

RESTRICTED

THE UNITED STATES
STRATEGIC BOMBING SURVEY

(Pacific)

**Evaluation of
Photographic Intelligence
in the Japanese Homeland**

**PART FIVE
CAMOUFLAGE,
CONCEALMENT, AND DECEPTION**

PHOTOGRAPHIC INTELLIGENCE SECTION

RESTRICTED

RESTRICTED

THE UNITED STATES
STRATEGIC BOMBING SURVEY

(Pacific)

**Evaluation of
Photographic Intelligence
in the Japanese Homeland**

**PART FIVE
CAMOUFLAGE,
CONCEALMENT, AND DECEPTION**

PHOTOGRAPHIC INTELLIGENCE SECTION

Dates of Survey:

7 October 1945 through 15 March 1946

JUNE 1946

RESTRICTED

RESTRICTED

F O R E W O R D

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 determining 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. Hitzo,

Henry C. Alexander, Vice-Chairmen.

Walter Wilos, Secretary.

Harry L. Bowman,

J. K. Galbraith,

Rensis Likert,

Frank A. McNamee,

Fred Searls, Jr.,

Monroe Spaght,

Dr. Louis K. 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.

RESTRICTED

I INTRODUCTION; - II CAMOUFLAGE

I INTRODUCTION

1. During most of world war II the subjects of camouflage, concealment, (defined here as underground construction), and deception (the use of decoys and dummies) were not special fields of photographic interpretation. Instead they were treated in a routine manner as they occurred in relation to standard subjects of reporting, i.e., airfields, shipping, industry, etc., and were not considered particularly troublesome or significant. However, when the aerial bombardment of Japan forced the Japanese to disperse vital military and industrial facilities, the detection of efforts toward camouflage and concealment suddenly became important. The war ended before Japanese attempts to hide essential targets assumed any great operational significance, but the threat implied to the effectiveness of photographic interpretation caused much speculation on the future usefulness of photographs as an intelligence source.

2. In order to answer the questions thus raised photographic interpreters attached to the United States Strategic Bombing Survey studied Japanese camouflage, concealment, and deception in the field. Due to the lack of any special reporting procedure for this type of interpretation, very little published photographic intelligence material was available for checking, and consequently the following evaluation is largely qualitative in nature.

3. All considerations of Japanese methods in this report are made strictly on the basis of their effectiveness in confusing the photographic interpreter. Some techniques of camouflage, concealment, and deception which did not greatly confuse the interpreters may have been effective in confusing an attacking pilot or bombardier.

II CAMOUFLAGE

1. Judging from the detailed efforts of the Japanese to camouflage installations at their Pacific outposts, it was expected that relatively intensive camouflage measures would be encountered in Japan Proper. Actually, although some excellent work was done,

camouflage in the Home Islands was never used as comprehensively as it was by Germany. Apparently few Japanese officials responsible for carrying out camouflage measures thoroughly appreciated the appearance of their work from the air. Small installations were often camouflaged well, but airfields and industrial targets were dealt with on a piecemeal basis, presumably with no relation to an overall plan. Camouflage paint and garnished nets were the principal media used on large target areas, and neither of these caused the photographic interpreter much difficulty.

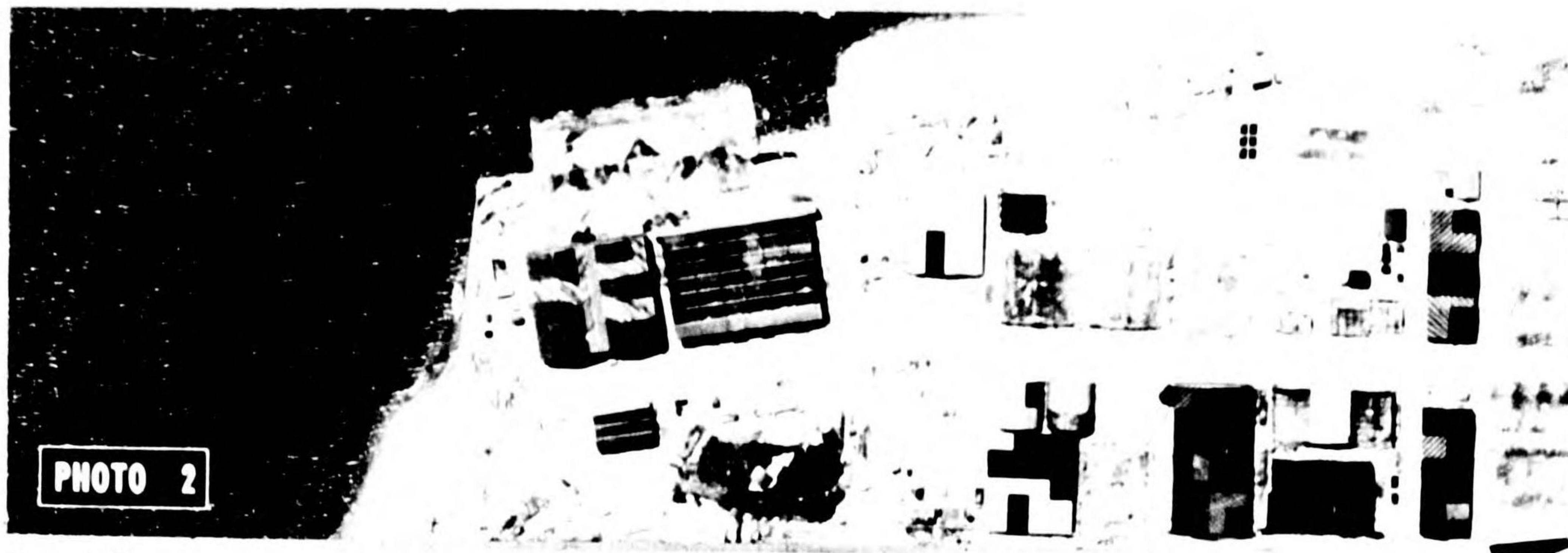
2. Use of Camouflage Paint

a. In terms of area covered, disruptive painting for the purpose of dazzling, or toning down, was the most commonly used Japanese camouflage method. In all of this work individual plant managers, airfield commanders, etc., were apparently held responsible for the camouflaging of facilities under their supervision without benefit of technical assistance or overall direction from outside sources. Consequently, disruptive painting was seldom planned to fit the pattern of the surrounding countryside or to match adjacent facilities. Factory buildings, oil tanks (Photo 1), airfield

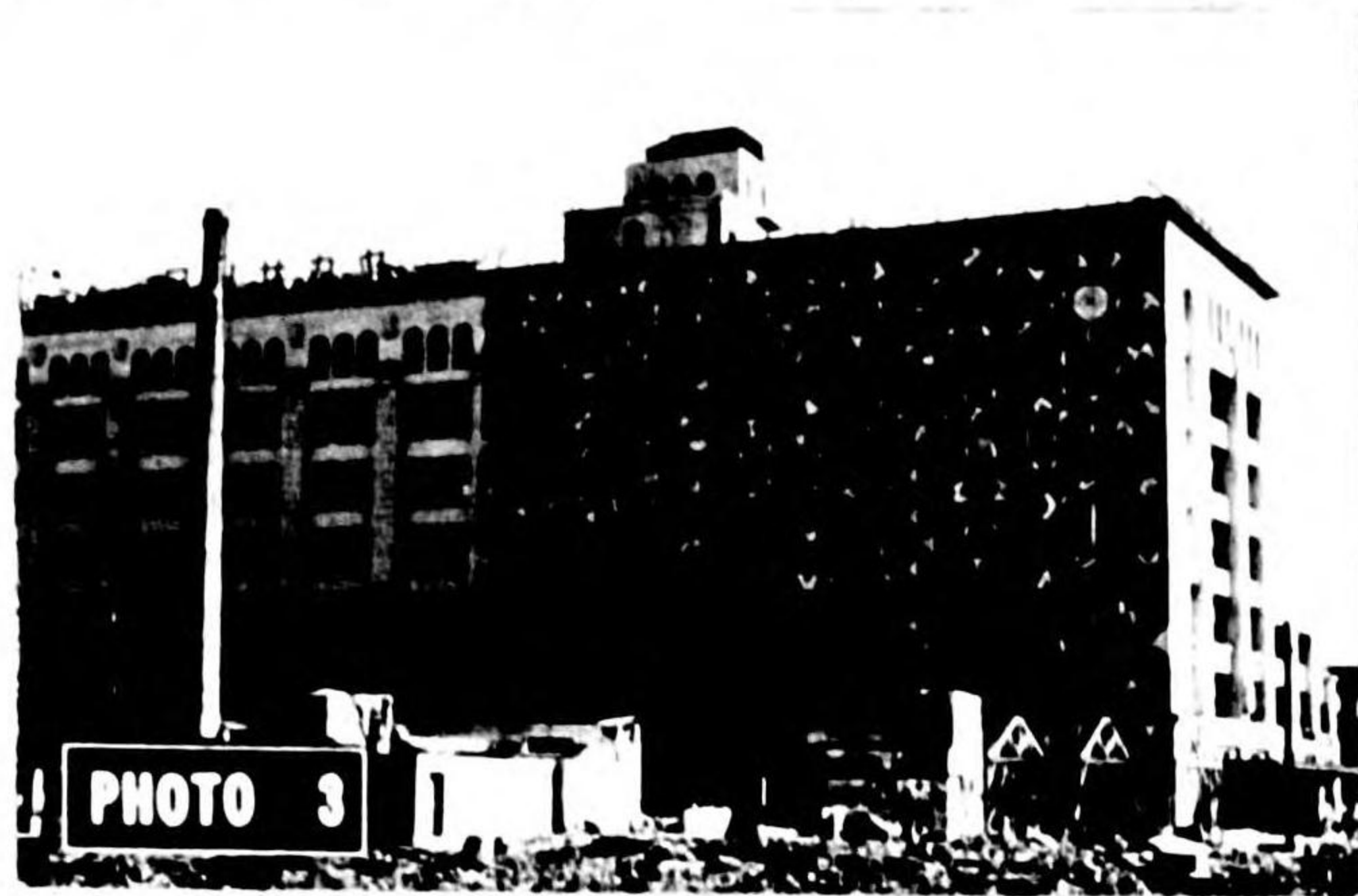


Partially painted tank farm near Kure.

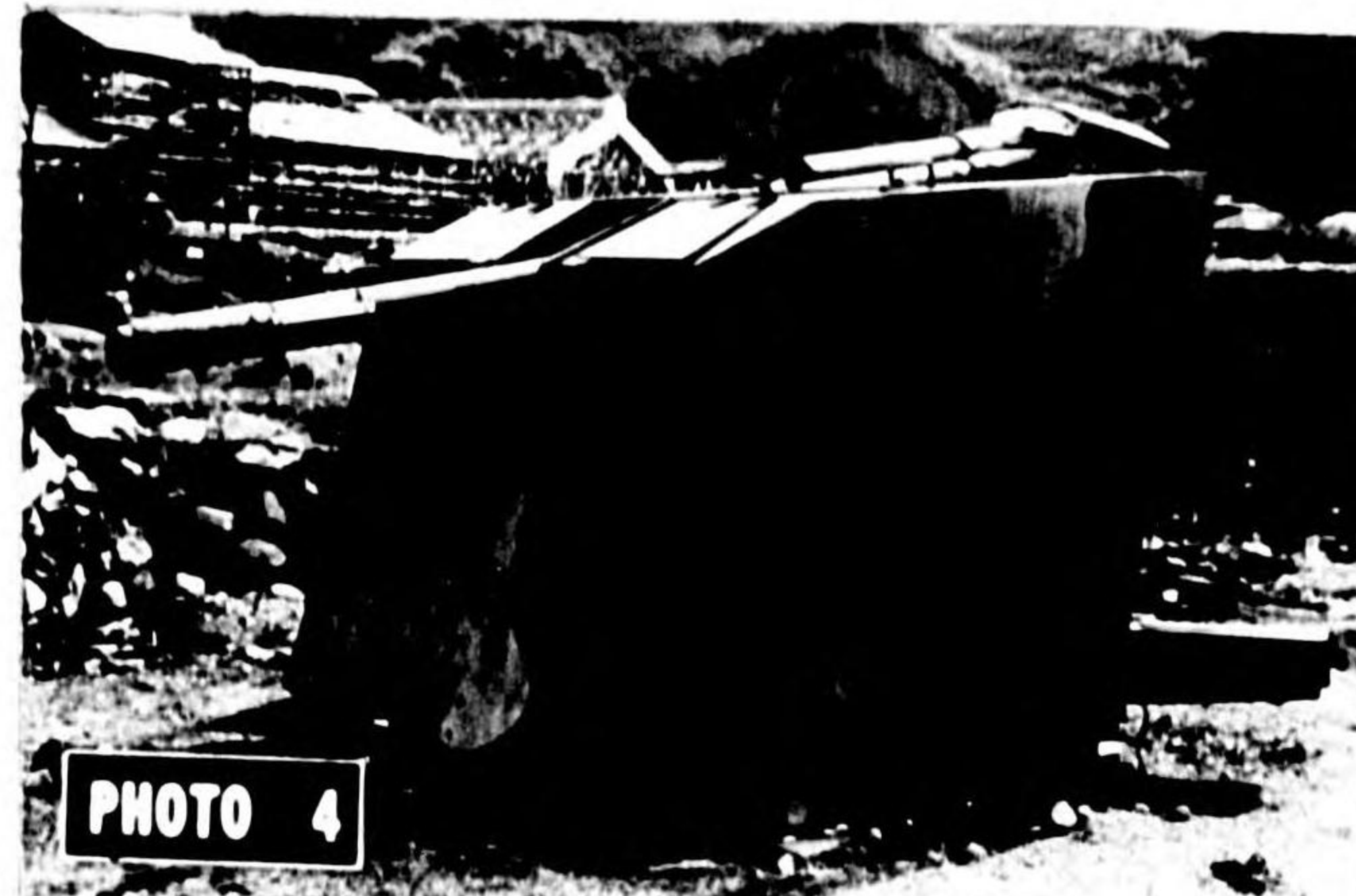
II CAMOUFLAGE



Disruptive painting of hangars and shops, Yokosuka Seaplane Base.



Disruptive painting of public building at Osaka.



Disruptively painted 88mm AA gun.



Dazzle painted runways, Ottawa A/F.

facilities (Photo 2), public buildings (Photo 3), and even individual AA guns (Photo 4) were disruptively painted, but in none of the cases checked had the painting technique caused the photographic interpreter much difficulty. In fact in some cases, such as the dazzle painting of runways at Ottawa Airfield (Photo 5), painting made outlines more distinct than if no attempt had been made to camouflage them. Similarly, the very

fact that an attempt had been made to camouflage a building or an installation indicated that the enemy considered it important.

3. Use of Standard Sod-Covered Dispersal Buildings

a. It is possible that some Japanese realized the tremendous cost and relative futility of attempting to camouflage large

II CAMOUFLAGE

pre-war targets. In any event their efforts were much more effective in the camouflaging of small dispersed plants constructed during the war. The standard dispersed type of plant (used primarily in the aircraft industry) consisted of a number of low arched wooden buildings of varying size up to 50 x 75 feet which were sited to take advantage of natural concealment, frequently in the lee of hills along narrow wooded valleys. Their color blended with the surrounding terrain and in most instances their roofs were sod covered. Although plants of this type were often used to assemble aircraft, there was rarely more than an unimproved road or a narrow gauge



Final assembly building, Atsugi A/F.

railway leading to them. In areas of adequate photography a number of these plants were detected, but their function usually was not correctly interpreted and they were generally reported simply as concentrations of warehouses.

b. Photographs 5-8 of an aircraft assembly plant located near Atsugi A/F illustrate a typical use of sod-covered buildings. At this plant main assembly operations were carried on in a row of buildings partially hidden in the trees at the



Three sub-assembly buildings, Atsugi A/F. base of a low ridge (Photo 6). Sub-assembly took place in smaller structures of the same type sited adjacent to farm buildings, and in tunnels dug into the ridge (Photos 7 and 8). Exhibit D presents a three dimensional view of the plant as it appeared from the air. Because there was a small landing strip located near these dispersal buildings, the entire group was reported as aircraft repair facilities.



Sub-assembly tunnel entrance, Atsugi A/F.

II CAMOUFLAGE

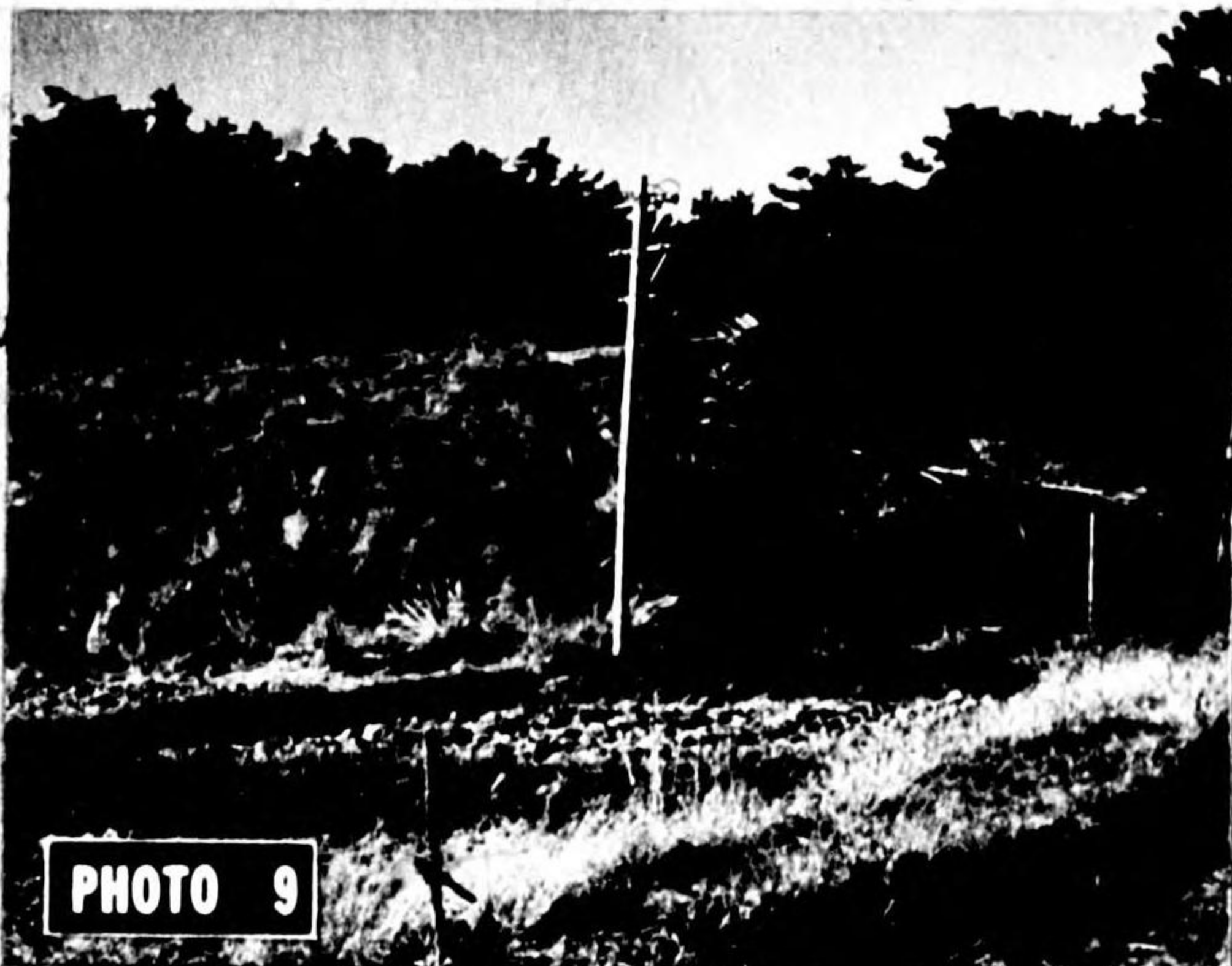


PHOTO 9

Assembly building, Kyushu Aircraft Co.



PHOTO 11

Sod covered barracks under construction west of Kawasaki.

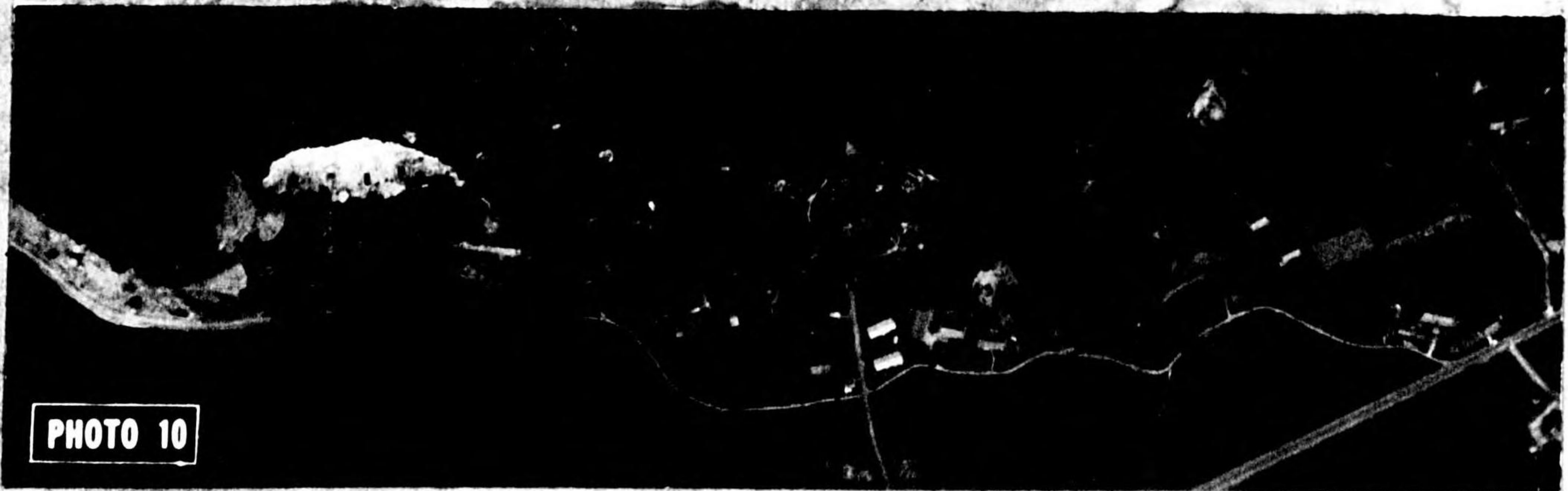


PHOTO 10

Aircraft Dispersal Plant, Kyushu Aircraft Co. Circled building shown in Photo 9.

c. A similar example of the use of sod-covered buildings is illustrated by Photos 9 and 10 showing the Fukuoka Seaplane Works of the Kyushu Aircraft Company at Kashii. Again sod-covered buildings were sited near a wooded ridge, and tunnels were being dug into the ridge itself. This development was detected but it was not reported because its function and importance were not recognized.

d. The difficulty in reporting the exact function of arch-roofed sod-covered buildings is indicated by Photo 11 which shows two Army barracks buildings similar in construction to those used as shops at many aircraft assembly plants. Usually the character of roads and paths leading to such buildings gave a clue concerning their function, but the appearance of the structure

itself did not. However, the standard pitch-roofed sod-covered barracks buildings illustrated in Photo 12 were consistently reported correctly as barracks because their function and appearance had been determined from ground surveys of facilities at captured Japanese Pacific outposts.

e. A number of small aircraft dispersal hangars (Photo 13) were both sod-covered and painted in disruptive patterns, but because of the easily detected taxiways which led to their entrances, no difficulty was experienced in identifying them.

4. Use of Nets, Garnishing and False Structures

a. Japanese use of the standard camouflage media of false structures and garnished nets or frames, although not

II CAMOUFLAGE

applied to installations as large as those camouflaged at German military posts or industrial plants, was in some instances very effective. This effectiveness naturally varied with the size of the installation camouflaged and with the understanding of the individual directing the work.

b. The most extensive use of garrisoned netting, in fact the most extensive Japanese camouflage effort of any kind, was directed toward the hiding of Naval units in the Kure area, where most of the carriers, a cruiser, and a few destroyers were moored

near land and partially concealed by nets strung between their decks and the shore (Photos 14-16 and Exhibit E). The outlines of a few of these vessels were further disrupted by false structures built over important elements of their superstructures. All camouflaged ships were successfully located and identified on aerial photographs. Target photographs prepared for US Carrier Task Forces by photographic intelligence units familiarized pilots with Japanese ship locations and nullified the potential effectiveness of camouflage during the Kure strikes of late July 1945.



PHOTO 12

Typical Army type barracks, Muroran.



PHOTO 13

Sod covered dispersal hangar, Atsugi A/F.



PHOTO 14

Cruiser Tone near Kure.



PHOTO 16

CVL Ryuho, near Kure. Inset indicates scale (1/60,000) at which PI's discovered carrier location.

