Report; Part A; Part B; Appendices I, II, III
12 Dornier Works, Friedrichshafen & Munich, Germany
13 Gerhard Fieseler Werke G m b H, Kassel, Germany
14 Wiener Neustaedter Flugzeugwerke, Wiener Neustadt, Austria

Aero Engines Branch

15 Bussing NAG Flugmotorenwerke G m b H, Brunswick, Germany
16 Mittel-Deutsche Motorenwerke G m b H, Taucha, Germany
17 Bavarian Motorworks Inc, Eisenach & Durrenhof, Germany
18 Bayerische Motorenwerke A G (BMW) Munich, Germany
19 Henschel Flugmotorenwerke, Kassel, Germany

Light Metal Branch

20 Light Metals Industry of Germany. — Part I, Aluminum; Part II, Magnesium
21 Vereinigte Deutsche Metallwerke, Hildesheim, Germany
22 Metallgussgesellschaft G m b H, Leipzig, Germany
23 Aluminiumwerk G m b H, Plant No. 2, Bitterfeld, Germany
24 Gebrueder Giulini G m b H, Ludwigshafen, Germany
25 Luftschiffbau Zeppelin G m b H, Friedrichshafen on Bodensee, Germany
26 Wieland Werke A G, Ulm, Germany
27 Rudolph Rautenbach Leichtmetallgiessereien. Solingen, Germany
28 Lippewerke Vereinigte Aluminiumwerke A G, Lunen, Germany
29 Vereinigte Deutsche Metallwerke, Heddernheim, Germany
30 Duerener Metallwerke A G, Duren Wittenau-Berlin & Waren, Germany

AREA STUDIES DIVISION

31 Area Studies Division Report
32 A Detailed Study of the Effects of Area Bombing on Hamburg
33 A Detailed Study of the Effects of Area Bombing on Wuppertal
34 A Detailed Study of the Effects of Area Bombing on Dusseldorf
35 A Detailed Study of the Effects of Area Bombing on Solingen
36 A Detailed Study of the Effects of Area Bombing on Remscheid
37 A Detailed Study of the Effects of Area Bombing on Darmstadt
38 A Detailed Study of the Effects of Area Bombing on Lubeck
39 A Brief Study of the Effects of Area Bombing on Berlin, Augsburg, Bochum, Leipzig, Hagen, Dortmund, Oberhausen, Schweinfurt, and Bremen

CIVILIAN DEFENSE DIVISION

40 Civilian Defense Division—Final Report
41 Cologne Field Report
42 Bonn Field Report
43 Hanover Field Report
44 Hamburg Field Report—Vol I, Text; Vol II, Exhibits
45 Bad Oldesloe Field Report
46 Augsburg Field Report
47 Reception Areas in Bavaria, Germany

EQUIPMENT DIVISION

Electrical Branch

48 German Electrical Equipment Industry Report
49 Brown Boveri et Cie, Mannheim Kafertal, Germany

Optical and Precision Instrument Branch

50 Optical and Precision Instrument Industry Report

Abrasives Branch

51 The German Abrasive Industry
52 Mayer and Schmidt, Offenbach on Main, Germany

Anti-Friction Branch

53 The German Anti-Friction Bearings Industry

Machine Tools Branch

54 Machine Tools & Machinery as Capital Equipment
55 Machine Tool Industry in Germany
56 Herman Kolb Co, Cologne, Germany
57 Collet and Engelhard, Offenbach, Germany
58 Naxos Union, Frankfort on Main, Germany

MILITARY ANALYSIS DIVISION

59 The Defeat of the German Air Force
60 V-Weapons (Crossbow) campaign
61 Air Force Rate of Operation
62 Weather Factors in Combat Bombardment Operations in the European Theatre
63 Bombing Accuracy, USAAF Heavy and Medium Bombers in the ETO
64 Description of RAF Bombing

MORALE DIVISION

Medical Branch

65 The Effect of Bombing on Health and Medical Care in Germany

MUNITIONS DIVISION

Heavy Industry Branch

66 The Coking Industry Report of Germany
67 Coking Plant Report No. 1, Sections A, B, C, & D
68 Gutehoffnungshuette, Oberhausen, Germany
69 Friedrich-Alfred Hutte, Rheinhausen, Germany
70 Neunkirchen Eisenwerke A G, Neunkirchen, Germany
71 Reichswerke Hermann Goering A G, Hallendorf, Germany
72 August Thyssen Huette A G, Hamborn, Germany
73 Friedrich Krupp A G, Borbeck Plant, Essen, Germany
74 Dortmund Hoerder Huettenverein, A G, Dortmund, Germany
75 Hoesch A G, Dortmund, Germany
76 Bochumer Verein fuer Gusstahlfabrikation A G, Bochum, Germany