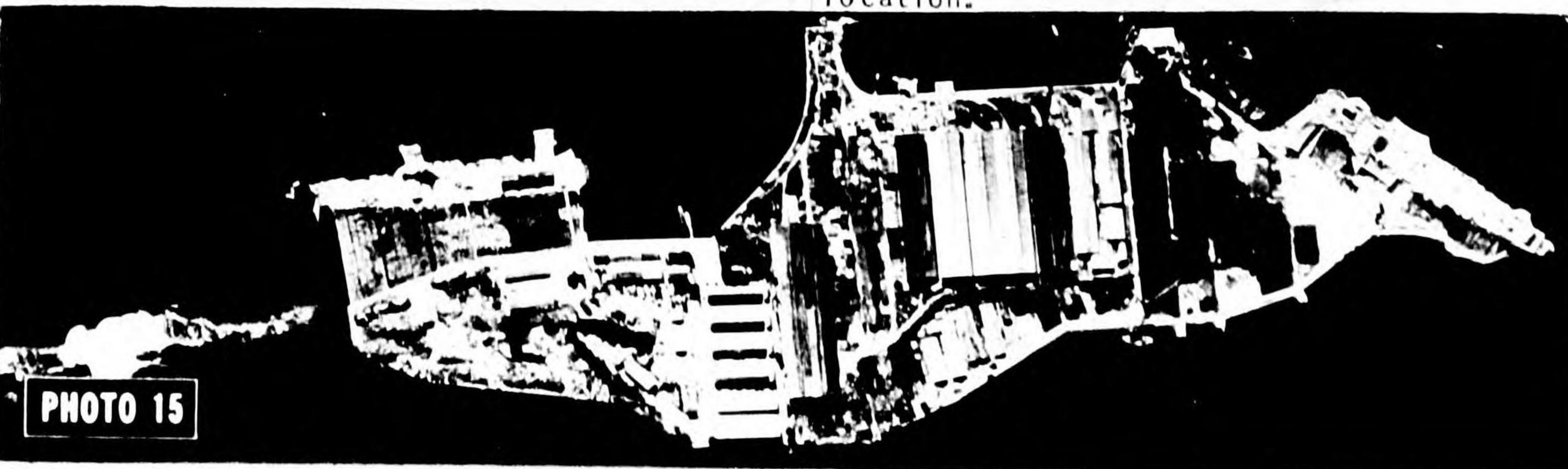


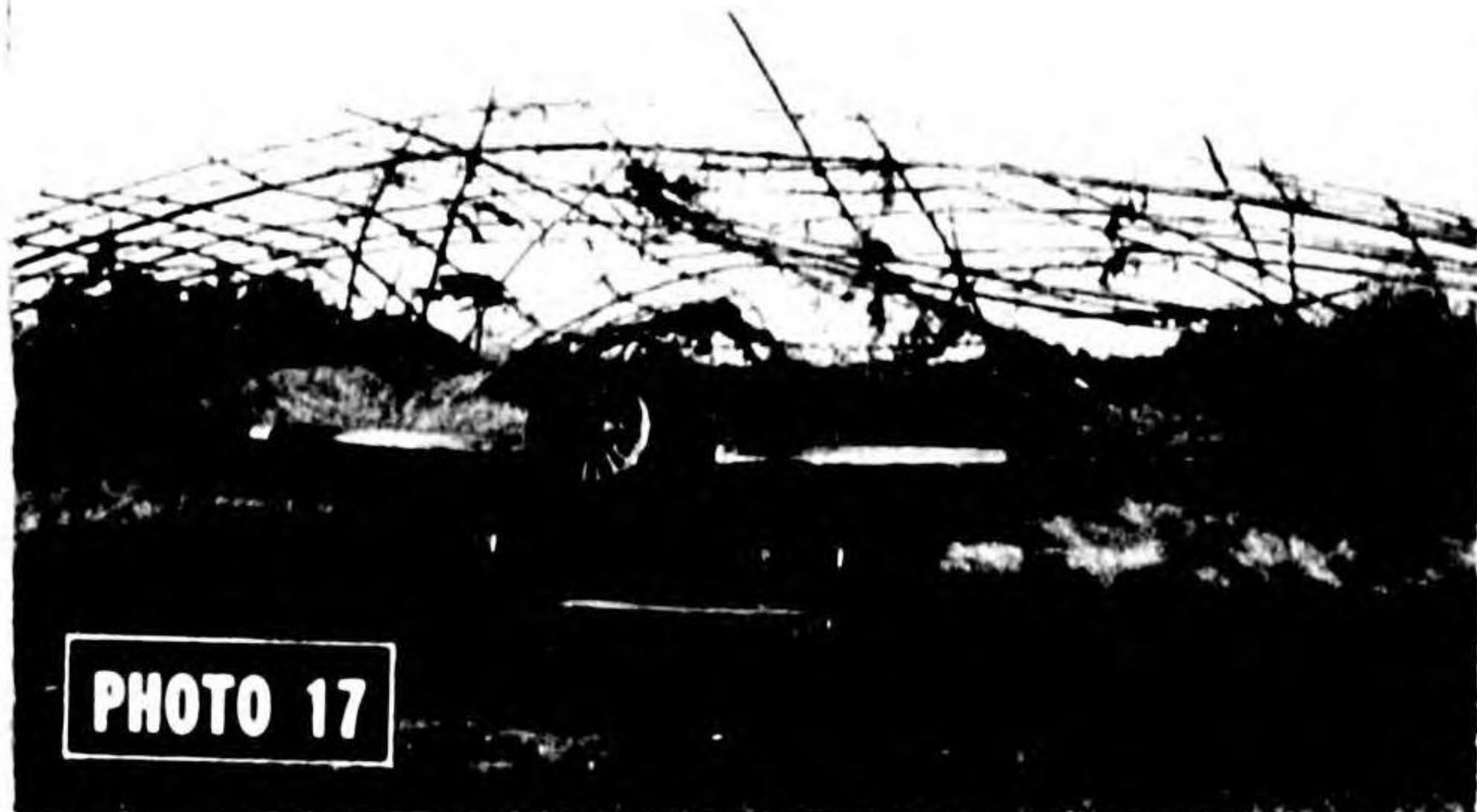
PHOTO 15

Mitsuko Jima near Kure showing the camouflaged carriers Amagi and Katsuragi.

II CAMOUFLAGE

c. Other fairly general uses of garnishing and false structures were in the covering of aircraft revetments, gun emplacements, and electronics installations. Garnished cover of aircraft revetments usually hid the planes within, but seldom concealed revetment locations (Photos 17 and 18). Similarly, in some instances of camouflaged gun emplacements (e.g., the 280mm howitzer battery illustrated by Photos 19 and 20), although the garnished framing was visible

on aerial photographs, interpreters could not identify the installations underneath. A large percentage of the examples of guns camouflaged with nets or framing, however, caused little or no difficulty (Photos 21 and 22). Generally speaking, all efforts to camouflage heavy AA positions met with limited success because (a) even though the guns themselves were occasionally obscured, the pattern of battery layout was usually still plainly visible on aerial photographs,



Fighter revetment, with garnishing stripped off bamboo framework, Fujisawa A/F.



Revetments covered with garnished framings, Fujisawa A/F. Circled revetment shown on Photo 17.



280mm howitzer battery, outer harbor Nagasaki.



Interior of ammunition track, howitzer battery, Nagasaki.

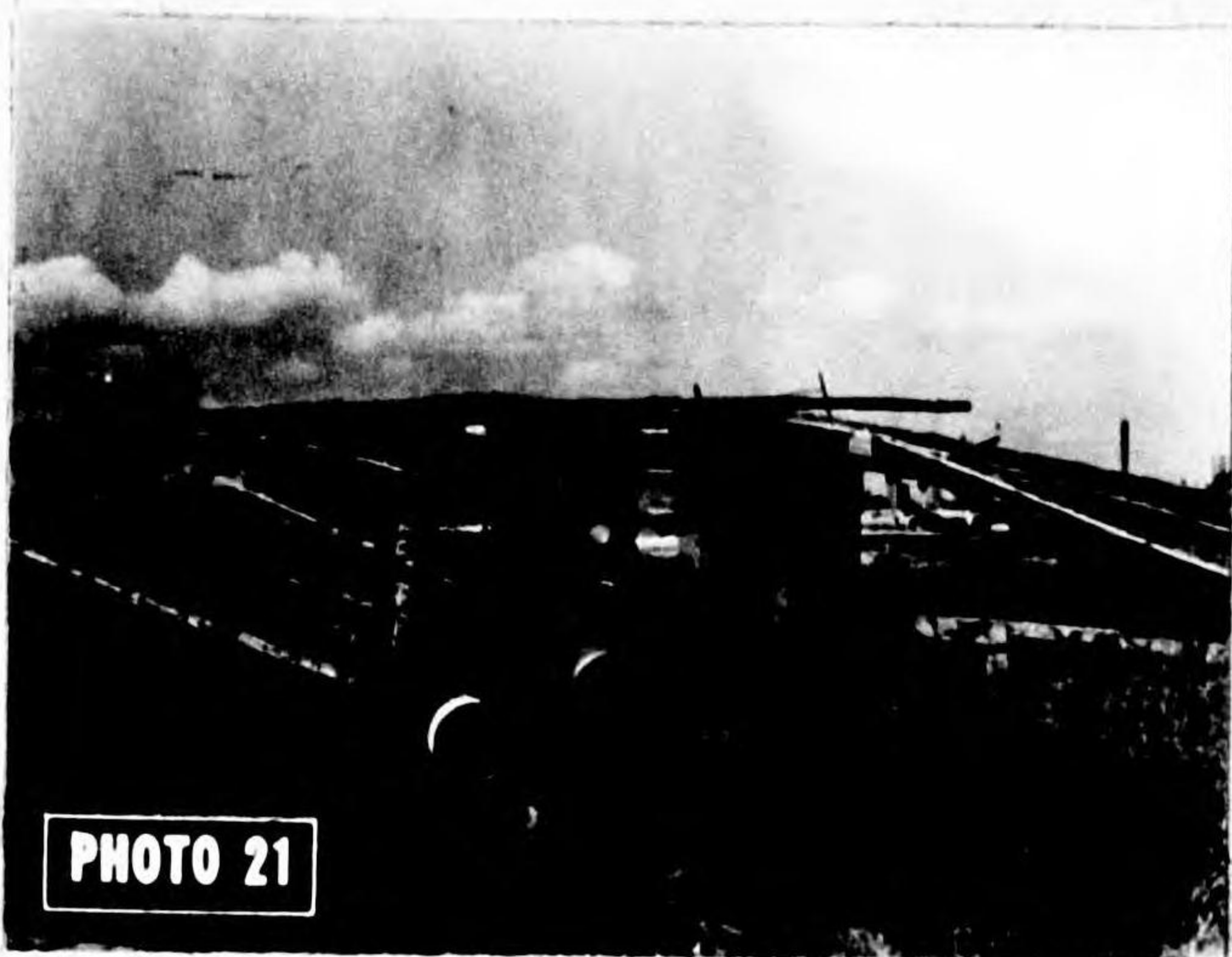
II CAMOUFLAGE

(L) theneed for free movement of guns during firing restricted camouflage types to framing that could be quickly removed, and (c) when framing was removed for firing, guns were clearly visible on good quality strike photography.

d. Searchlights sited in revetments, and fixed radar installations of the "bed spring" type were ordinarily quite easily spotted on photographs. Portable radar and searchlights, and even smaller types of fixed radar, however, were quite often expertly camouflaged and as a result were not always detected by photographic interpreters. Photo 23 illustrates the effort sometimes expended by the Japanese in concealing portable radar installations. Tracks made by

radar trucks during installation of the equipment shown in Photo 23 would probably point to the existence of its position on photographs, but without large scale photography revealing the antenna, it is doubtful that interpreters would be able to recognize the position as a radar installation. Photo 24 shows a technique for garnishing radar antennae which if carried out more thoroughly could have been highly effective.

e. One of the best techniques used by the Japanese to hide defenses and electronics installations was the construction of movable structures which slid into position over equipment when it was not in use.

**PHOTO 21**

Bamboo lattice over 120mm AA gun, Kawasaki.

**PHOTO 23**

Camouflaged portable radar type Tachi 7.

**PHOTO 22**

CD position for 75mm artillery piece, Mu ro ran.

**PHOTO 24**

Radar antennae garnished with branches, near Fukuoka.

II CAMOUFLAGE

Photo 25 illustrates a radar installation of this type with the false covering in place, while Photo 26 shows a gun revetment with its covering removed. In neither of these cases had photographic intelligence reported the nature of the installation beneath the housing. Nevertheless, it is believed that the movable character of positions of this type can be interpreted from good photographic cover by the analysis of adjacent rails.

f. Further proof that many Japanese

did not understand the various techniques of camouflage is given in Photos 27-29. In Photo 27 the netting stretched over engine test cells at the Nakajima Omiya Plant never acted as a deterrent to identification. In fact the net was not even visible on available aerial photographs. Although the bamboo cover shown in Photo 28 concealed the locomotive which it housed, its use was obvious from the tracks which led into either end. An attempt to break up the outline of the Sasebo reservoir dam was completely unsuccessful as an examination of Photo 29 will reveal.



PHOTO 25

Mobile house covering radar, Kawasaki.

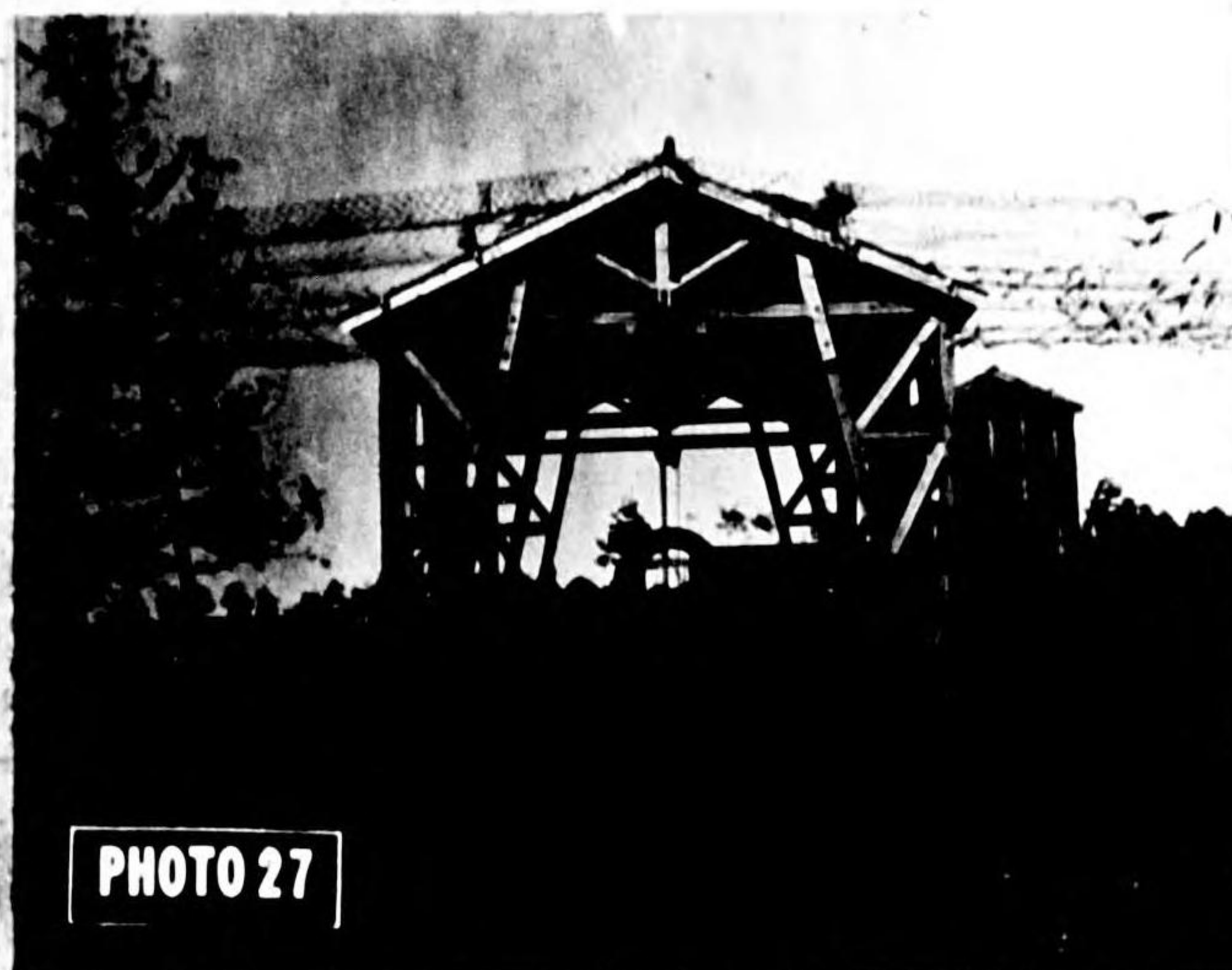


PHOTO 27

Netting covered engine test cell, Nakajima Aircraft Engine Plant, Omiya.

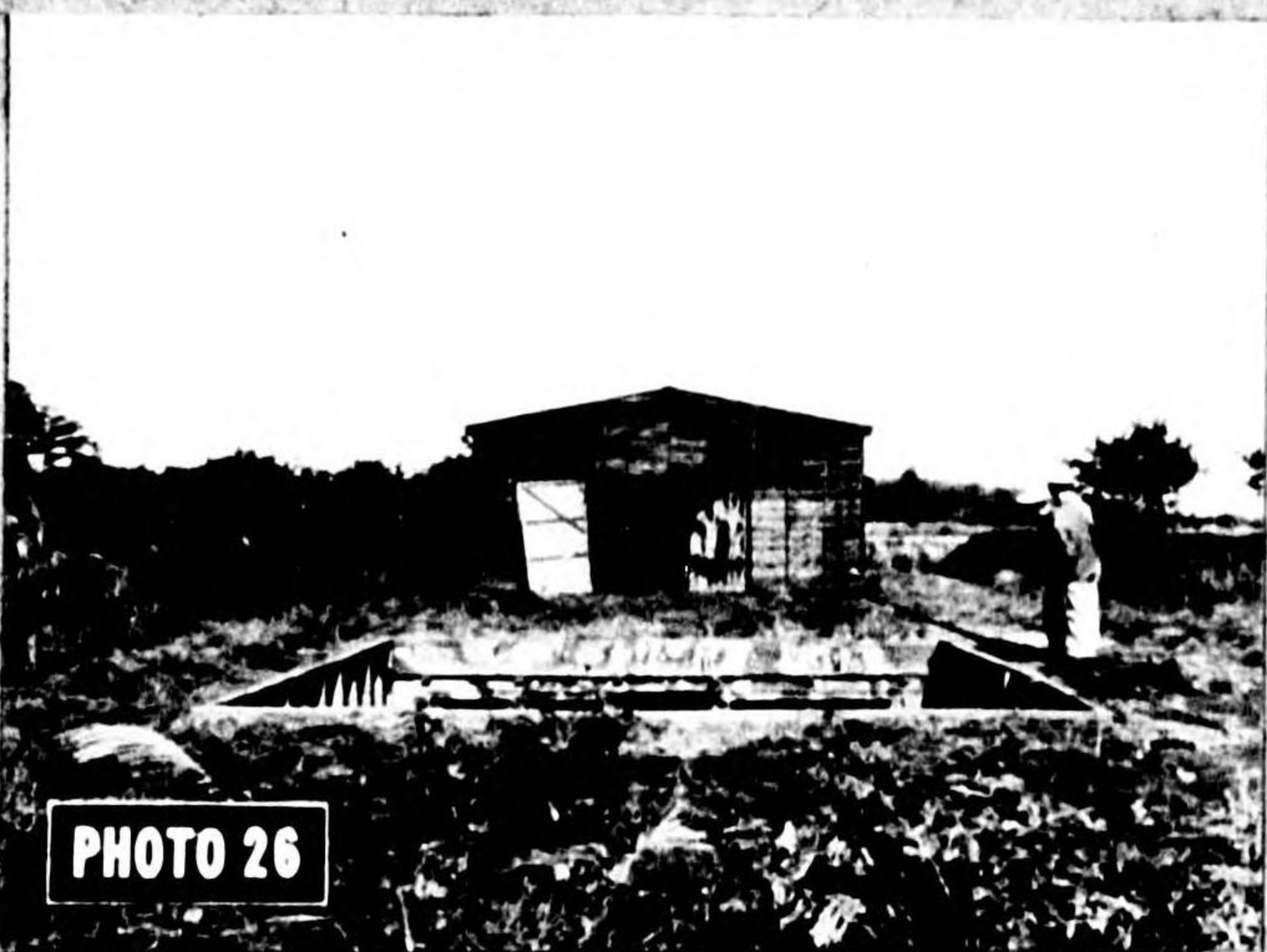


PHOTO 26

AA position with movable house, Tokorozawa Airfield.



PHOTO 28

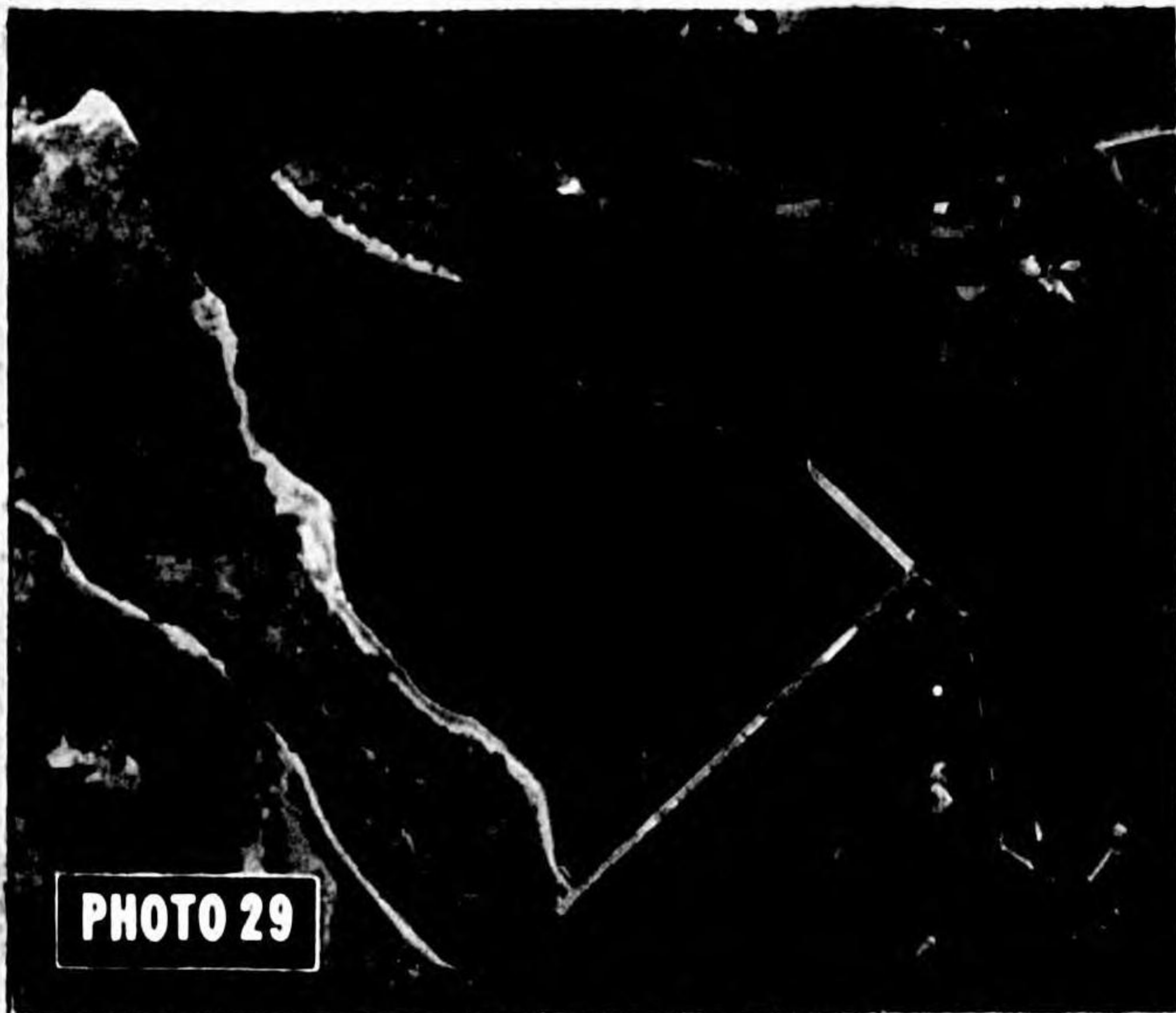
Locomotive shed, Omura A/C factory, Kyushu.

II CAMOUFLAGE**b. Use of Natural Features and Terrain**

a. Some of the most successful results of Japanese efforts to hide installations, equipment, and materials from the aerial view were obtained by use of natural terrain features such as small groves of trees. Natural features were employed most extensively in the dispersal of aircraft and in the siting of a multitude of small storage dumps. In general, hardstands under trees were located, but it was seldom possible to tell whether or not they contained aircraft. It was the exception when storage depots sited in woodland areas were detected primarily because (1) dumps were usually small and were often used for small items such as

gasoline drums or bombs; (2) the materiel stored in these dumps was transported by small vehicles which did not leave heavy tracks; and (3) some materiel was buried in the woodland floor.

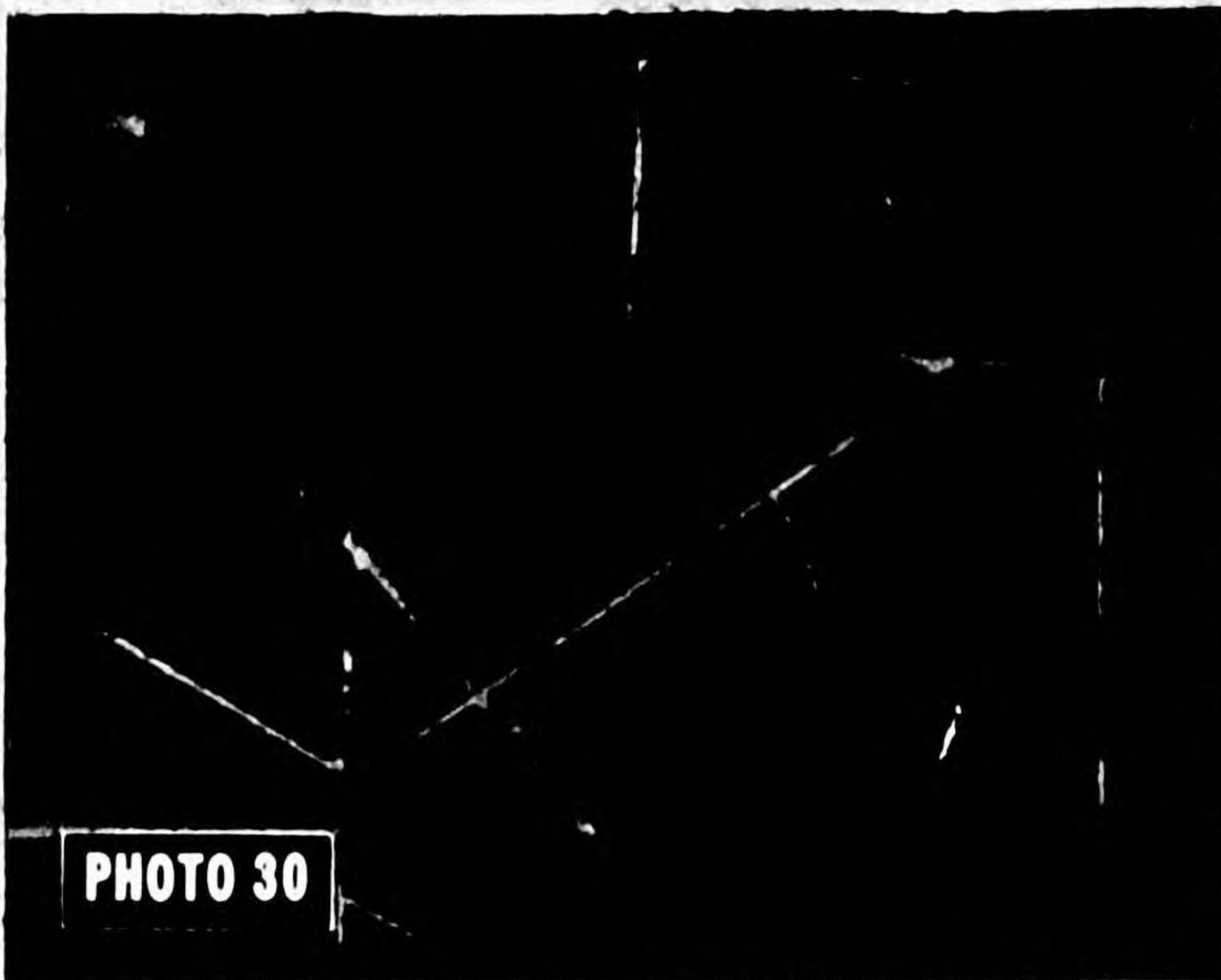
b. Photo 30 indicates the relative ease with which dispersed hardstand can be located even when sited in wooded areas. The fuselage parts in the shrine area illustrated by Photos 31 and 32 were dispersed in a grove of trees and were therefore not detected. When stores were placed in warehouses, in gullies, or in large dumps in the open (Photo 33), they were generally located and occasionally described by type.



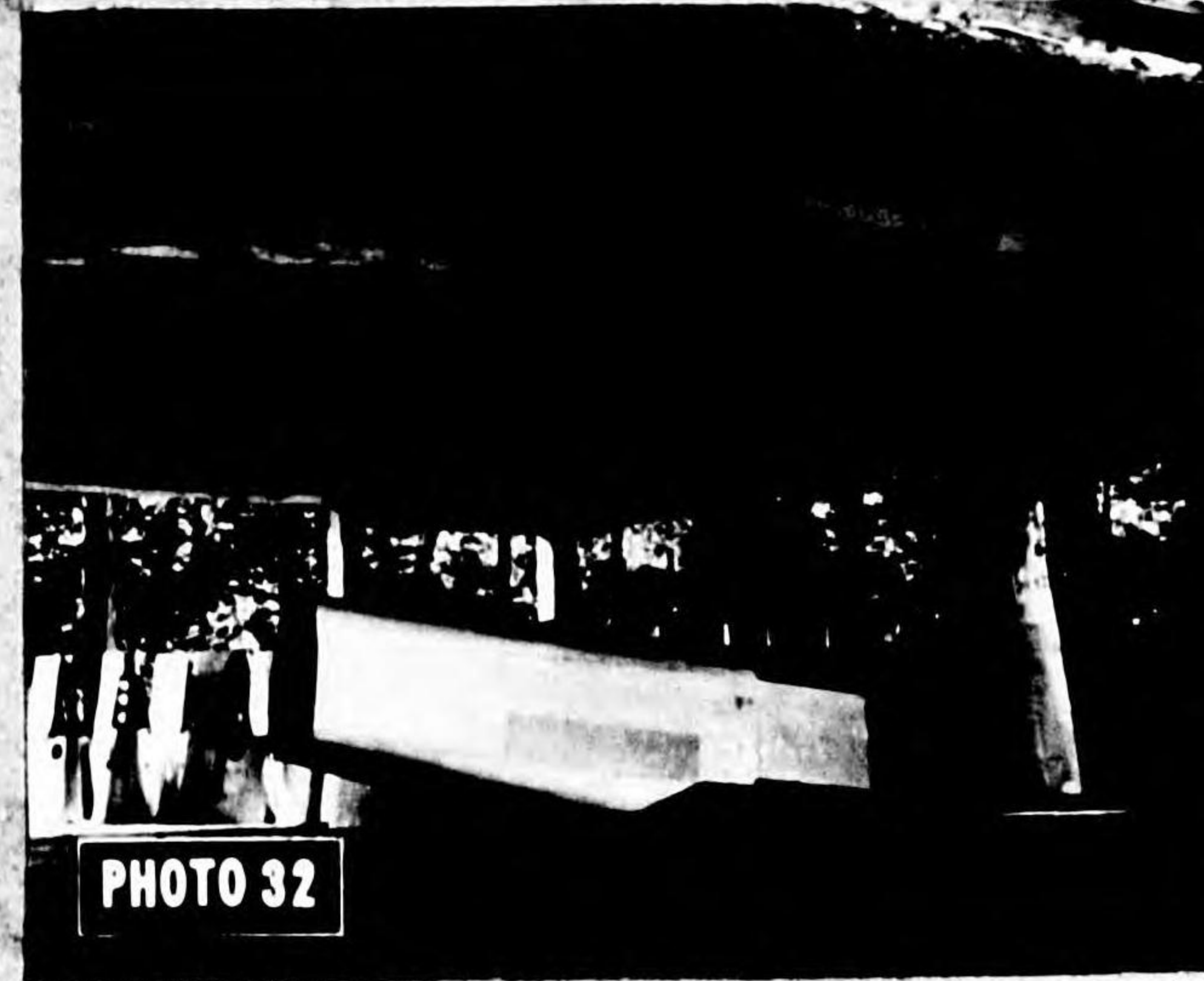
Unfinished attempt to camouflage reservoir near Sasebo.



Fuselage parts stored in Shrine, near Kawasaki Aircraft Works at Kagamigahara A/F.



Dispersal hardstands concealed in woods, Atsugi A/F.

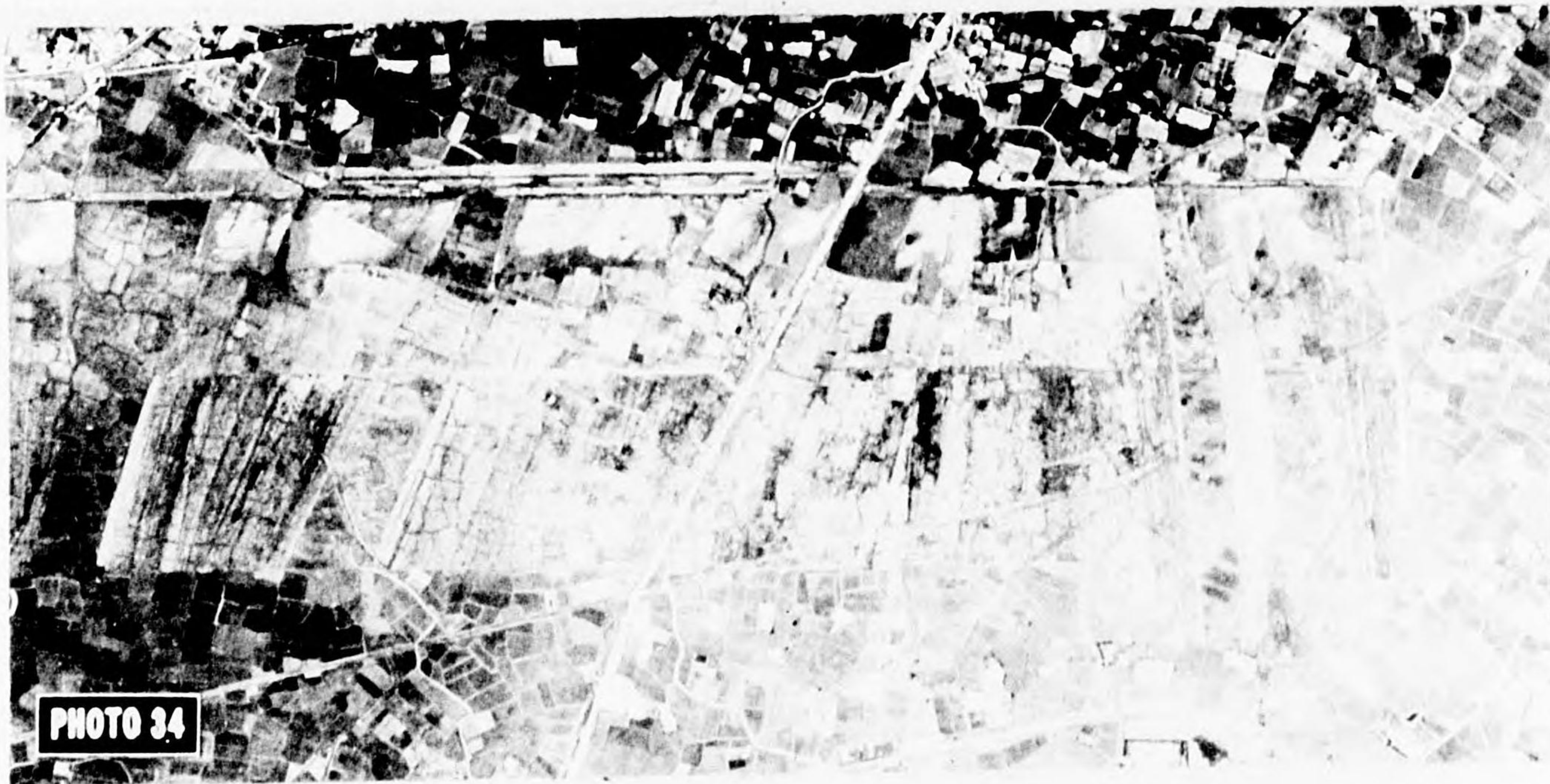


Fuselage parts stored in Shrine, near Kawasaki Aircraft Works at Kagamigahara A/F.

II CAMOUFLAGE



Dispersed storage, near Zushi, Miura Peninsula.



Edojawa Airfield, Tokyo Area.

Edojawa Airfield (Photo 34), known to the Japanese as a "secret" field, illustrates an additional use of natural terrain for camouflage purposes. Although never completed, this field was being built by draining rice paddies and sodding them over, thereby giving a fair weather sod runway that tended to keep the broken pattern of individual cultivated paddies. An auto

road which crossed the field area was to be graded to the level of the runway surface but retained to create deception. Along one edge of the field paddies were dredged out to provide catch basins into which water from the runway could drain, and airfield facilities were to be placed underground. Despite all of these efforts to make the Edojawa field secret, it was detected on aerial photographs soon after construction started.

III CONCEALMENT

III CONCEALMENT

1. Summary Description of Japanese Underground Construction

a. By far the most effective technique used to hide Japanese activity from the aerial view, and potentially the greatest threat to photographic intelligence was the practice of concealing important military and industrial facilities in systems of underground tunnels. By the end of the war, although only a few underground plants were actually in operation, the construction of tunnel-type factories for the dispersal of plant units doing light machining and assembly was beginning to assume major importance. Within a few more months, an important percentage of Japan's essential war plants might have been operating underground. The trend toward subterranean dispersal of industry was particularly evident in the aircraft industry in which a total of 37 assembly or parts plants were either wholly or largely underground at the end of the war.

b. A few of the underground developments present in Japan were identified from photographs as "areas of tunnel activity", but only one or two were described in published reports, and none was recognized for its true function. Short tunnels were widely used as air raid shelters. Unfortunately, however, there was little indication on aerial photographs as to whether a tunnel entrance opened into a shelter or was an entrance to an underground factory. The clues ordinarily present according to standard training doctrine, namely extent of spoil and track activity, were found to be generally unrelated to the function of the tunnel.

c. The tunnel entrance portrayed in Photo 35 has nothing distinctive about it to indicate that it opened into a machine shop. Similarly, although the spoil visible in Photos 36 and 37 indicates extensive tunneling, apparently not intended for air raid shelters, there is no clue to suggest that the tunnels in Photo 36 were planned for aircraft component machinery, or that those in Photo 37 were being built to house the mine producing units of a Naval Arsenal.

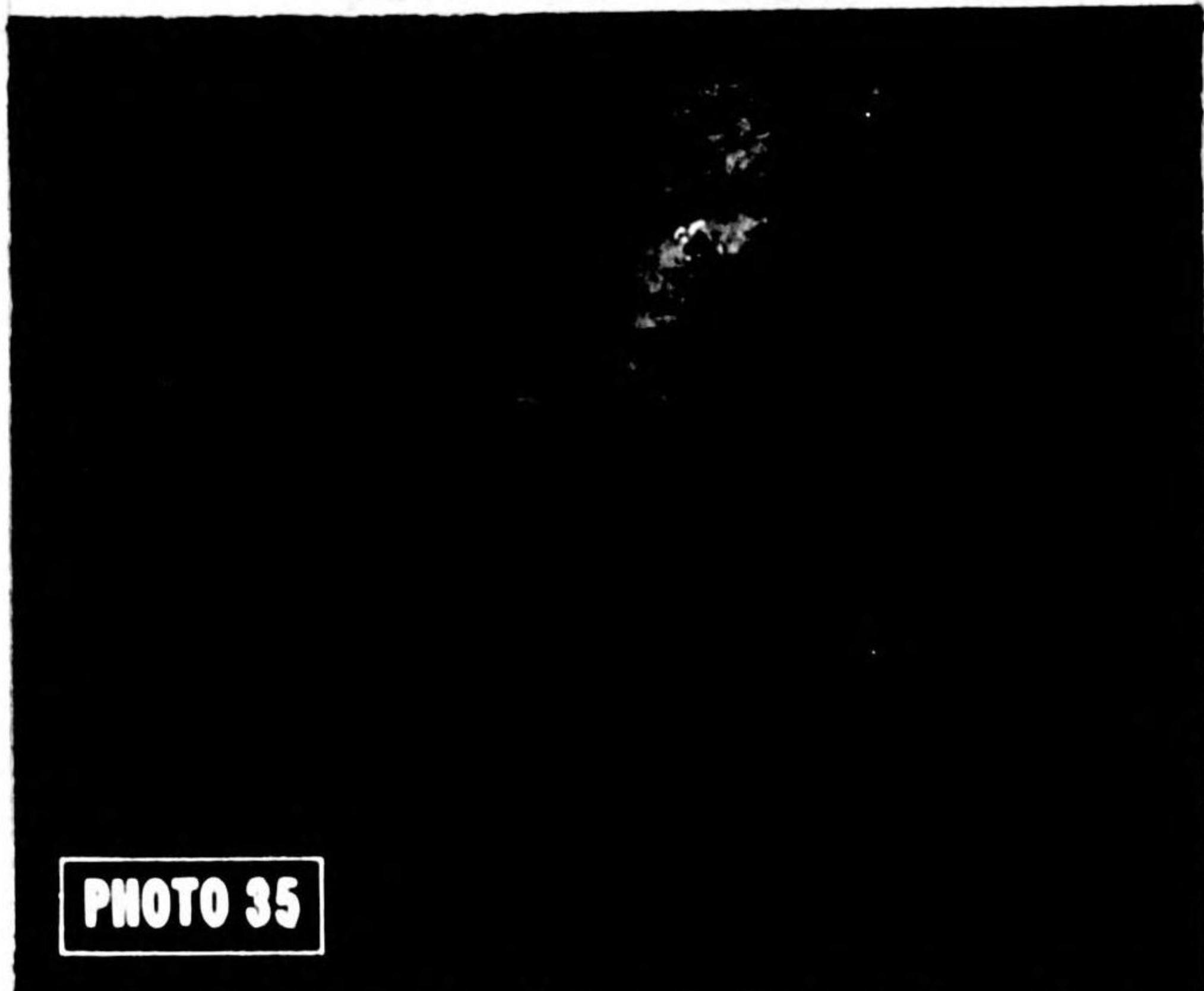


PHOTO 35

Machine shop entrance near Takahagi.



PHOTO 36

Tunnel entrances and spoil, Kukuri Aircraft Engine Plant.



PHOTO 37

Two levels of tunnel entrances (note spoil), at Ojima Naval Mine Arsenal.

~~CAMOUFLAGE~~ III CONCEALMENT



PHOTO 38

Diagram showing extent of tunnels at the First Technical Naval Air Arsenal, Yokosuka.

5
0.12

III CONCEALMENT — CAMOUFLAGE

Furthermore, the presence of spoil is usually an identifying factor only during plant construction and not always then, for careful spoil disposal eliminates tell-tale evidence. In short, during the attacks on the Japanese Homeland, the combination of ground information and photographic intelligence provided the only reliable evidence in regard to subterranean dispersal of industry.

2. First Technical Naval Air Arsenal, Yokosuka

a. One of the best examples of a Japanese underground aircraft plant, and one of the few that were actively in operation during the war was the First Technical Naval Air Arsenal at Yokosuka. This plant possesses a total tunnel floor space of 350,000 square feet (Photo 38) and was complete with offices, laboratories, machine shops (Photos 39 and 40), power supply, and storage facilities (Photo 41). Since the terrain around Yokosuka was quite rugged, with steep low hills and narrow valleys, it was ideally suited to the construction of a plant of this type. To assist in concealment, the principal entrances to the arsenal had been built to open into pre-war highway tunnels of which there were a great number in the area.

b. Photographic interpreters working on the Yokosuka Naval Base were aware of the existence of some of the tunnel entrances, had noted some evidences of spoil, and had detected instances where roads led directly into hillsides. There was no indication of the use of the tunnels, however, and it was the prevailing opinion that they contained stores. The extent and function of the different tunnels were not realized nor was it understood that all were connected to form a single system.

c. At the Yokosuka Naval Air Station (Exhibit A) which was adjacent to the First Technical Naval Air Arsenal, hangars (Photos 42-44), storage vaults (Photos 45 and 46), repair facilities, schools, and barracks were all housed in tunnels. As in the case of the air arsenal the presence of entrances and spoil on photographs of the air base was noted but the purpose of individual tunnels could not be determined. Consequently, these facilities were reported only as "evidence of underground activity".

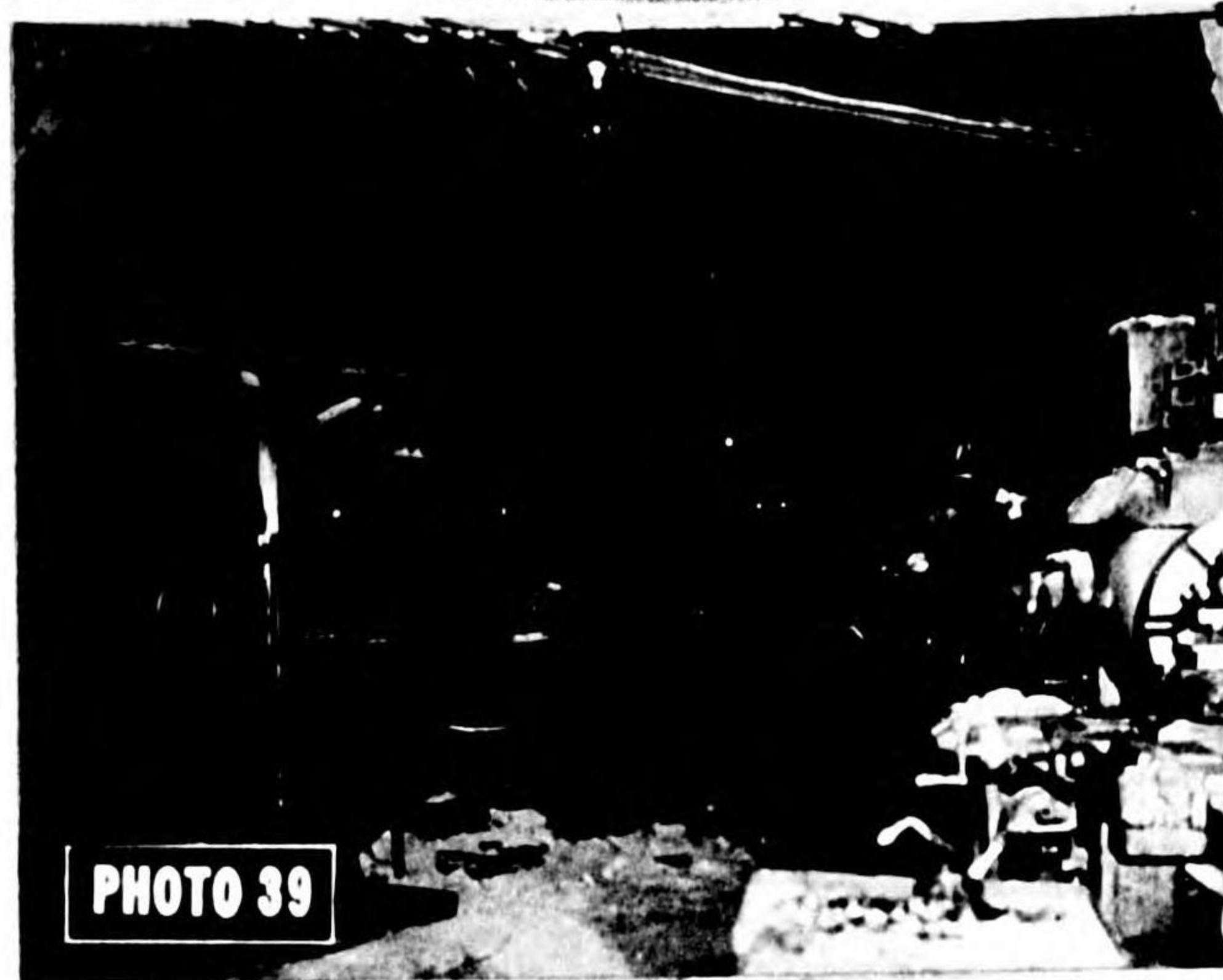


PHOTO 39
Underground machine shop, Yokosuka Naval Arsenal.



PHOTO 40
Machine shop entrances, Yokosuka Naval Arsenal.