Motor Vehicles and Tanks Branch

77 German Motor Vehicles Industry Report
78 Tank Industry Report
79 Daimler Benz A G, Unterturkheim, Germany
80 Renault Motor Vehicles Plant, Billancourt, Paris
81 Adam Opel, Russelheim, Germany
82 Daimler Benz-Gaggenau Works, Gaggenau, Germany
83 Maschinenfabrik Augsburg-Nurnberg, Nurnberg, Germany
84 Auto Union A G, Chemnitz and Zwickau, Germany
85 Henschel and Sohn, Kassel, Germany
86 Maybach Motor Works, Friedrichshafen, Germany
87 Voigtlander Maschinenfabrik A G, Plauen, Germany
88 Volkswagenwerke, Fallersleben, Germany
89 Bussing NAG, Brunswick, Germany
90 Muehlenbau Industrie A G (Miag) Brunswick, Germany
91 Friedrich Krupp Grusonwerke, Magdeburg, Germany

Submarine Branch

92 German Submarine Industry Report
93 Maschinenfabrik Augsburg-Nurnberg A G, Augsburg, Germany
94 Blohm and Voss Shipyards, Hamburg, Germany
95 Deutschewerke A G, Kiel, Germany
96 Deutsche Schiff und Maschinenbau, Bremen, Germany
97 Friedrich Krupp Germaniawerft, Kiel, Germany
98 Howaldtswerke A G, Hamburg, Germany
99 Submarine Assembly Shelter, Farge, Germany
100 Bremer Vulkan, Vegesack, Germany

Ordnance Branch

101 Ordnance Industry Report
102 Friedrich Krupp Grusonwerke A G, Magdeburg, Germany
103 Bochumer Verein fuer Gusstahlfabrikation A G, Bochum, Germany
104 Henschel and Sohn, Kassel, Germany
105 Rheinmetall-Borsig, Dusseldorf, Germany
106 Hermann Goering Werke, Braunschweig, Hallendorf, Germany
107 Hannoverische Maschinenbau, Hanover, Germany
108 Gusstahlfabrik Friedrich Krupp, Essen, Germany

OIL DIVISION

109 Oil Division Final Report
110 Oil Division Final Report, Appendix
111 Powder, Explosives, Special Rockets and Jet Propellants, War Gases and Smoke Acid (Ministerial Report #1)
112 Underground and Dispersal Plants in Greater Germany
113 The German Oil Industry, Ministerial Report Team 78
114 Ministerial Report on Chemicals

Oil Branch

115 Ammoniakwerke Merseburg G m b H, Leuna, Germany—2 appendices
116 Braunkohle Benzin A G, Zeitz and Bohlen, Germany
Wintershall A G, Luetzkendorf, Germany
117 Ludwigshafen-Oppau Works of I G Farbenindustrie A G, Ludwigshafen, Germany
118 Ruhroel Hydrogenation Plant, Bottrop-Boy, Germany, Vol I, Vol II
119 Rhenania Ossag Mineraloelwerke A G, Harburg Refinery, Hamburg, Germany
120 Rhenania Ossag Mineraloelwerke A G, Grassbrook Refinery, Hamburg, Germany
121 Rhenania Ossag Mineraloelwerke A G, Wilhelmsburg Refinery, Hamburg, Germany
122 Gewerkschaft Victor, Castrop-Rauxel, Germany, Vol I & Vol II
123 Europaeische Tanklager und Transport A G. Hamburg, Germany
124 Ebano Asphalt Werke A G, Harburg Refinery, Hamburg, Germany
125 Meerbeck Rheinpreussen Synthetic Oil Plant—Vol I & Vol II

Rubber Branch

126 Deutsche Dunlop Gummi Co., Hanau on Main, Germany
127 Continental Gummiwerke, Hanover, Germany
128 Huels Synthetic Rubber Plant
129 Ministerial Report on German Rubber Industry

Propellants Branch

130 Elektro Chemischewerke, Munich, Germany
131 Schoenebeck-Explosive Plant, Lignose Sprengstoff Werke G m b H, Bad Salzemen, Germany
132 Plants of Dynamit A G, Vormal, Alfred Nobel & Co, Troisdorf, Clausthal, Drummel and Duneberg, Germany
133 Deutsche Sprengchemie G m b H, Kraiburg, Germany

OVERALL ECONOMIC EFFECTS DIVISION

134 Overall Economic Effects Division Report
Gross National Product
Kriegs Eil Berichte
Herman Goering Works
Food and Agriculture
} Special papers which together comprise the above report