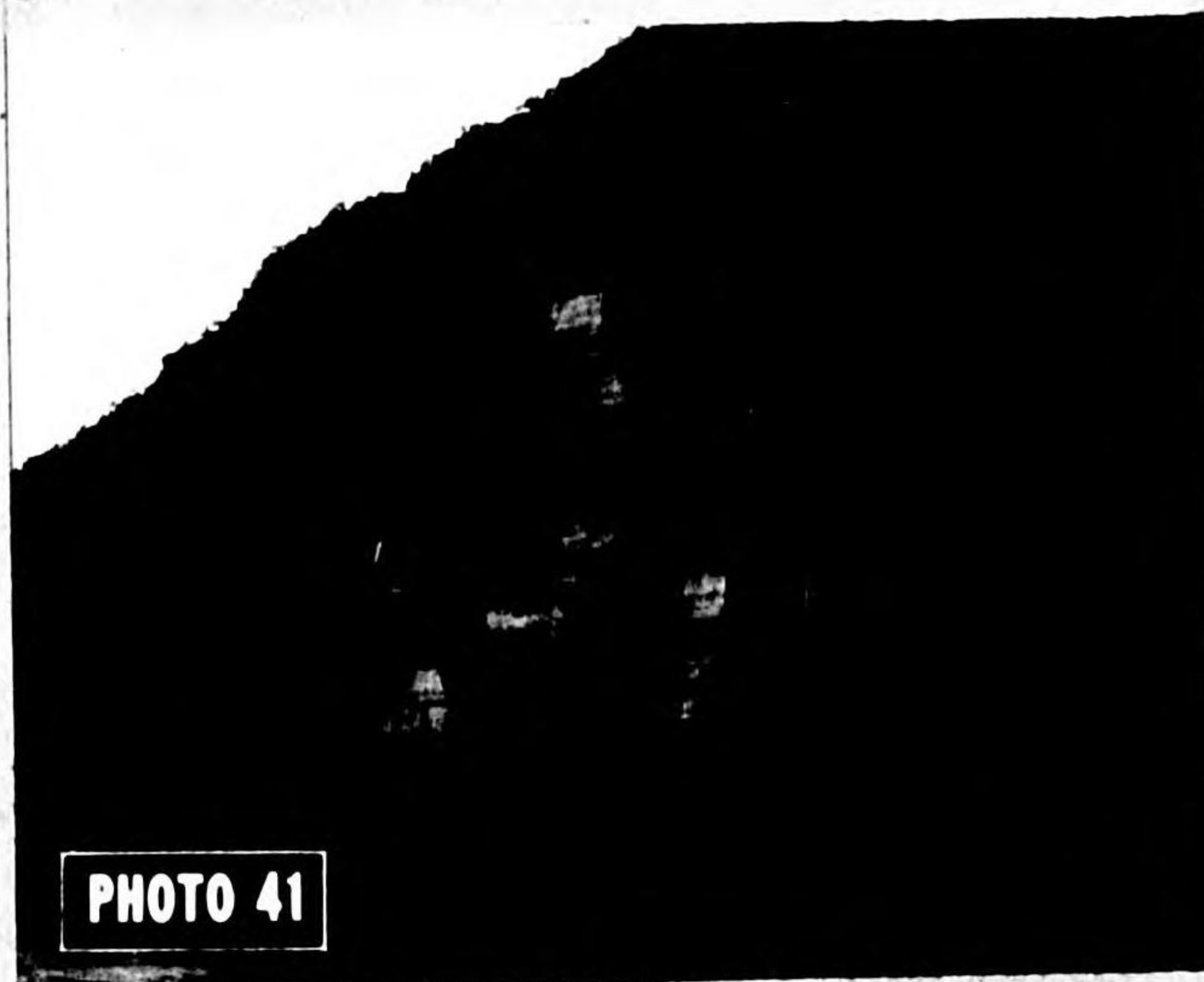


PHOTO 41
Storage tunnel entrance, 1st Tech. Naval Air Arsenal, Yokosuka.

III CONCEALMENT

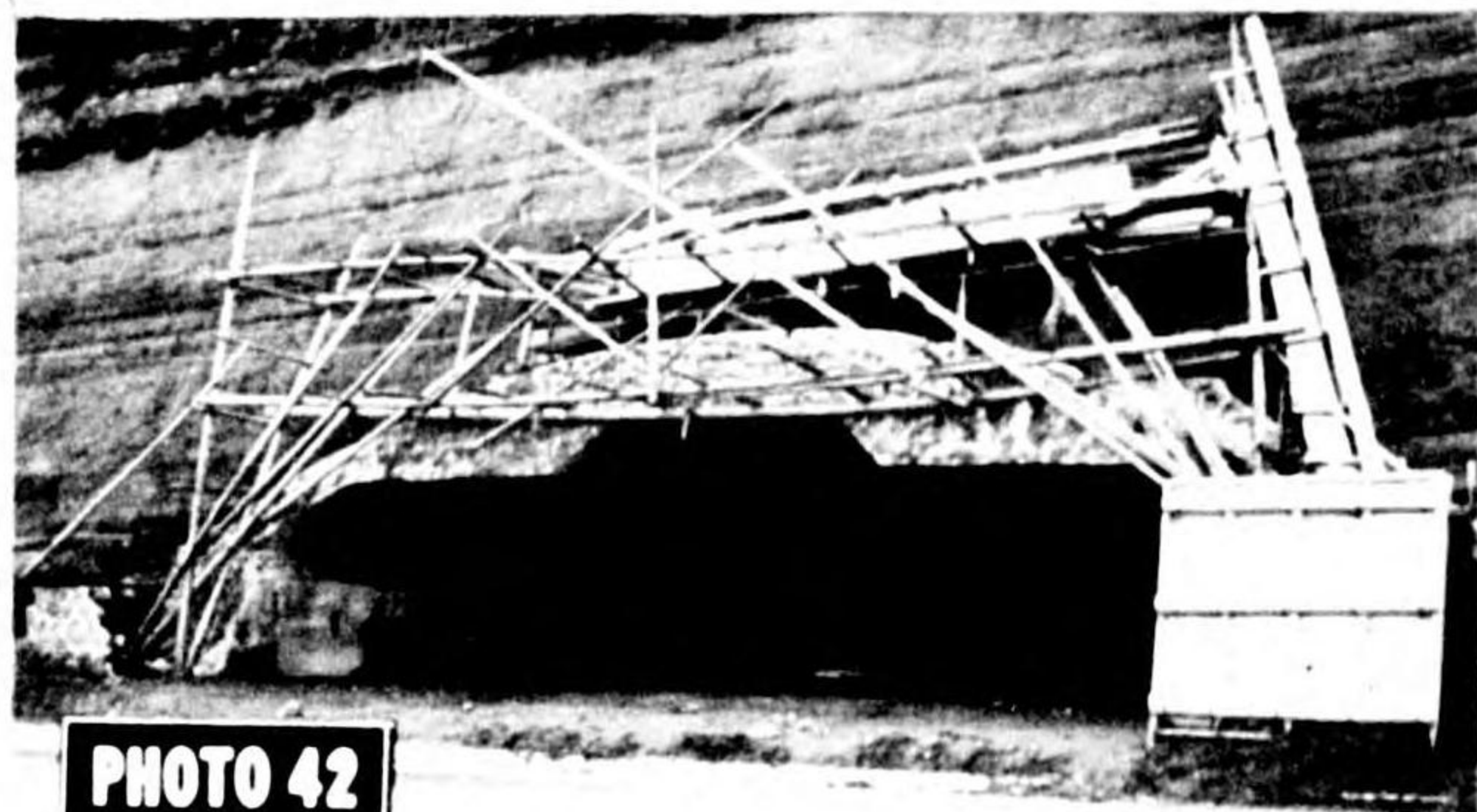


PHOTO 42

Nearly completed underground hangar, Yokosuka Airfield.



PHOTO 43

Interior of underground hangar, Yokosuka Airfield.

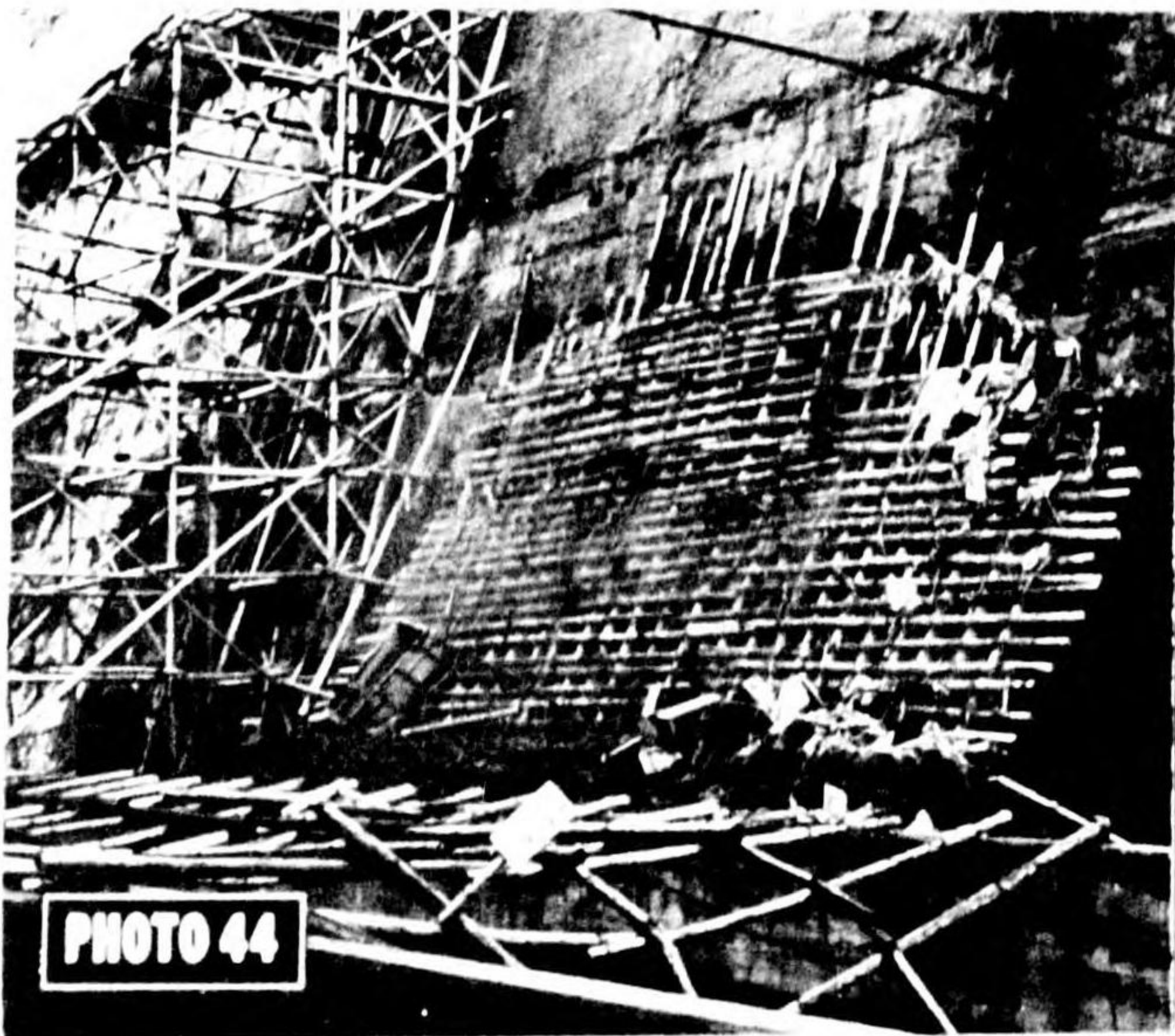


PHOTO 44

Entrance to hangar, Yokosuka Airfield.



PHOTO 45

Ammunition storage, Yokosuka Airfield.



PHOTO 46

Interior of ammunition storage, Yokosuka Airfield.

III CONCEALMENT**3. Miura Peninsula Midget Submarine Base**

a. In the hills of Miura Peninsula north of Misaki the Japanese had constructed a complete midget submarine base (Exhibit B) which consisted of five submarine shelters (Photo 47), torpedo and torpedo tube storage, a battery charging station, and repair workshops. All facilities were located in tunnels with the exception of quarters which were in earth-covered barracks on a plateau above the base.

b. As long as photographic coverage of the Miura Submarine base was limited to small-scale verticals, its existence was not detected. When large scale obliques became available, however, observation of a midget submarine in the bay near the peninsula led to discovery of the base itself. At no time, however, was there any conception of the completeness of base facilities.

4. Coast Defense Guns

a. Because coast defense positions were ordinarily either casemated or emplaced in caves, very few of those checked by USSS field teams had been located from the plan-view afforded by vertical aerial photographs. It should be noted, however, that no ground check was made of coast defense batteries in Southern Kyushu where the greatest effort to locate CD positions in the Four Islands had been made. Photo 48 illustrates the character of casemated positions and indicates the difficulty of detecting the location of such guns on vertical photographs. In several instances casemates were served by tunnels entered on the opposite side of a hill. Where this is true, or where emplacements are carved out of cliffs, it is probably easier to discover apertures on oblique photographs rather than on verticals (Photo 49).



Cave storage for two man subs, at submarine base, Miura Peninsula.



Casemated 75 mm CD gun, Kamakura.



Hillside apertures of three 5 inch CD gun emplacements under construction, Katase.

III CONCEALMENT - IV DECEPTION



Looking SW across Koshiha Pt., oil storage. Note buried tanks in foreground.

5. Buried Oil Storage

a. In nearly all of the cases checked in Japan buried fuel tanks had been correctly reported by photographic intelligence. A great many small dumps of oil drums, however, escaped detection.

b. The tanks at Koshiha Point on Tokyo Bay (exhibit C) are a typical example of buried oil storage. At this location seven large tanks had been completed, while others were still under construction (Photo 50). Both the buried tanks and the tanks under construction were reported correctly, but oil drums stored in tunnels at the base of the hill were not reported.

c. Fuel at the Tomioka Seaplane Station (Photo 51) was stored in horizontal tanks covered by a reinforced concrete roof which was then sodded over. For this reason the dump looked like a highly camouflaged building. Nevertheless, the tanks were correctly identified on the basis of their logical location and the presence of a servicing road connecting them with the Seaplane Station.



Oil storage, Tomioka Seaplane Base

IV DECEPTION

1. Principal Japanese Uses of Dummies

a. In the difficulties they caused photographic interpreters, Japanese dummy installations were second only to underground installations. The two types of equipment most often simulated by dummies were AA weapons and aircraft. Makeshift fabrications (Photo 52) were often detected, but dummies which had been carefully copied were quite frequently misinterpreted as real (Photo 53). The identification of aircraft was further confused by the Japanese use of inoperative planes as decoys. It is estimated that together decoys and dummies made up about 25 per cent of the total apparent aircraft at Japanese fields. The most important technique photographic interpreters can use to interpret well made dummy planes is a careful study of their positions on successive photographic coverages. Planes which are in the same position week after week are likely to be dummies although it is obvious that once the enemy understands this method of interpretation he can easily nullify its effectiveness. Gun positions which week after week show no track activity or no evidence of firing are also likely to be dummies.

IV DECEPTION

2. Other Uses of Dummies.

a. At Sasebo in areas of inadequate photographic coverage excellent reproductions of radar installations were erected. Some of them had been misinterpreted. At Atada Island, 3½ miles from the Otaki Oil Refinery, a decoy tank farm had been constructed (Photo 54). The tanks were built of bamboo poles and slats, but possessed no simulated pipe lines or protective fire walls. This installation was erroneously reported by photographic intelligence as a tank farm because of carelessness rather than because of any inability to recognize it as a decoy. Photographs taken prior to the end of the war were re-checked, and it was found that they left no doubt as to the classification of this installation as a decoy (Photo 55).

3. Dispersal of War Industry in Unorthodox Buildings

a. One final practice of the Japanese which, although perhaps not intended to create deception, confused the photographic interpreter was the Japanese use of small

factories and public buildings for industrial dispersal. Schools, theaters, shrines, and economically unimportant mills were all used for light machining of aircraft and ordnance parts. Examples of this type of dispersal were the repair shops at Kasumigaura Airfield which were dispersed in sheds and barns five miles from the field, the parts machinery of the Tachikawa Air Arsenal which was set up in a museum several miles distant, the light machine tools of the Aichi Aircraft Company, Nagoya, which were moved to small pottery mills in Seto 12 miles away, the innumerable examples of small textile mills converted to aircraft parts, and the dispersal of Mitsubishi Electric Company equipment from Nagoya to an elementary school approximately thirty miles distant along the Chuo Railroad line.

b. It is likely that much of this uneconomical dispersal was due to an acute shortage of building space resulting from urban area fire raids rather than to an effort to conceal, yet the fact remains that practically none of the dispersal of this kind was detected by photographic intelligence.

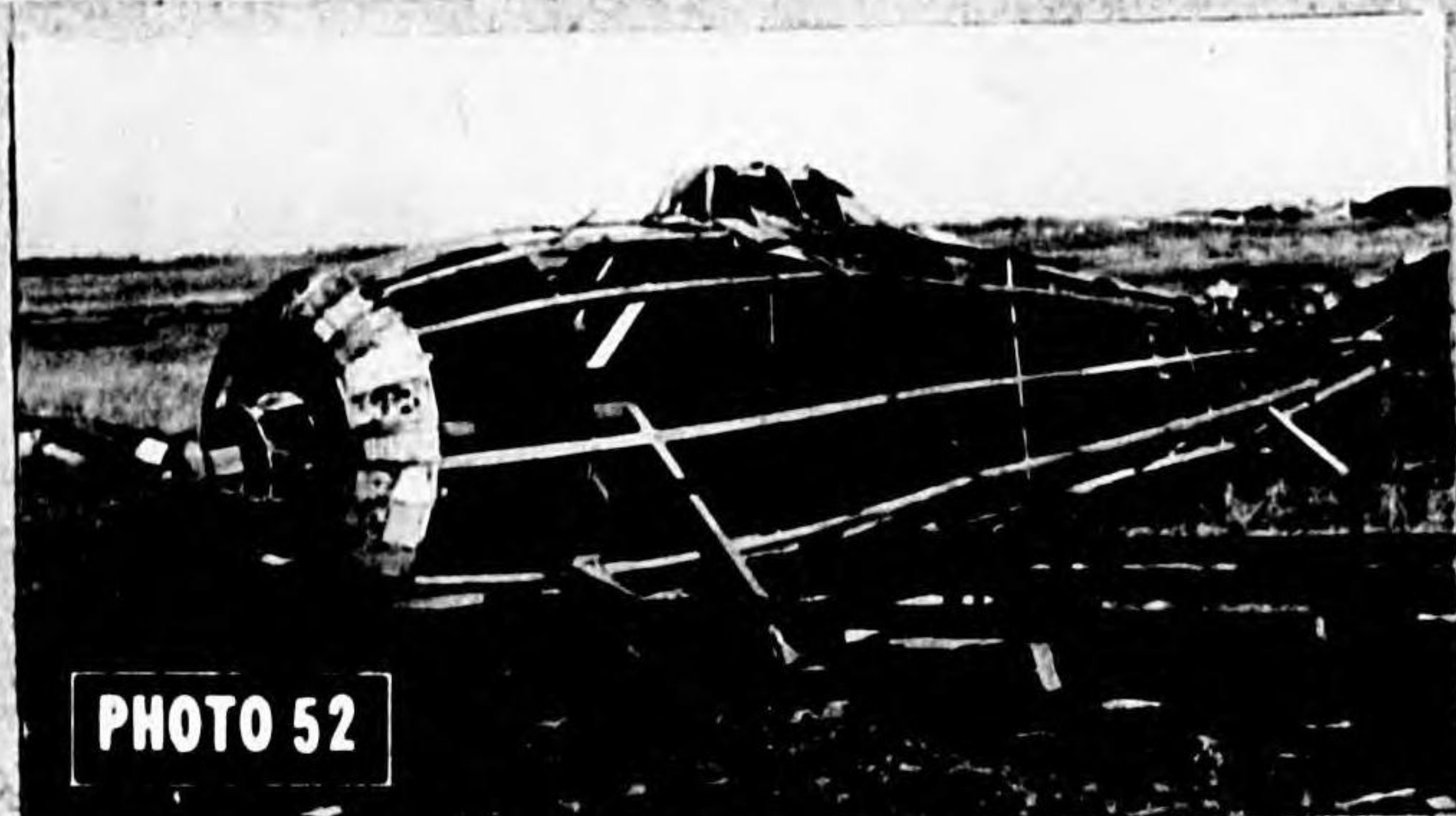


PHOTO 52

A typical Japanese aircraft dummy easily interpreted by photographic intelligence.



PHOTO 53

Small plane in foreground illustrates a well made dummy of the type that could seldom be distinguished on photographs from real planes.



PHOTO 54

Decoy tank storage, Atada Island.



PHOTO 55

War time aerial view of decoy tank farm, Atada Island.

V CONCLUSIONS AND RECOMMENDATIONS

V CONCLUSIONS AND RECOMMENDATIONS

1. The camouflage media most widely used by the Japanese, in terms of area covered, was paint. Much of this painting work was apparently undertaken by amateur camoufleurs who had little technical knowledge or comprehensive understanding of its applications. Consequently, results, especially on large installations, were often uncoordinated and inexpert, and caused photographic interpreters very little difficulty. It is believed that in the future whenever stereoscopic aerial photography is taken of installations camouflaged with paint alone, unless amazing new paint properties are developed, little difficulty in interpretation will be experienced.

2. Japanese use of garnished nets and frames was spotty. There were few attempts to conceal large installations with garnished material, and although some small installations were very well camouflaged by nets and frames, many more were inadequately hidden. Some garnished cover of small installations, such as radar or automatic weapons positions, made interpretation difficult, but generally speaking, nets and garnishing were not successful in concealment.

3. In areas of adequate photography many concentrations of tunnels were detected but in the few instances in which reports were made the significance of the activity noted was underestimated. When evaluating the effectiveness of PI work on underground installations it should be remembered that no concentrated effort was made to locate and determine the significance of such activity. Most work on the Japanese Homeland was necessarily devoted to the task of meeting specific requests for information on airfields, shipping, industry, bomb damage, etc. No requests were made for specific data on underground activity, hence in an already full schedule only cursory attention was given to this work.

a. A well executed program of underground factory construction in the future could greatly reduce the effectiveness of photographs as a source of intelligence on industries so constructed, particularly if

the terrain was favorable for digging tunnels and concealings their entrances. In such cases it is doubtful that the photographic interpreter would be able to detect more than a small percentage of the entrances to underground plants. Even when he did note entrances, spoil, and track activity, he could not be sure that they indicated the presence of an underground factory, nor could he make more than a rough guess of factory size and function. In fact, although it is possible that methods may be developed for detecting underground plants from the location of associated facilities such as otherwise unexplained housing for workers, the only reliable assistance the photographic interpreter can provide in this field at present is the photographic confirmation of underground plants reported from other sources.

b. Nevertheless, despite the desirability from a military standpoint of concealing subterranean war plants, it seems unlikely that all future industry essential to war production will be placed underground. During World War II most industries vital to war had also been important in peace. To place these industries underground now would greatly compromise their peacetime efficiency. Furthermore, although the assembly plants and light machining units built underground in this war were relatively easily adapted to such production, basic industries such as iron and steel, alumina, and copper, are not well fitted for underground production because of their tremendous quantities of raw material, wastes, noxious fumes, and heat. In short, although many important war plants of the future may be placed underground, it is likely that the majority of industry, including basic industries upon which war plants are dependent, will continue to remain on the surface.

c. Other types of underground installations such as airfield hangars, storage dumps, rocket launching sites, and coast defense positions might occasionally be detected, but if cleverly constructed, they could be concealed. To a great extent the success or failure of photographic intelligence in this respect would depend upon the regularity of photographic coverage and the

V CONCLUSIONS AND RECOMMENDATIONS

care taken to prevent detection during construction.

4. In the difficulties it caused photographic interpreters, the Japanese use of dummy installations was second only to the use of underground installations. Dummies of small equipment such as automatic AA and aircraft were a constant source of trouble, but decoys of larger installations such as oil tanks were too clumsily made to be successful. It seems likely that in the future carefully constructed copies of aircraft, guns, radar, rocket launchers, and other types of small equipment will be indistinguishable on aerial photography from real equipment regardless of photographic scale. With relatively good photography, however, dummies of large installations such as tank farms or factories should be easily distinguished.

5. If any large measure of success in the interpretation of underground activities and dummy installations is to be achieved in the future, regular, good-quality photography at scales of 1:10,000 or larger is believed essential.

6. In addition to the need for regular photography two other recommendations which have an important bearing on the adequacy of intelligence in the future should be mentioned.

a. It is certain that more complete knowledge of enemy underground activity will result from closer liaison between the different branches of intelligence. If there had been better procedures for channeling information, and a greater knowledge of the problems confronting the various types of intelligence officers during the Pacific War, many underground plants which were either unreported or only suspected probably would have been confirmed. Unless the scraps of information gained from all intelligence sources are well coordinated, intelligence on underground plants in the future may be woefully inadequate. Photographic interpreters can supply an important percentage of these "scraps".

b. To insure that all possible intelligence on enemy camouflage, concealment, and deception may be supplied, it is recommended that research in this phase of photo intelligence be intensified during peacetime. This research should include (1) keeping abreast of new developments in camouflage technique, (2) detailed studies of facilities associated with industrial plants in the different countries of the world (i.e. housing, cooling facilities, waste dispersal, etc.) to determine whether these alone will indicate the presences of a plant when it is concealed underground, (3) the taking and study of photographs of areas of underground activity, and of experimental dummy installations.

EXHIBIT A

Underground installations of Yokosuka Naval Air station consisted of hangars, storage vaults, repair facilities, schools and barracks.

Tunnel entrances, track activity and spoil were observed by photographic interpreters but the purpose of the tunnels was not determined and the facilities were reported only as "evidences of underground activity."

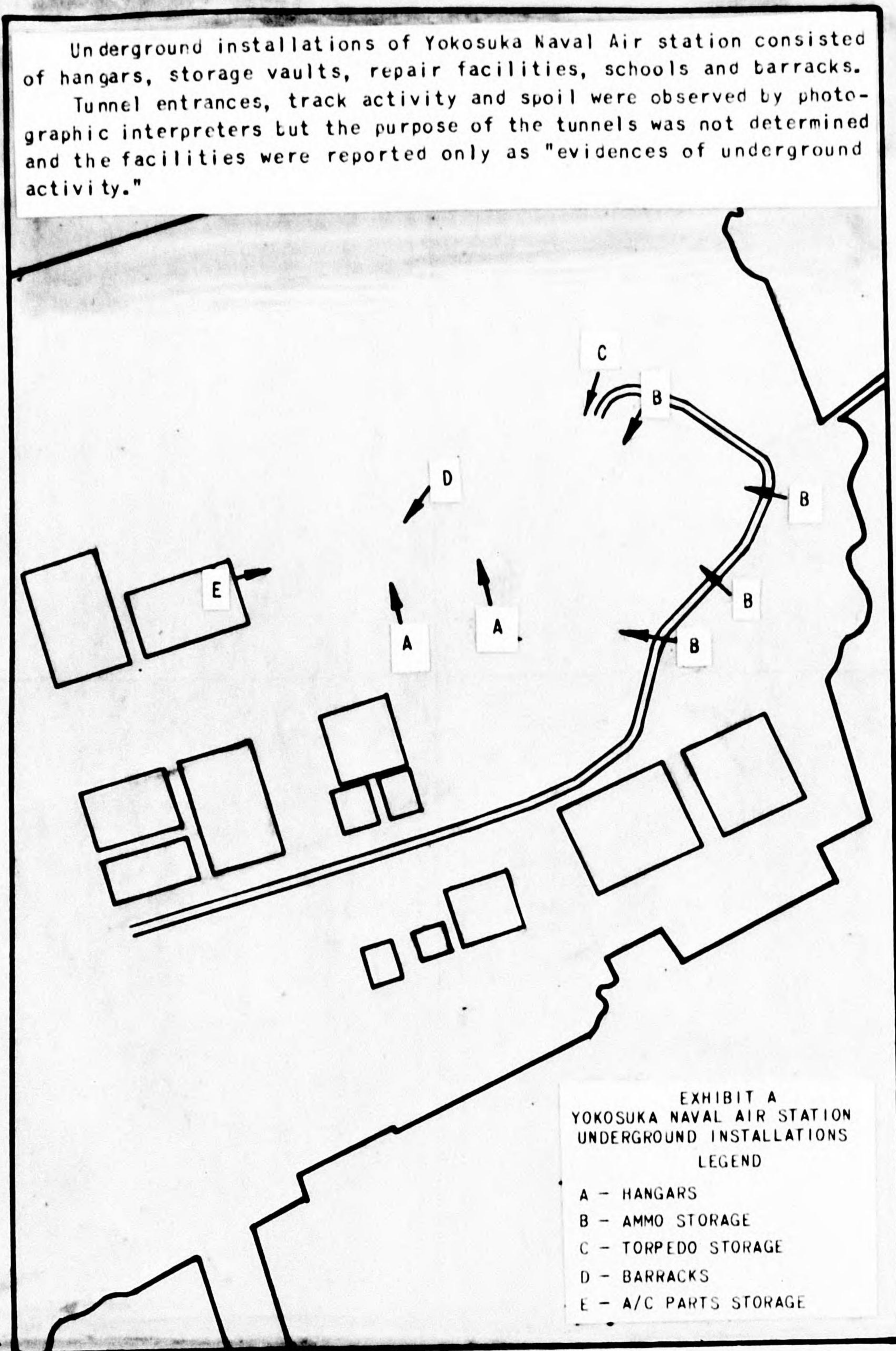


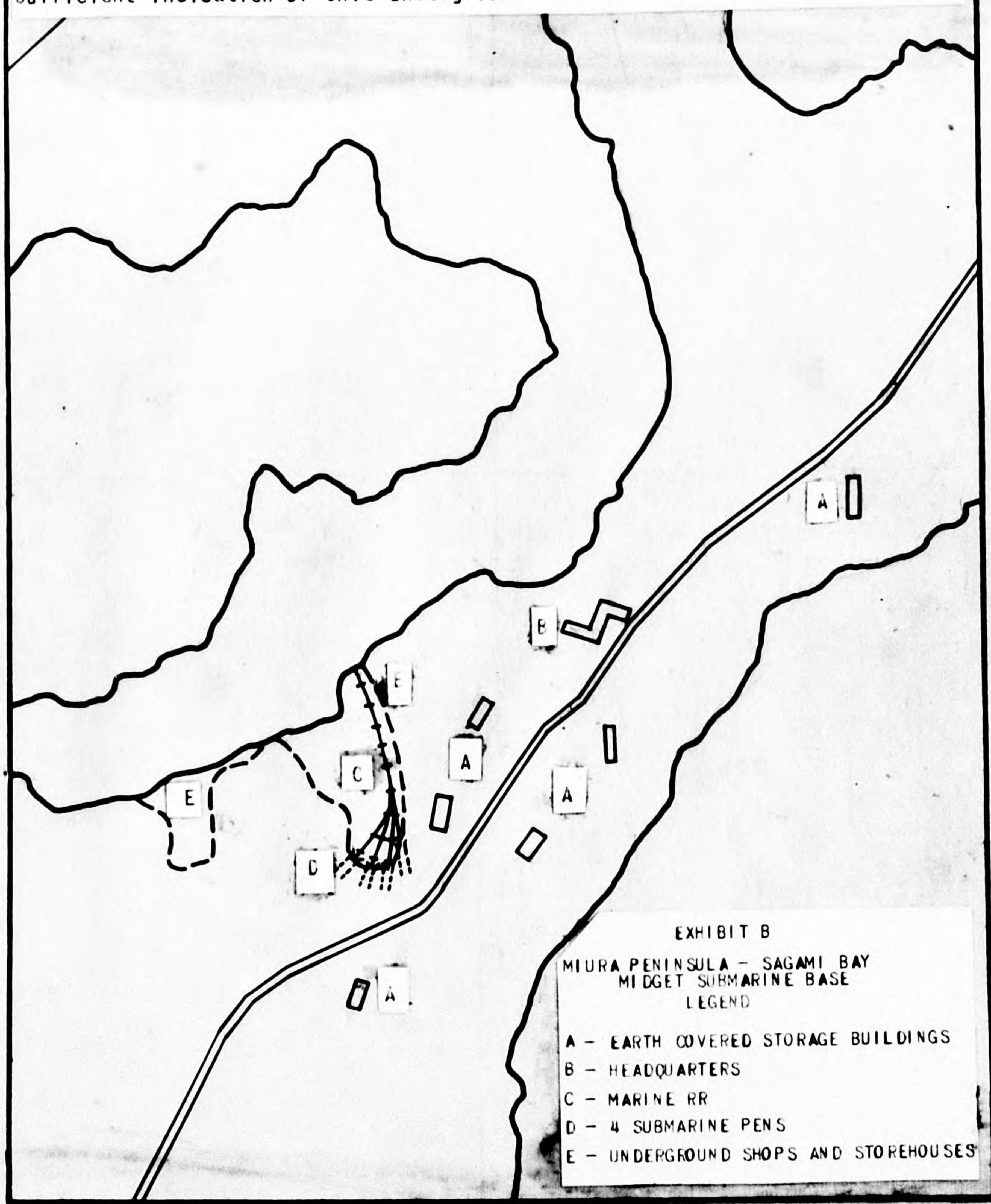
EXHIBIT A
YOKOSUKA NAVAL AIR STATION
UNDERGROUND INSTALLATIONS
LEGEND
A - HANGARS
B - AMMO STORAGE
C - TORPEDO STORAGE
D - BARRACKS
E - A/C PARTS STORAGE

See vectograph Exhibit A in envelope attached to last page of this report.

EXHIBIT B

This midget submarine base was hidden in the hills of Miura Peninsula on Sagami Wan. Facilities included five submarine shelters, torpedo and torpedo tube storage, a battery charging station and repair workshops, all located in caves and serviced by a marine railway. Several earth covered barracks or storage buildings were located on the plateau above the base.

This base was discovered only after low altitude obliques revealed a midget submarine in the area. Previous high altitude photography failed to show sufficient indication of this underground installation.



See vectograph Exhibit B in envelope attached to last page of this report.

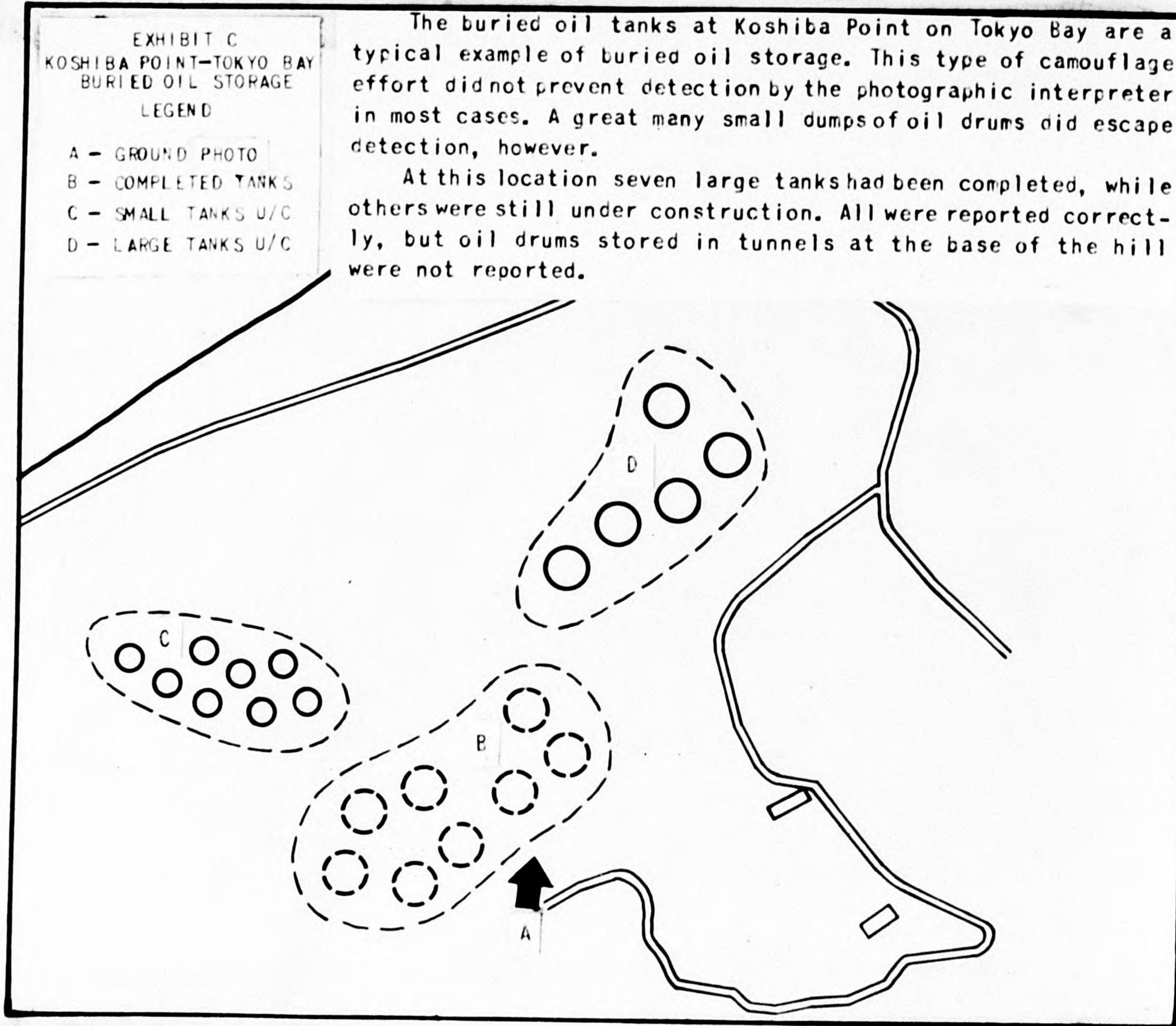
EXHIBIT C

EXHIBIT C
KOSHIBA POINT-TOKYO BAY
BURIED OIL STORAGE
LEGEND

- A - GROUND PHOTO
- B - COMPLETED TANKS
- C - SMALL TANKS U/C
- D - LARGE TANKS U/C

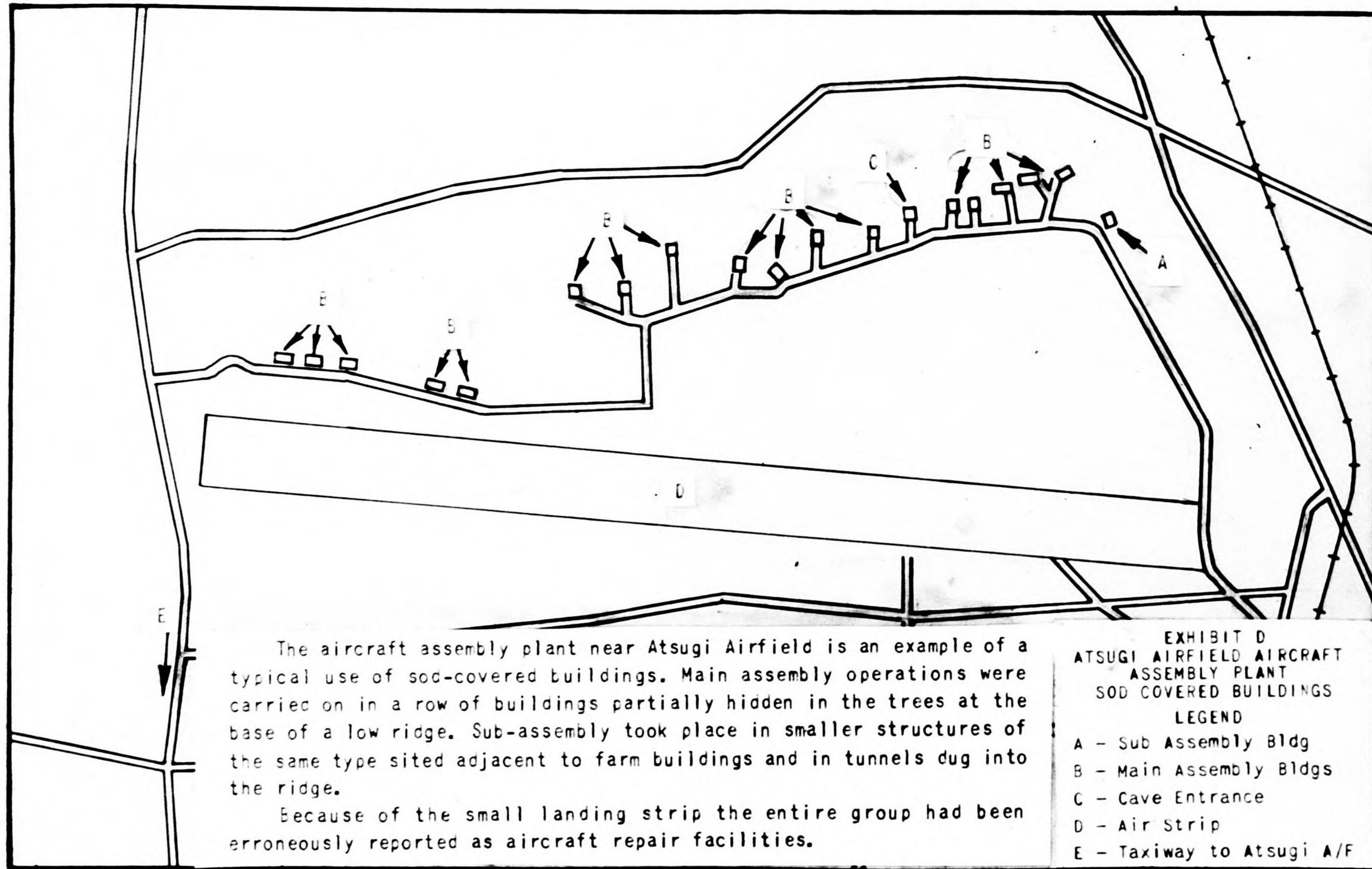
The buried oil tanks at Koshiba Point on Tokyo Bay are a typical example of buried oil storage. This type of camouflage effort did not prevent detection by the photographic interpreter in most cases. A great many small dumps of oil drums did escape detection, however.

At this location seven large tanks had been completed, while others were still under construction. All were reported correctly, but oil drums stored in tunnels at the base of the hill were not reported.



See vectograph Exhibit C in envelope attached to last page of this report.

See vectograph Exhibit D in envelope attached to last page of this report.



The aircraft assembly plant near Atsugi Airfield is an example of a typical use of sod-covered buildings. Main assembly operations were carried on in a row of buildings partially hidden in the trees at the base of a low ridge. Sub-assembly took place in smaller structures of the same type sited adjacent to farm buildings and in tunnels dug into the ridge.

Because of the small landing strip the entire group had been erroneously reported as aircraft repair facilities.

EXHIBIT D
ATSUGI AIRFIELD AIRCRAFT
ASSEMBLY PLANT
SOD COVERED BUILDINGS
LEGEND
A - Sub Assembly Bldg
B - Main Assembly Bldgs
C - Cave Entrance
D - Air Strip
E - Taxiway to Atsugi A/F

PHOTOGRAPHIC INTELLIGENCE - CAMOUFLAGE AND CONCEALMENT

EXHIBIT D

EXHIBIT E

The Japanese aircraft carrier "Katsuragi" is an example of the extensive camouflage effort the Japanese made to hide Naval units in the Kure area. Garnished netting was strung between the decks and shore and the outlines of the ship further disrupted by false structures built over important elements of the superstructure. All camouflaged ships were successfully located and identified by photographic interpretation.

PHOTOGRAPHIC INTELLIGENCE — CAMOUFLAGE AND CONCEALMENT
VECTOGRAPH EXHIBITS



5
● .25

RESTRICTED

- 141 Powder Plant, Angoulême, France
- 142 Powder Plant, Bergerac, France
- 143 Coking Plants, Montigny & Laëge-Belgium
- 144 Fort St. Blaise-Verdun Group, Metz, France
- 145 Gnome et Rhone, Lamoges, France
- 146 Michelin Tire Factory, Clermont-Ferrand, France
- 147 Gnome et Rhone Aero Engine Factory, Le Mans, France
- 148 Kugelfischer 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 Bayerische 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 Humboldt Deutz, Ulm, Germany
- 188 Ruhroel Hydrogenation Plant, Bettrop-Boy, Germany
- 189 Neunkirchen Eisenwerke A G, Neunkirchen, Germany
- 190 Railway Viaduct at Altenbecken, Germany
- 191 Railway Viaduct at Arnshurg, 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

RESTRICTED

RESTRICTED

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
- 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, Tautcha, 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 Giuliani 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, Lünen, Germany
- 29 Vereinigte Deutsche Metallwerke, Heddenheim, 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

RESTRICTED

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 Gutehoffnungshutte, Oberhausen, Germany
- 69 Friedrich-Alfred Hütte, Rheinhausen, Germany
- 70 Neunkirchen Eisenwerke A G, Neunkirchen, Germany
- 71 Reichswerke Hermann Goering A G, Hallendorf, Germany
- 72 August Thyssen Hütte A G, Hamborn, Germany
- 73 Friedrich Krupp A G, Borbeck Plant, Essen, Germany
- 74 Dortmund Hoerder Huetteneverein, 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-Nürnberg, Nürnberg, Germany
- 84 Auto Union A G, Chemnitz and Zwickau, Germany
- 85 Henschel and Sohn, Kassel, Germany
- 86 Maybach Motor Works, Friedrichshafen, Germany
- 87 Vortlander Maschinenfabrik A G, Plauen, Germany
- 88 Volkswagenwerke, Fallersleben, Germany
- 89 Bussing NAG, Brunswick, Germany
- 90 Muehlenbau Industrie A G (Mueg), Brunswick, Germany
- 91 Friedrich Krupp Grusonwerke, Magdeburg, Germany

Submarine Branch

- 92 German Submarine Industry Report
- 93 Maschinenfabrik Augsburg-Nürnberg A G, Augsburg, Germany
- 94 Blohm and Voss Shipyards, Hamburg, Germany
- 95 Deutsche Werke A G, Kiel, Germany
- 96 Deutsche Schiff- und Maschinenbau, Bremen, Germany
- 97 Friedrich Krupp Germanwerft, 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, Wilhelmshafen 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-Chemischwerke, Munich, Germany
- 131 Schoenebeck Explosive Plant, Lignose Sprengstoff Werke G m b H, Bad Salzungen, Germany
- 132 Plants of Dynamit A G, Vormal, Alfred Nobel & Co, Troisdorf, Clausthal, Drummel and Duenberg, Germany
- 133 Deutsche Sprengchemie G m b H, Kraiburg, Germany

OVERALL ECONOMIC EFFECTS DIVISION

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

PHYSICAL DAMAGE DIVISION

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

RESTRICTED

- 141 Powder Plant, Angoulême, France
142 Powder Plant, Bergerac, France
143 Coking Plants, Montigny & Laige-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 Kugelfischer 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 Bayerische 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-Icuma, 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 Humboldt Deutz, Ulm, Germany
188 Ruhrol Hydrogenation Plant, Bettrop-Boy, Germany
189 Neunkirchen Eisenwerke A G, Neunkirchen, 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 Hamtn, 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

RESTRICTED

Restricted

EXTRA COPY

**UNITED STATES STRATEGIC BOMBING SURVEY
PHOTOGRAPHIC INTELLIGENCE SECTION**

102-b

**EVALUATION OF PHOTOGRAPHIC INTELLIGENCE
IN THE JAPANESE HOMELAND.**

**PART ~~NINE~~ FIVE
CAMOUFLAGE, CONCEALMENT,
AND DECEPTION**

DATES OF SURVEY: 7 OCTOBER 1945 - 15 MARCH 1946

DATE OF PUBLICATION

Restricted

TABLE OF CONTENTS

I	INTRODUCTION	9.01
II	CAMOUFLAGE	9.01
	2. Use of Camouflage Paint	9.01
	3. Use of Standard Sod-Covered Dispersal Buildings	9.02
	4. Use of Nets, Garnishing and False Structures	9.04
	5. Use of Natural Features and Terrain	9.09
III	CONCEALMENT	9.11
	1. Summary Description of Japanese Underground Construction	9.11
	2. First Technical Naval Air Arsenal, Yokosuka	9.13
	3. Miura Peninsula Midget Submarine Base	9.15
	4. Coast Defense Guns	9.15
	5. Buried Oil Storage	9.16
IV	DECEPTION	9.16
	1. Principal Japanese Use of Dummies	9.16
	2. Other Uses of Dummies	9.17
	3. Dispersal of War Industry in Unorthodox Buildings	9.17
V	CONCLUSIONS AND RECOMMENDATIONS	9.18

I INTRODUCTION, - II CAMOUFLAGE

I INTRODUCTION

1. During most of World War II the subjects of camouflage, concealment, (defined here as underground construction), and deception (the use of decoys and dummies) were not special fields of photographic interpretation. Instead they were treated in a routine manner as they occurred in relation to standard subjects of reporting, i. e., airfields, shipping, industry, etc., and were not considered particularly troublesome or significant. However, when the aerial bombardment of Japan forced the Japanese to disperse vital military and industrial facilities, the detection of efforts toward camouflage and concealment suddenly became important. The war ended before Japanese attempts to hide essential targets assumed any great operational significance, but the threat implied to the effectiveness of photographic interpretation caused much speculation on the future usefulness of photographs as an intelligence source.

2. In order to answer the questions thus raised photographic interpreters attached to the United States Strategic Bombing Survey studied Japanese camouflage, concealment, and deception in the field. Due to the lack of any special reporting procedure for this type of interpretation, very little published photographic intelligence material was available for checking, and consequently the following evaluation is largely qualitative in nature.

3. All considerations of Japanese methods in this report are made strictly on the basis of their effectiveness in confusing the photographic interpreter. Some techniques of camouflage, concealment, and deception which did not greatly confuse the interpreters may have been effective in confusing an attacking pilot or bombardier.

II CAMOUFLAGE

1. Judging from the detailed efforts of the Japanese to camouflage installations at their Pacific outposts, it was expected that relatively intensive camouflage measures would be encountered in Japan Proper. Actually, although some excellent work was done,

camouflage in the Home Islands was never used as comprehensively as it was by Germany. Apparently few Japanese officials responsible for carrying out camouflage measures thoroughly appreciated the appearance of their work from the air. Small installations were often camouflaged well, but airfields and industrial targets were dealt with on a piecemeal basis, presumably with no relation to an overall plan. Camouflage paint and garnished nets were the principal media used on large target areas, and neither of these caused the photographic interpreter much difficulty.