PHYSICAL DAMAGE DIVISION

135 Villacoublay Airdrome, Paris, France
136 Railroad Repair Yards, Malines, Belgium
137 Railroad Repair Yards, Louvain, Belgium
138 Railroad Repair Yards, Hasselt, Belgium
139 Railroad Repair Yards, Namur, Belgium
140 Submarine Pens, Brest, France

141 Powder Plant, Angouleme, France
142 Powder Plant, Bergerac, France
143 Coking Plants, Montigny & Liege-Belgium
144 Fort St. Blaise Verdun Group, Metz, France
145 Gnome et Rhone, Limoges, France
146 Michelin Tire Factory, Clermont-Ferrand, France
147 Gnome et Rhone Aero Engine Factory, Le Mans, France
148 Kugelfisher Bearing Ball Plant, Ebelspach, Germany
149 Louis Breguet Aircraft Plant, Toulouse, France
150 S. N. C. A. S. E. Aircraft Plant, Toulouse, France
151 A. I. A. Aircraft Plant, Toulouse, France
152 V Weapons in London
153 City Area of Krefeld
154 Public Air Raid Shelters in Germany
155 Goldenberg Thermal Electric Power Station, Knapsack, Germany
156 Brauweiler Transformer & Switching Station, Brauweiler, Germany
157 Storage Depot, Nahbollenbach, Germany
158 Railway and Road Bridge, Bad Munster, Germany
159 Railway Bridge, Eller, Germany
160 Gustloff-Werke Weimar, Weimar, Germany
161 Henschel and Sohn G m b H, Kassel, Germany
162 Area Survey at Pirmasens, Germany
163 Hanomag, Hanover, Germany
164 M A N Werke Augsburg, Augsburg, Germany
165 Friedrich Krupp A G, Essen, Germany
166 Erla Maschinenwerke, G m b H, Heiterblick, Germany
167 A T G Maschinenbau G m b H, Mockau, Germany
168 Erla Maschinenwerke G m b H, Mockau, Germany
169 Bayerischa Motorenwerke Durrerhoff, Germany
170 Mittel-Deutsche Motorenwerke G m b H, Taucha, Germany
171 Submarine Pens Deutsche-Werft, Hamburg, Germany
172 Multi-Storied Structures, Hamburg, Germany
173 Continental Gummiwerke, Hanover, Germany
174 Kassel Marshalling Yards, Kassel, Germany
175 Ammoniskwerke, Mersburg-leuna, Germany
176 Brown Boveri et Cie, Mannheim, Kafertal, Germany
177 Adam Opel A G, Russelheim, Germany
178 Daimler-Benz A G, Unterturkheim, Germany
179 Valentin Submarine Assembly, Farge, Germany
180 Volkswaggonwerke, Fallersleben, Germany
181 Railway Viaduct at Bielefeld, Germany
182 Ship Yards Howaldtswerke, Hamburg, Germany
183 Blohm and Voss Shipyards, Hamburg, Germany
184 Daimler-Benz A G, Mannheim, Germany
185 Synthetic Oil Plant, Meerbeck-Hamburg, Germany
186 Gewerkschaft Victor, Castrop-Rauzel, Germany
187 Klockner Humblolt Deutz, Ulm, Germany
188 Ruhroel Hydrogenation Plant, Bettrop-Boy, Germany
189 Neukirchen Eisenwereke A G, Neukirchen, Germany
190 Railway Viaduct at Altenbecken, Germany
191 Railway Viaduct at Arnsburg, Germany
192 Deurag-Nerag Refineries, Misburg, Germany
193 Fire Raids on German Cities
194 I G Farbenindustrie, Ludwigshafen, Germany, Vol I & Vol II
195 Roundhouse in Marshalling Yard, Ulm, Germany
196 I G Farbenindustrie, Leverkusen, Germany
197 Chemische-Werke, Huels, Germany
198 Gremberg Marshalling Yard, Gremberg, Germany
199 Locomotive Shops and Bridges at Hamm, Germany

TRANSPORTATION DIVISION

200 Transportation Division Report
201 Rail Operations Over the Brenner Pass
202 Effects of Bombing on Railroad Installations in Regensburg, Nurnberg and Munich Divisions.
203 German Locomotive Industry During the War
204 Wehrmacht Traffic Over the German Railroads

UTILITIES DIVISION

205 German Electric Utilities Industry Report
206 1 to 10 in Vol I "Utilities Division Plant Reports"
207 11 to 20 in Vol II "Utilities Division Plant Reports"
208 21 Rheinische-Westfalische Elektrizitatswerk A G