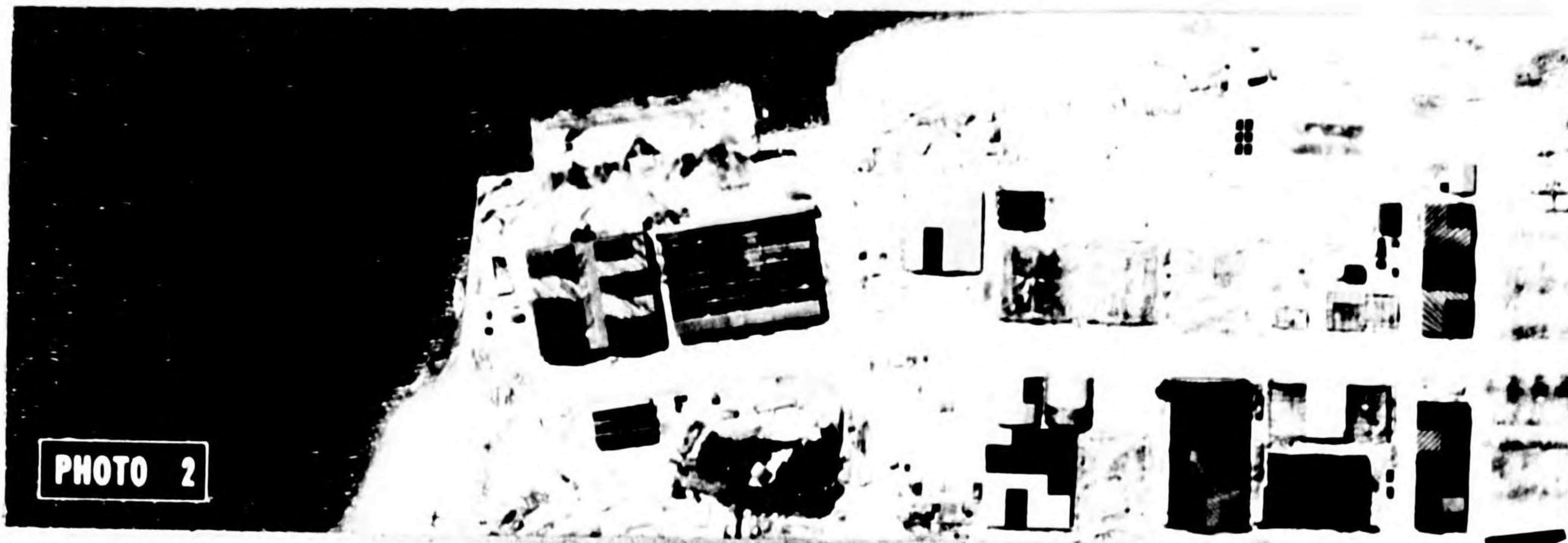
2. Use of Camouflage Paint

a. In terms of area covered, disruptive painting for the purpose of dazzling, or toning down, was the most commonly used Japanese camouflage method. In all of this work individual plant managers, airfield commanders, etc., were apparently held responsible for the camouflaging of facilities under their supervision without benefit of technical assistance or overall direction from outside sources. Consequently, disruptive painting was seldom planned to fit the pattern of the surrounding countryside or to match adjacent facilities. Factory buildings, oil tanks (Photo 1), airfield

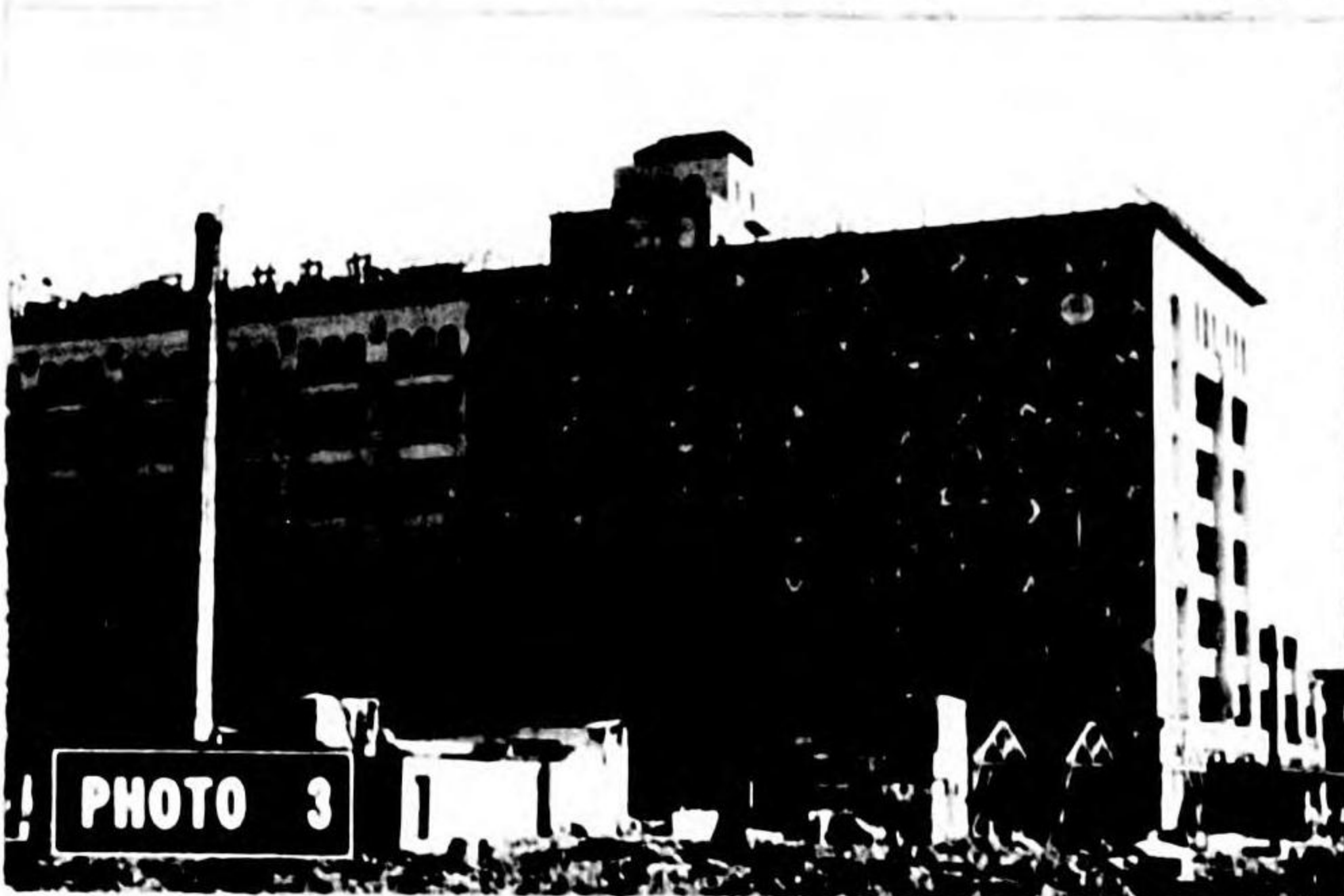


Partially painted tank farm near Kure.

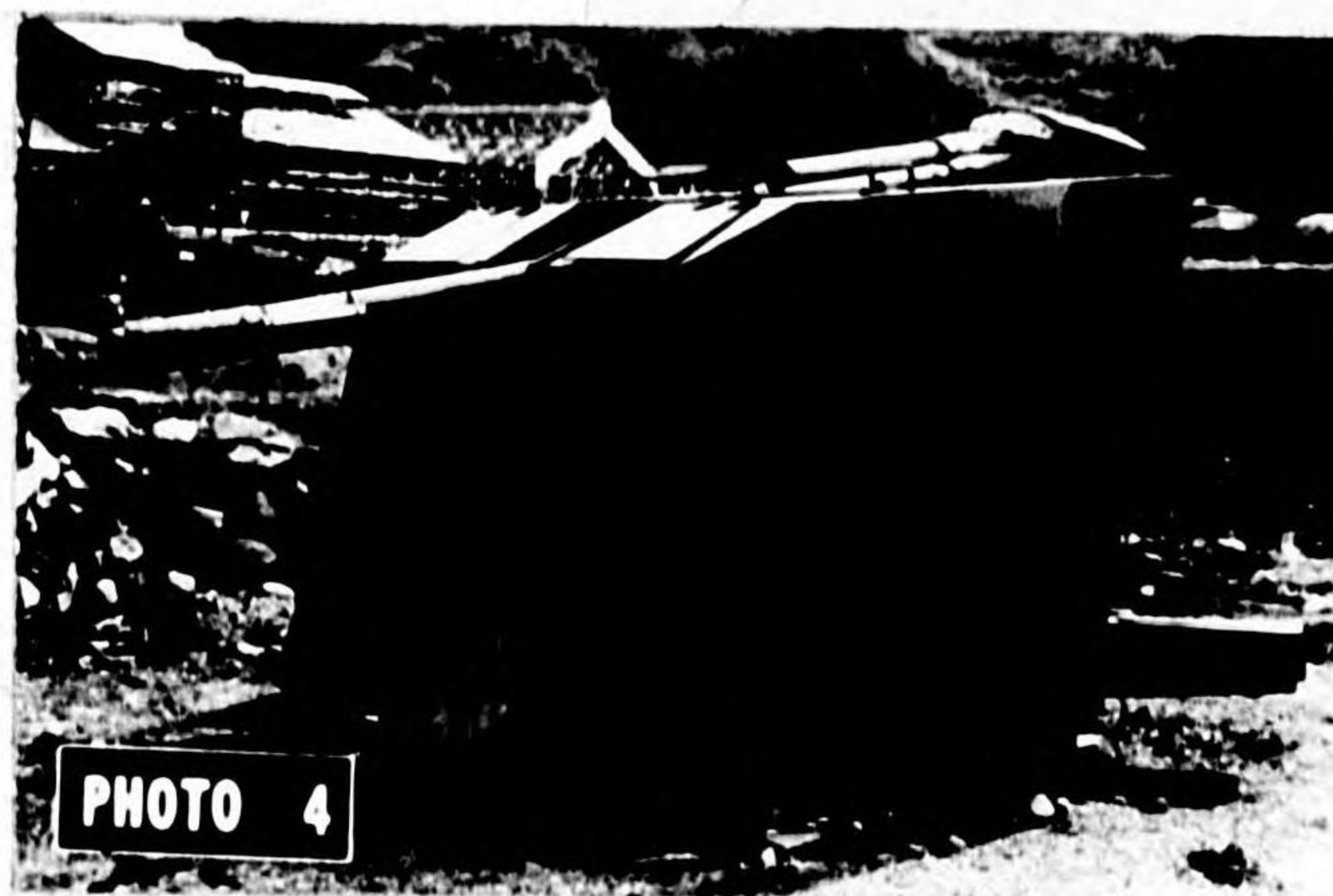
II CAMOUFLAGE



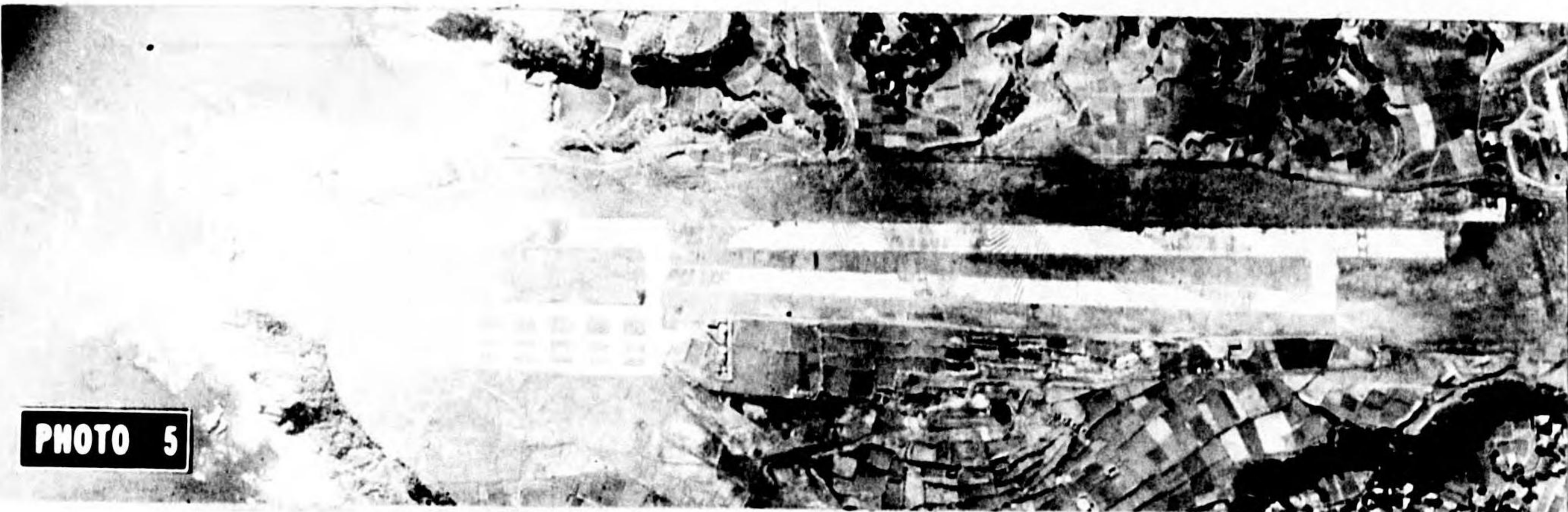
Disruptive painting of hangars and shops, Yokosuka Seaplane Base.



Disruptive painting of public building at Osaka.



Disruptively painted 88mm AA gun.



Dazzle painted runways, Ottawa A/F.

facilities (Photo 2), public buildings (Photo 3), and even individual AA guns (Photo 4) were disruptively painted, but in none of the cases checked had the painting technique caused the photographic interpreter much difficulty. In fact in some cases, such as the dazzle painting of runways at Ottawa Airfield (Photo 5), painting made outlines more distinct than if no attempt had been made to camouflage them. Similarly, the very

fact that an attempt had been made to camouflage a building or an installation indicated that the enemy considered it important.

3. Use of Standard Sod-Covered Dispersal Buildings

a. It is possible that some Japanese realized the tremendous cost and relative futility of attempting to camouflage large

II CAMOUFLAGE



PHOTO 9

Assembly building, Kyushu Aircraft Co.

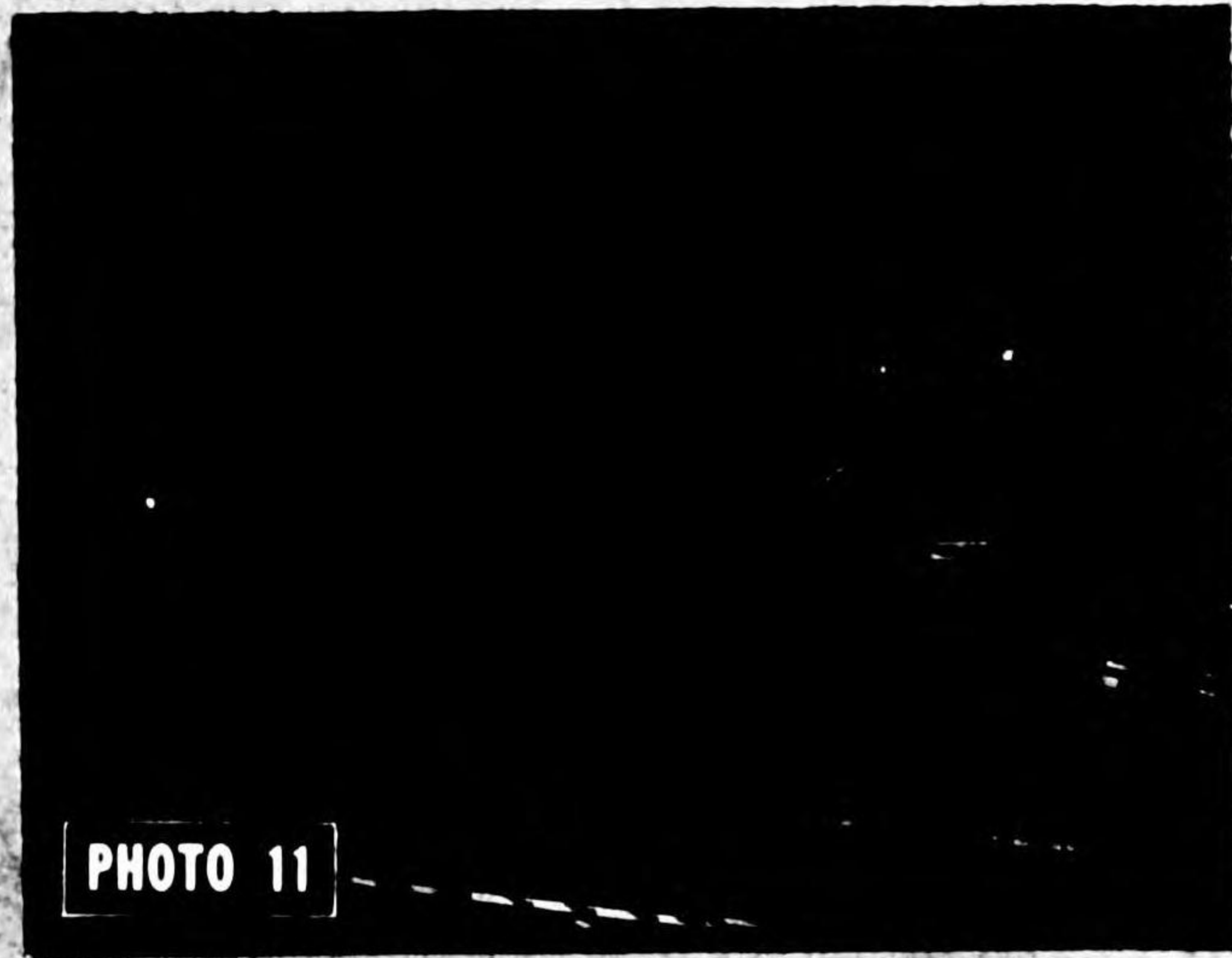


PHOTO 11

Sod covered barracks under construction west of Kawasaki.

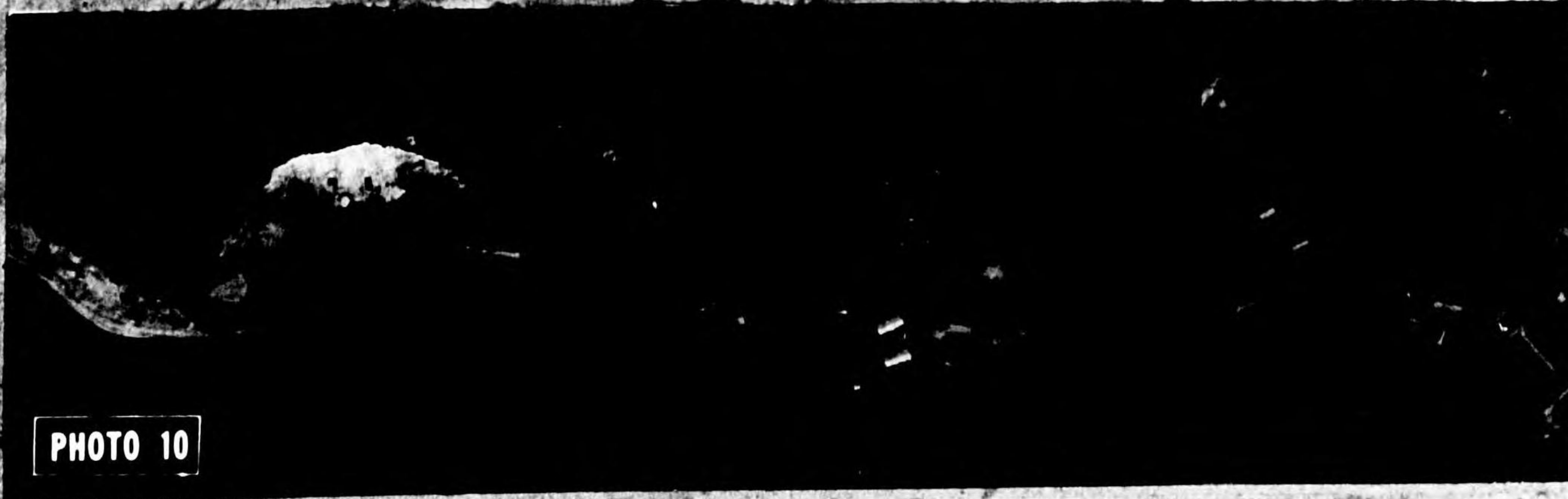


PHOTO 10

Aircraft Dispersal Plant, Kyushu Aircraft Co. Circled building shown in Photo 9.

c. A similar example of the use of sod-covered buildings is illustrated by Photos 9 and 10 showing the Fukuoka Seaplane Works of the Kyushu Aircraft Company at Kashii. Again sod-covered buildings were sited near a wooded ridge, and tunnels were being dug into the ridge itself. This development was detected but it was not reported because its function and importance were not recognized.

d. The difficulty in reporting the exact function of arch-roofed sod-covered buildings is indicated by Photo 11 which shows two Army barracks buildings similar in construction to those used as shops at many aircraft assembly plants. Usually the character of roads and paths leading to such buildings gave a clue concerning their function, but the appearance of the structure

itself did not. However, the standard pitch-roofed sod-covered barracks buildings illustrated in Photo 12 were consistently reported correctly as barracks because their function and appearance had been determined from ground surveys of facilities at captured Japanese Pacific outposts.

e. A number of small aircraft dispersal hangars (Photo 13) were both sod-covered and painted in disruptive patterns, but because of the easily detected taxiways which led to their entrances, no difficulty was experienced in identifying them.

4. Use of Nets, Garnishing and False Structures

a. Japanese use of the standard camouflage media of false structures and garnished nets or frames, although not

II CAMOUFLAGE

pre-war targets. In any event their efforts were much more effective in the camouflaging of small dispersed plants constructed during the war. The standard dispersed type of plant (used primarily in the aircraft industry) consisted of a number of low arched wooden buildings of varying size up to 50 x 75 feet which were sited to take advantage of natural concealment, frequently in the lee of hills along narrow wooded valleys. Their color blended with the surrounding terrain and in most instances their roofs were sod covered. Although plants of this type were often used to assemble aircraft, there was rarely more than an unimproved road or a narrow gauge

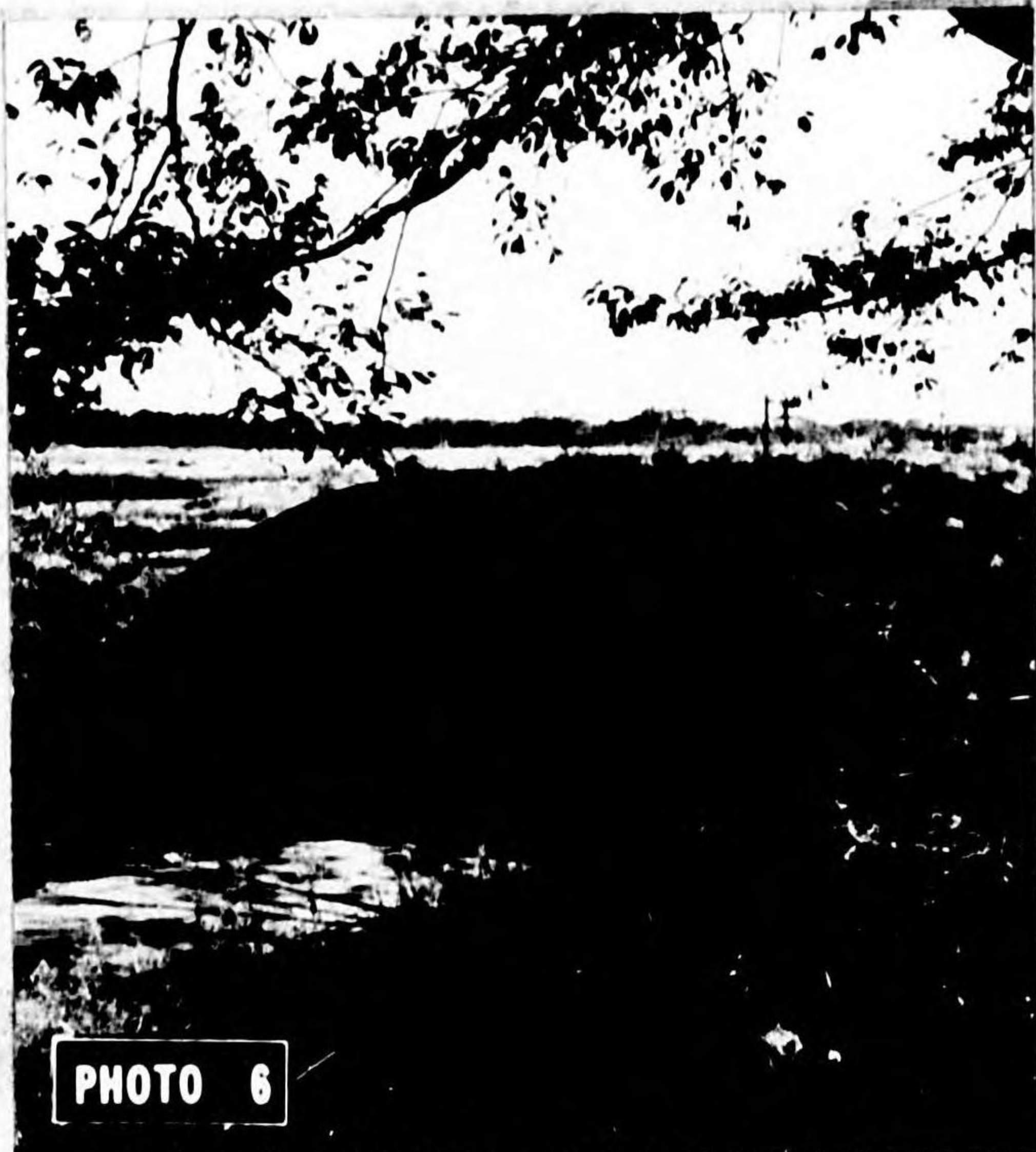


PHOTO 6

Final assembly building, Atsugi A/F.

railway leading to them. In areas of adequate photography a number of these plants were detected, but their function usually was not correctly interpreted and they were generally reported simply as concentrations of warehouses.

b. Photographs 6-8 of an aircraft assembly plant located near Atsugi A/F illustrate a typical use of sod-covered buildings. At this plant main assembly operations were carried on in a row of buildings partially hidden in the trees at the



PHOTO 7

Three sub-assembly buildings, Atsugi A/F.

base of a low ridge (Photo 6). Sub-assembly took place in smaller structures of the same type sited adjacent to farm buildings, and in tunnels dug into the ridge (Photos 7 and 8). Exhibit D presents a three dimensional view of the plant as it appeared from the air. Because there was a small landing strip located near these dispersal buildings, the entire group was reported as aircraft repair facilities.



PHOTO 8

Sub-assembly tunnel entrance, Atsugi A/F.

II CAMOUFLAGE

applied to installations as large as those camouflaged at German military posts or industrial plants, was in some instances very effective. This effectiveness naturally varied with the size of the installation camouflaged and with the understanding of the individual directing the work.

b. The most extensive use of gar-nished netting, in fact the most extensive Japanese camouflage effort of any kind, was directed toward the hiding of Naval units in the Kure area, where most of the carriers, a cruiser, and a few destroyers were moored

near land and partially concealed by nets strung between their decks and the shore (Photos 14-15 and Exhibit E). The outlines of a few of these vessels were further disrupted by false structures built over important elements of their superstructures. All camouflaged ships were successfully located and identified on aerial photographs. Target photographs prepared for US Carrier Task Forces by photographic intelligence units familiarized pilots with Japanese ship locations and nullified the potential effectiveness of camouflage during the Kure strikes of late July 1945.



PHOTO 12

Typical Army type barracks, Muroran.

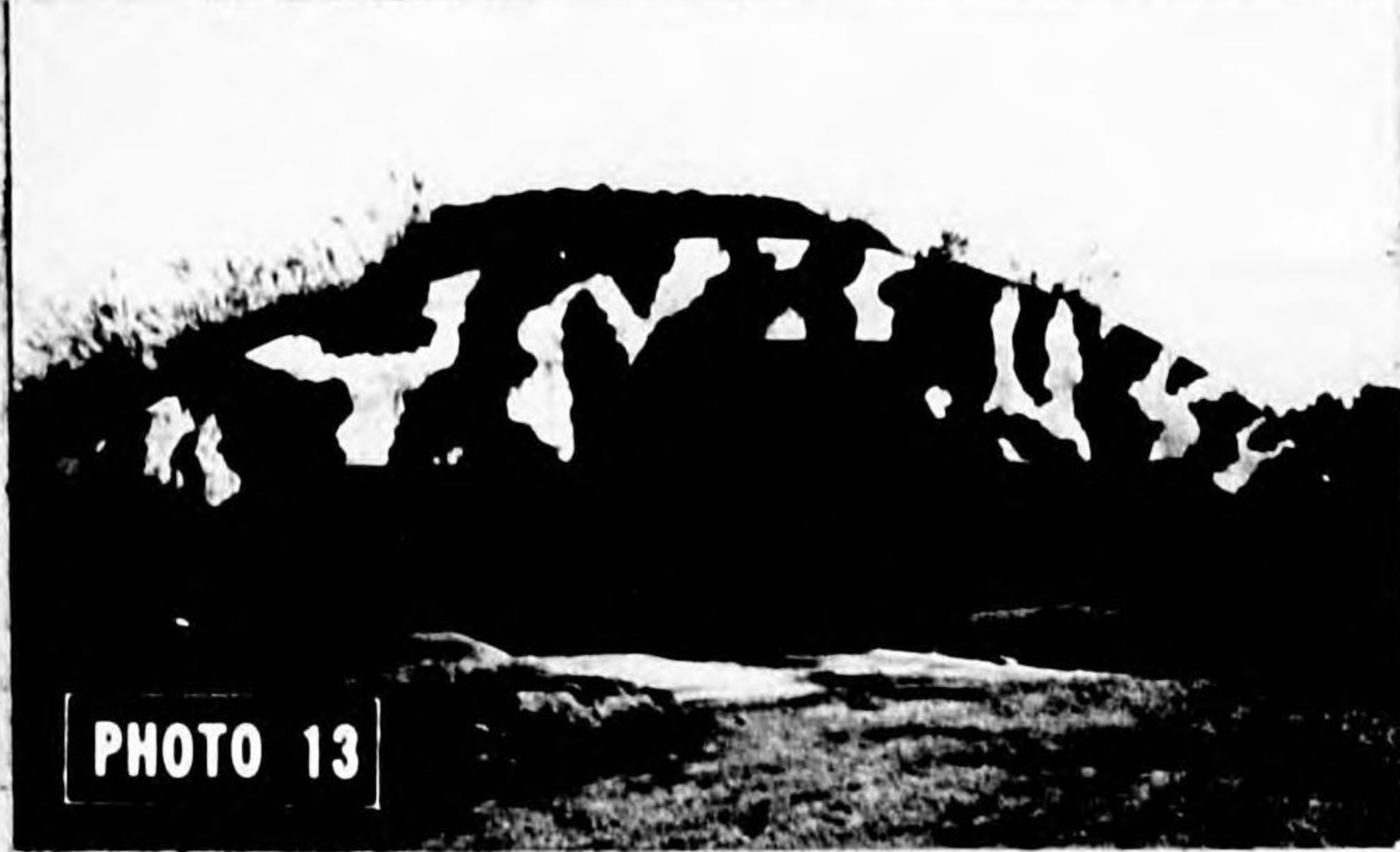


PHOTO 13

Sod covered dispersal hangar, Atsugi A/F.

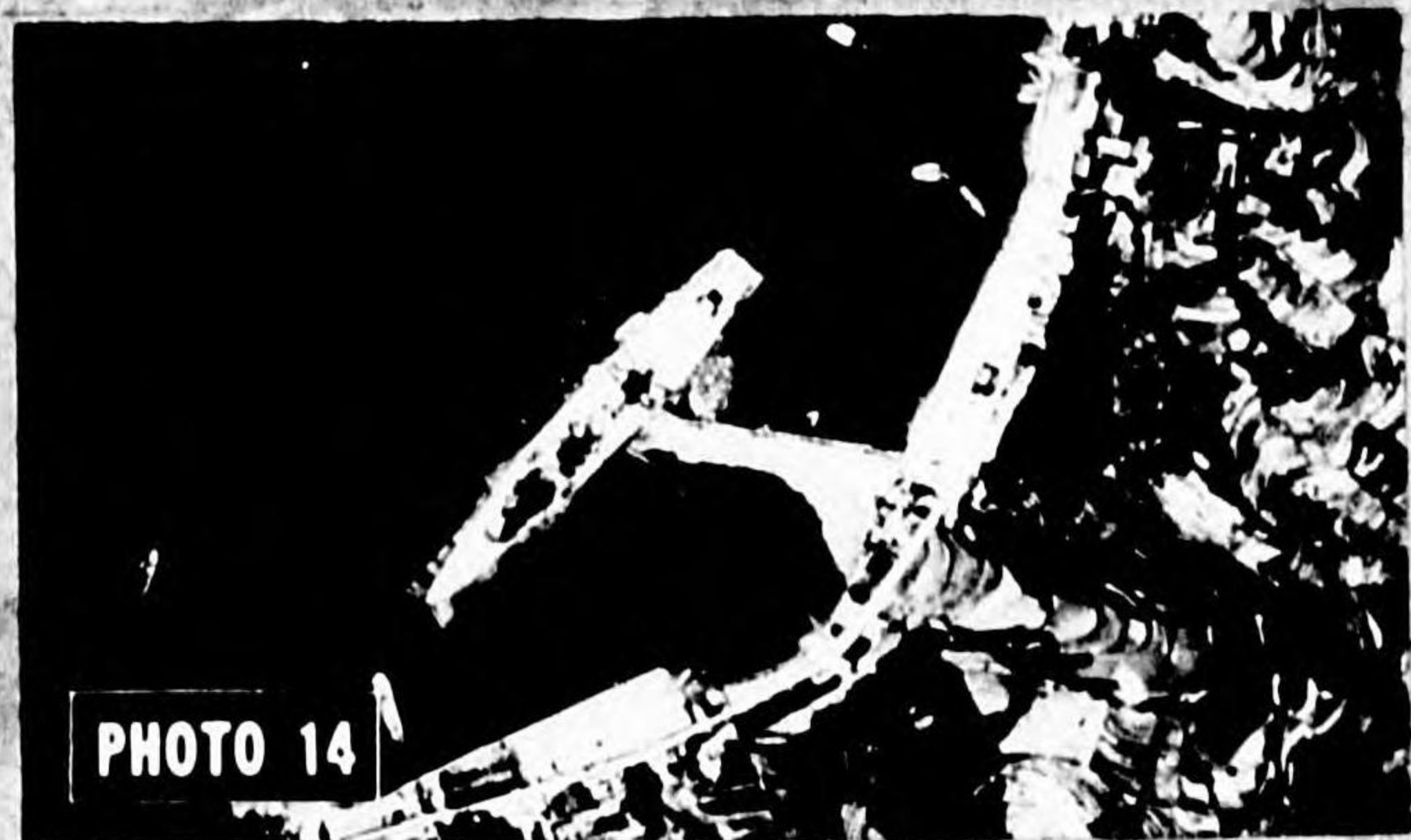


PHOTO 14

Cruiser Tone near Kure.

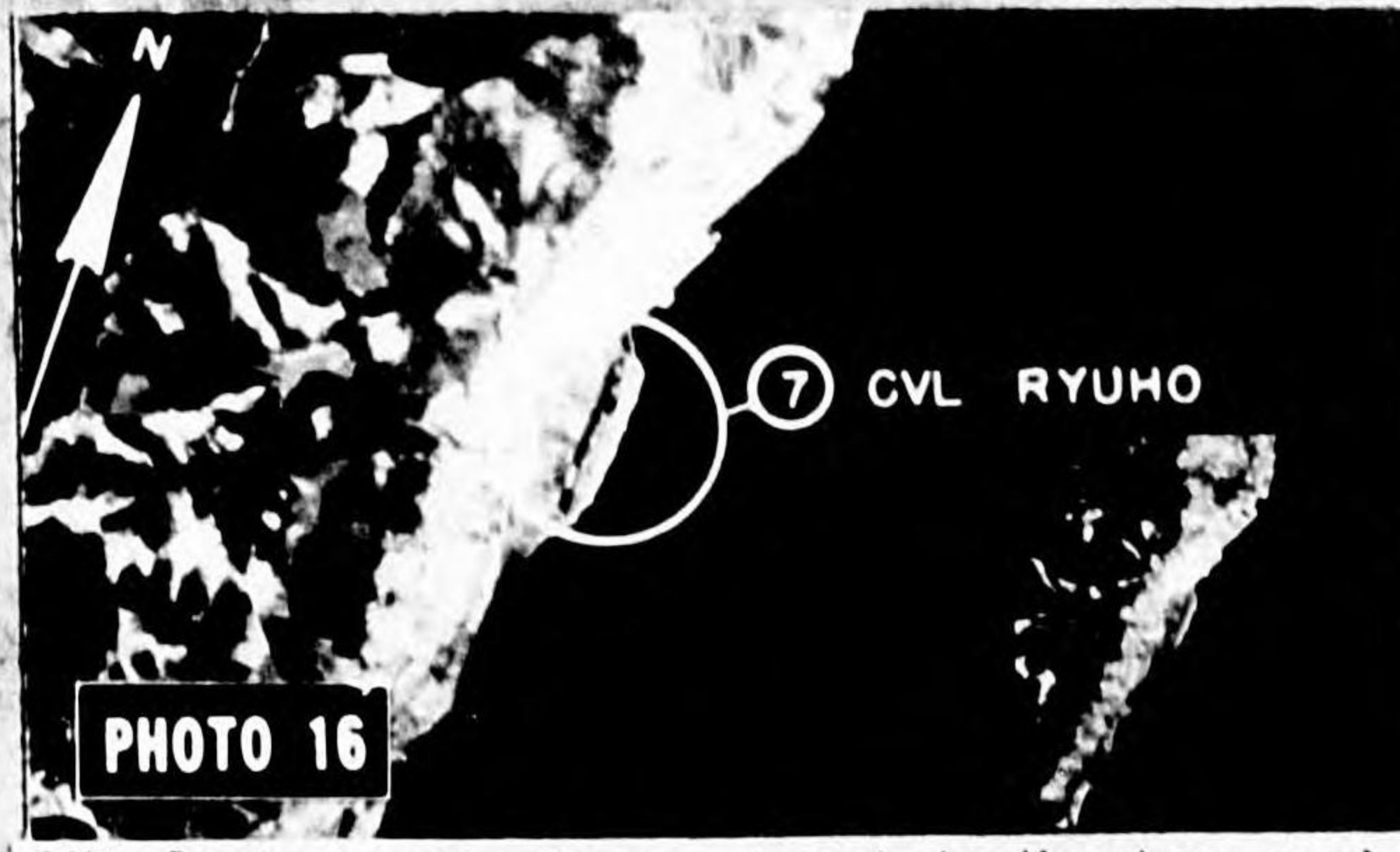


PHOTO 16

CVL Ryuho, near Kure. Inset indicates scale (1/60,000) at which PI's discovered carrier location.



PHOTO 15

Mitsuko Jima near Kure showing the camouflaged carriers Amagi and Katsuragi.

II CAMOUFLAGE

c. Other fairly general uses of garnishing and false structures were in the covering of aircraft revetments, gun emplacements, and electronics installations. Garnished cover of aircraft revetments usually hid the planes within, but seldom concealed revetment locations (Photos 17 and 18). Similarly, in some instances of camouflaged gun placements (e. g. the 280mm howitzer battery illustrated by Photos 19 and 20), although the garnished framing was visible

on aerial photographs, interpreters could not identify the installations underneath. A large percentage of the examples of guns camouflaged with nets or framing, however, caused little or no difficulty (Photos 21 and 22). Generally speaking, all efforts to camouflage heavy AA positions met with limited success because (a) even though the guns themselves were occasionally obscured, the pattern of battery layout was usually still plainly visible on aerial photographs,

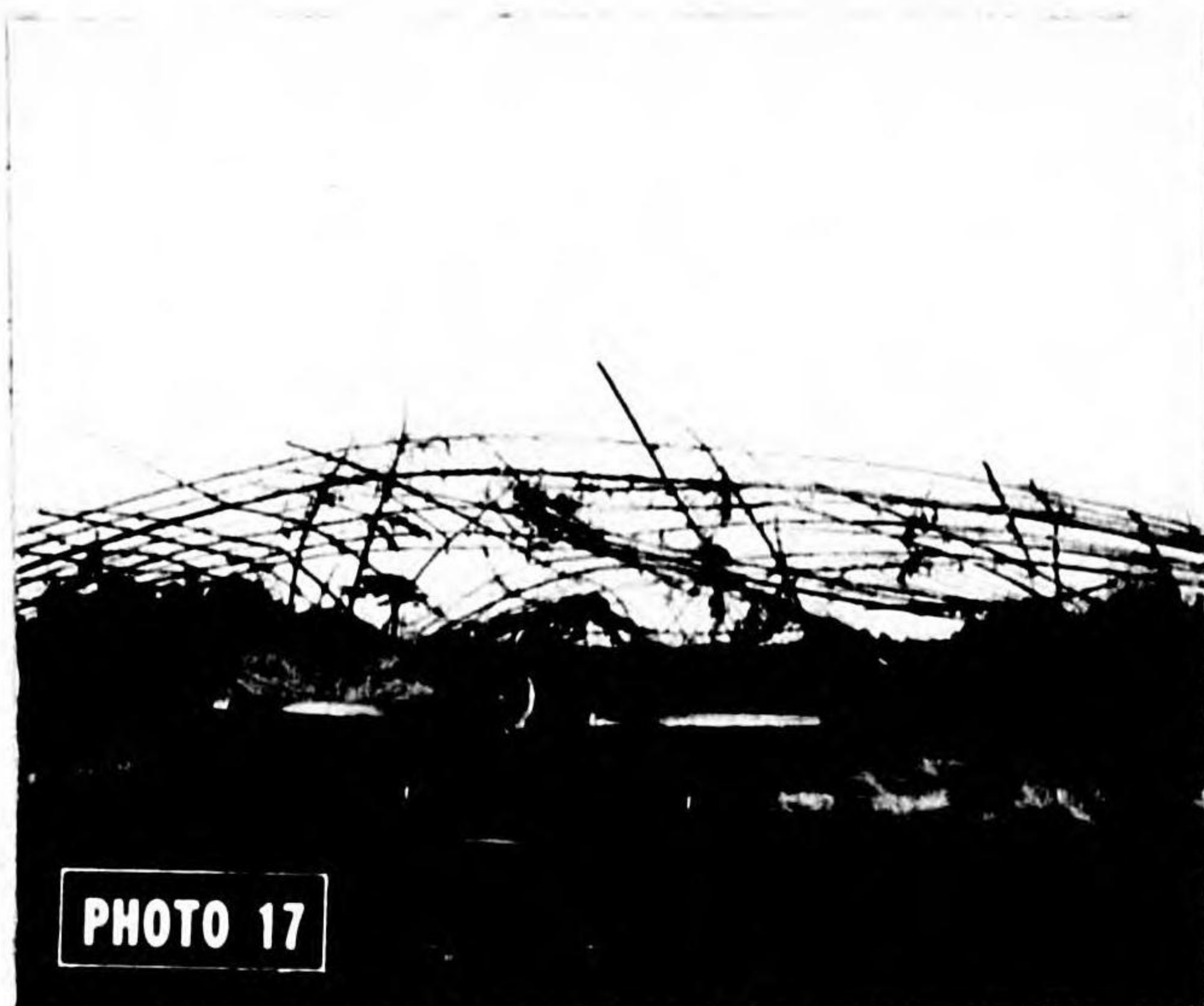


PHOTO 17

Fighter revetment, with garnishing stripped off bamboo framework, Fujisawa A/ F.



PHOTO 18

Revetments covered with garnished framings, Fujisawa A/ F. Circled revetment shown on Photo 17.



PHOTO 19

280mm howitzer battery, outer harbor Nagasaki.



PHOTO 20

Interior of ammunition track, howitzer battery, Nagasaki.

II CAMOUFLAGE

(b) thence for free movement of guns during firing restricted camouflage types to framing that could be quickly removed, and (c) when framing was removed for firing, guns were clearly visible on good quality strike photography.

d. Searchlights sited in revetments, and fixed radar installations of the "bed spring" type were ordinarily quite easily spotted on photographs. Portable radar and searchlights, and even smaller types of fixed radar, however, were quite often expertly camouflaged and as a result were not always detected by photographic interpreters. Photo 23 illustrates the effort sometimes expended by the Japanese in concealing portable radar installations. Tracks made by

radar trucks during installation of the equipment shown in Photo 23 would probably point to the existence of its position on photographs, but without large scale photography revealing the antenna, it is doubtful that interpreters would be able to recognize the position as a radar installation. Photo 24 shows a technique for garnishing radar antennae which if carried out more thoroughly could have been highly effective.

e. One of the best techniques used by the Japanese to hide defenses and electronics installations was the construction of movable structures which slid into position over equipment when it was not in use.

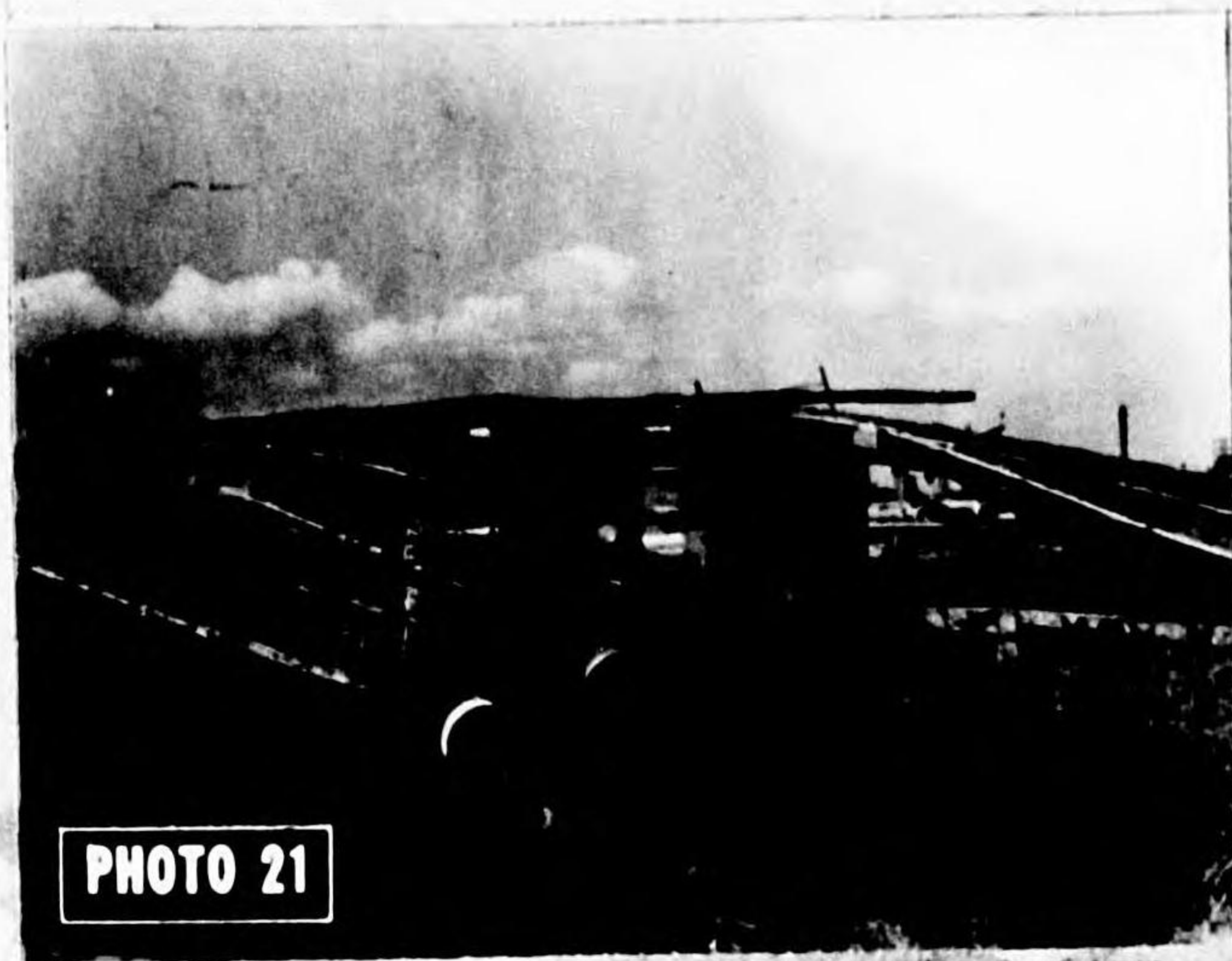


PHOTO 21

Bamboo lattice over 120mm AA gun, Kawasaki.



PHOTO 23

Camouflaged portable radar type Tachi 7.



PHOTO 22

CC position for 75mm artillery piece, Muroran.



PHOTO 24

Radar antennae garnished with branches, near Fukuoka.

II CAMOUFLAGE

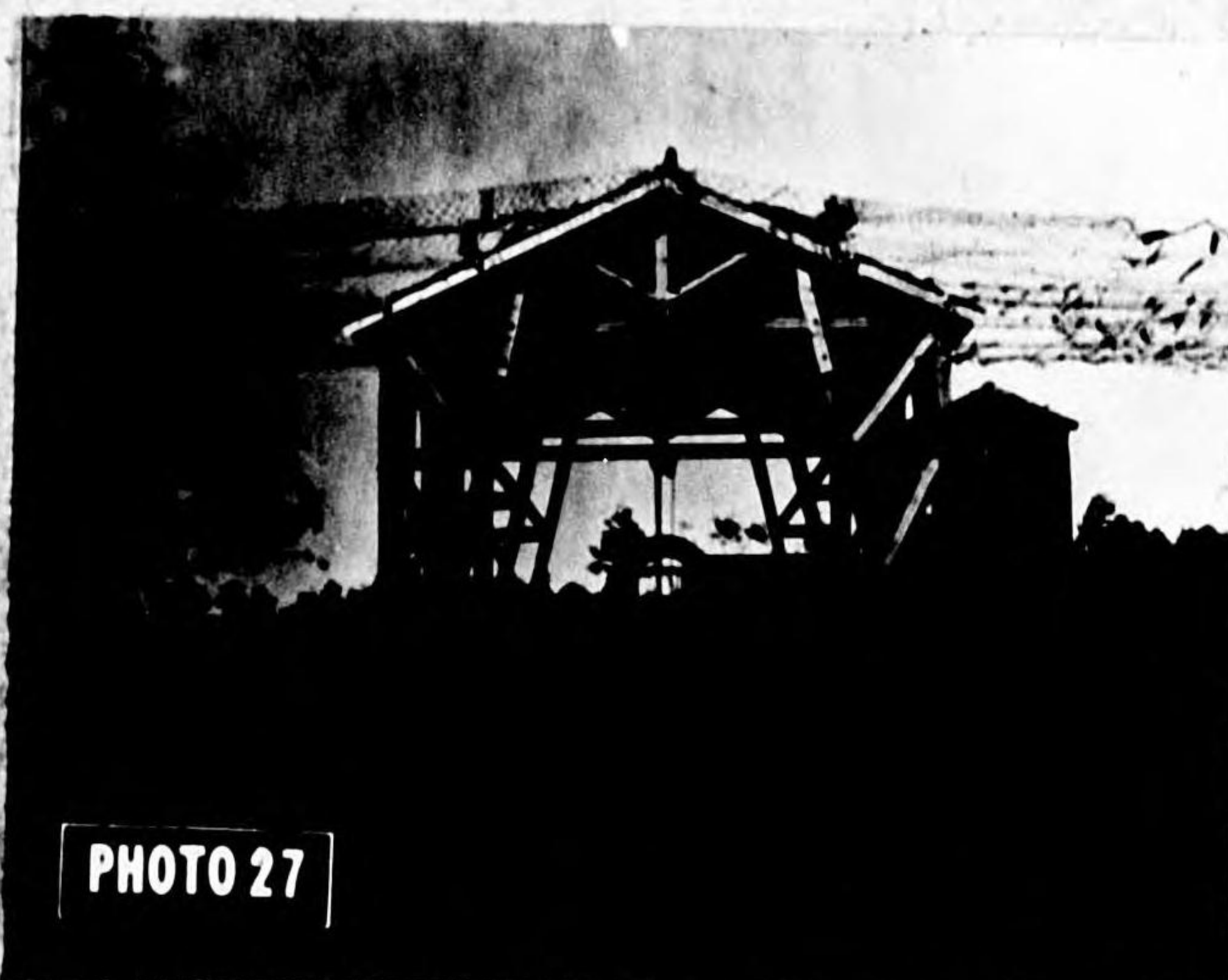
Photo 25 illustrates a radar installation of this type with the false covering in place, while Photo 26 shows a gun revetment with its covering removed. In neither of these cases had photographic intelligence reported the nature of the installation beneath the housing. Nevertheless, it is believed that the movable character of positions of this type can be interpreted from good photographic cover by the analysis of adjacent rails.

f. Further proof that many Japanese

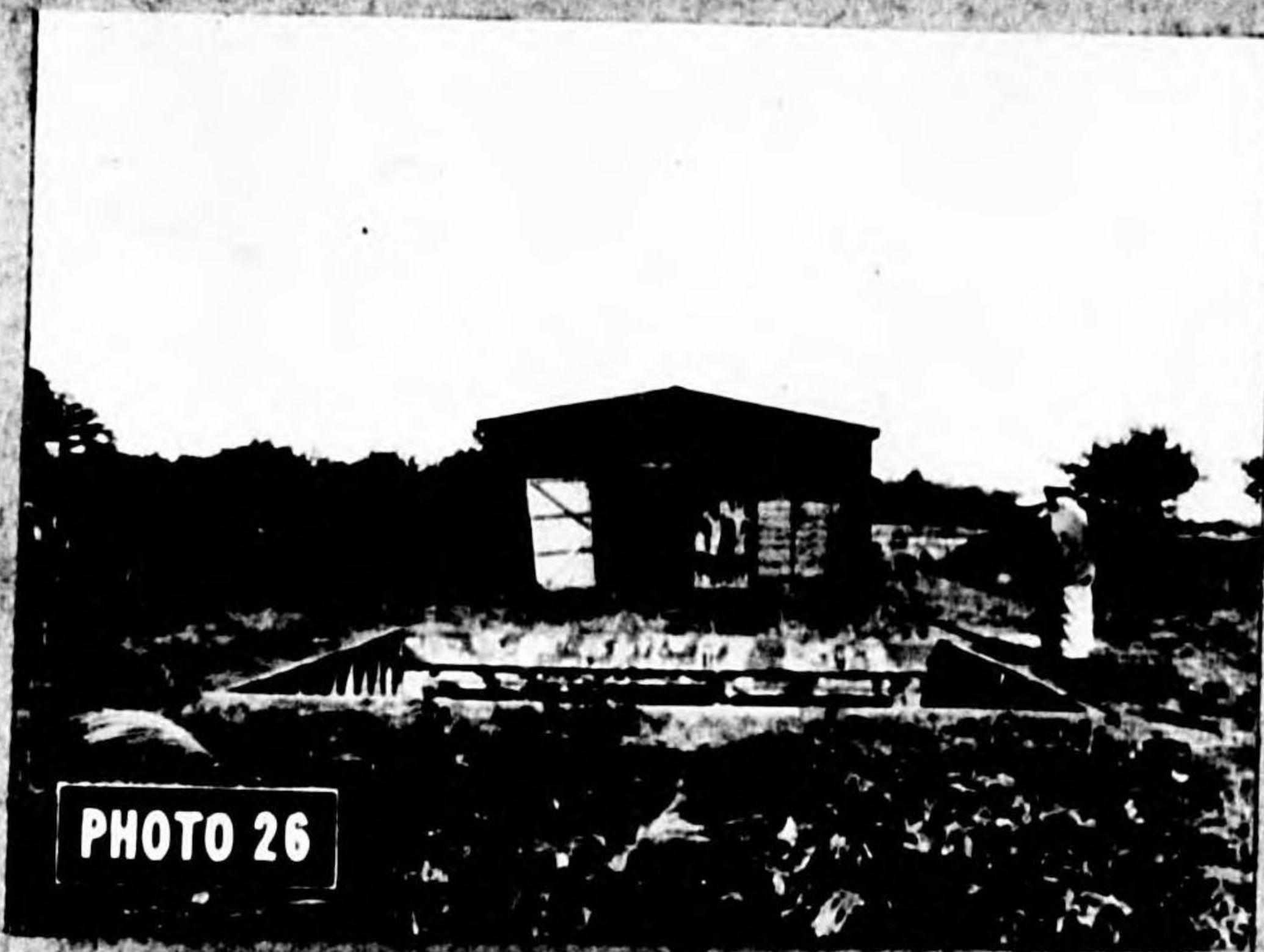
did not understand the various techniques of camouflage is given in Photos 27-29. In Photo 27 the netting stretched over engine test cells at the Nakajima Omiya Plant never acted as a deterrent to identification. In fact the net was not even visible on available aerial photographs. Although the bamboo cover shown in Photo 28 concealed the locomotive which it housed, its use was obvious from the tracks which led into either end. An attempt to break up the outline of the Sasebo reservoir dam was completely unsuccessful as an examination of Photo 29 will reveal.



Mobile house covering radar, Kawasaki.



Netting covered engine test cell, Nakajima Aircraft Engine Plant, Omiya.



AA position with movable house, Tokorozawa Airfield.



Locomotive shed, Omura A/C factory, Kyushu.

II CAMOUFLAGE

5. Use of Natural Features and Terrain

a. Some of the most successful results of Japanese efforts to hide installations, equipment, and materials from the aerial view were obtained by use of natural terrain features such as small groves of trees. Natural features were employed most extensively in the dispersal of aircraft and in the siting of a multitude of small storage dumps. In general, hardstands under trees were located, but it was seldom possible to tell whether or not they contained aircraft. It was the exception when storage depots sited in woodland areas were detected primarily because (1) dumps were usually small and were often used for small items such as

gasoline drums or bombs; (2) the materiel stored in these dumps was transported by small vehicles which did not leave heavy tracks; and (3) some materiel was buried in the woodland floor.

b. Photo 30 indicates the relative ease with which dispersed hardstand can be located even when sited in wooded areas. The fuselage parts in the shrine area illustrated by Photos 31 and 32 were dispersed in a grove of trees and were therefore not detected. When stores were placed in warehouses, in gullies, or in large dumps in the open (Photo 33), they were generally located and occasionally described by type.



PHOTO 29

Unfinished attempt to camouflage reservoir near Sasebo.

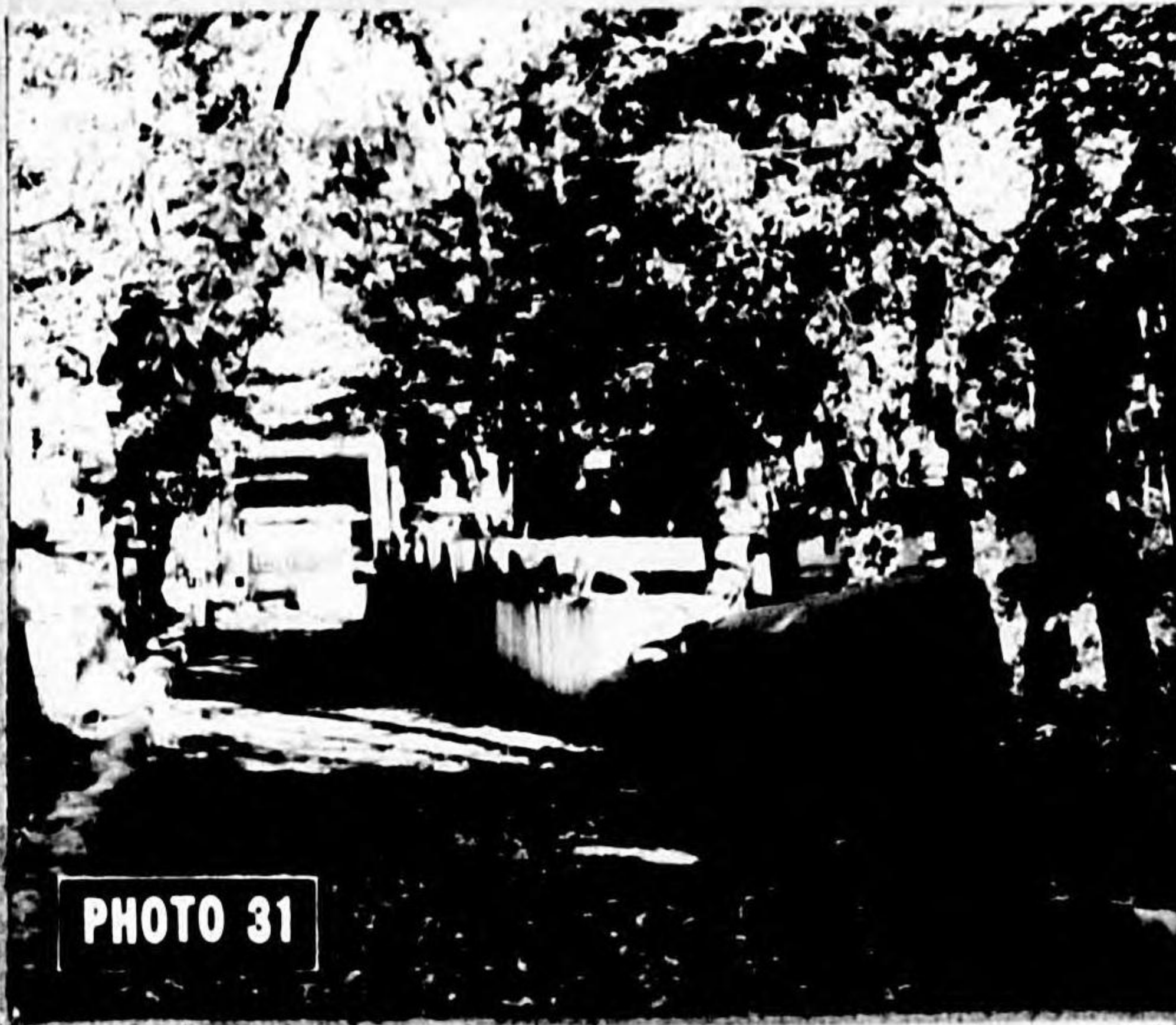


PHOTO 31

Fuselage parts stored in Shrine, near Kawasaki Aircraft Works at Kagamigahara A/F.

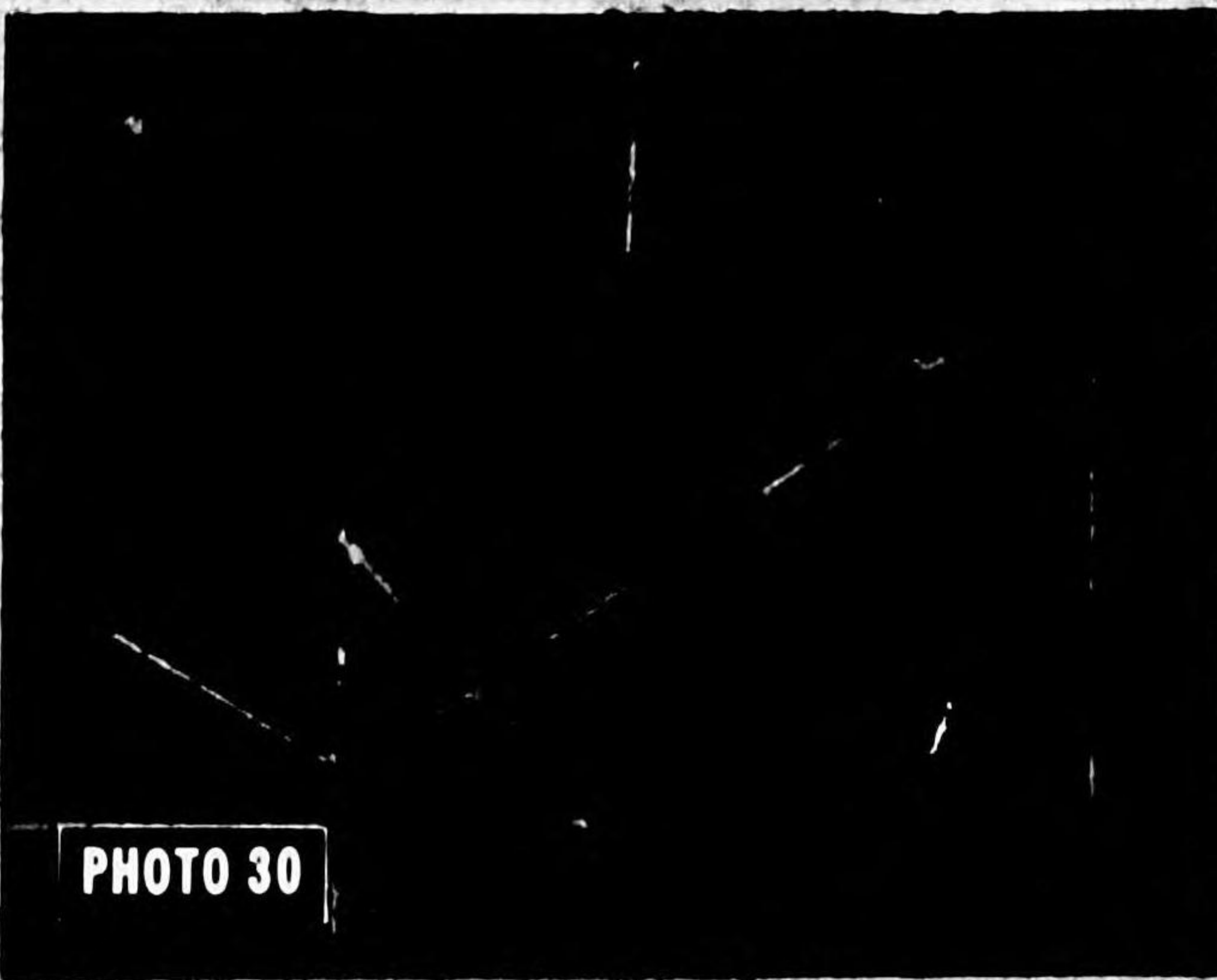


PHOTO 30

Dispersal hardstands concealed in woods, Atsugi A/F.

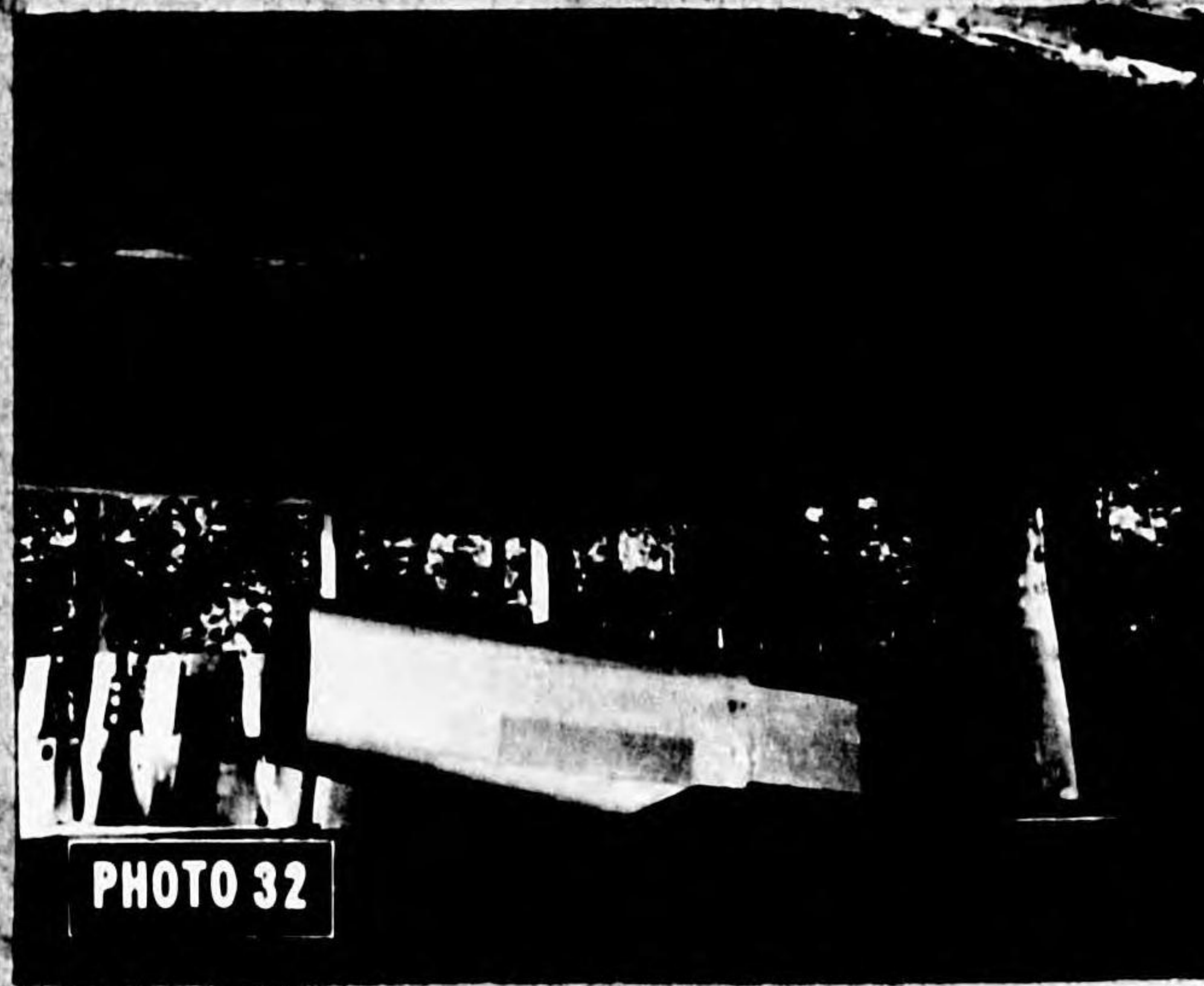


PHOTO 32

Fuselage parts stored in Shrine, near Kawasaki Aircraft Works at Kagamigahara A/F.

II CAMOUFLAGE

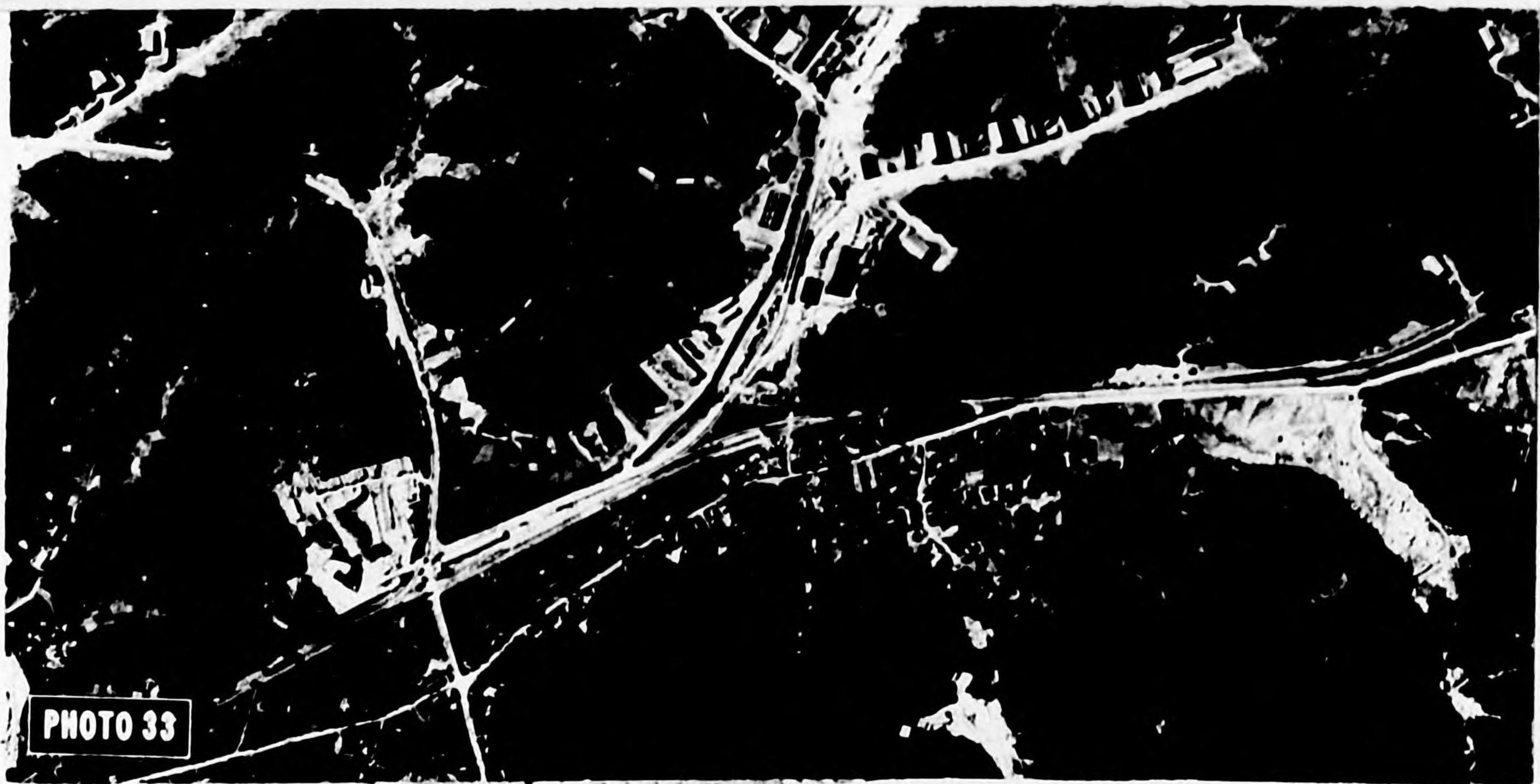


PHOTO 33

Dispersed storage, near Zushi, Miura Peninsula.



PHOTO 34

Edogawa Airfield, Tokyo Area.

Edogawa Airfield (Photo 34), known to the Japanese as a "secret" field, illustrates an additional use of natural terrain for camouflage purposes. Although never completed, this field was being built by draining rice paddies and sodding them over, thereby giving a fair weather sod runway that tended to keep the broken pattern of individual cultivated paddies. An auto

road which crossed the field area was to be graded to the level of the runway surface but retained to create deception. Along one edge of the field paddies were crested out to provide catch basins into which water from the runway could drain, and airfield facilities were to be placed underground. Despite all of these efforts to make the Edogawa field secret, it was detected on aerial photographs soon after construction started.

III CONCEALMENT

III CONCEALMENT

I. Summary Description of Japanese Underground Construction

a. By far the most effective technique used to hide Japanese activity from the aerial view, and potentially the greatest threat to photographic intelligence was the practice of concealing important military and industrial facilities in systems of underground tunnels. By the end of the war, although only a few underground plants were actually in operation, the construction of tunnel-type factories for the dispersal of plant units doing light machining and assembly was beginning to assume major importance. Within a few more months, an important percentage of Japan's essential warplants might have been operating underground. The trend toward subterranean dispersal of industry was particularly evident in the aircraft industry in which a total of 37 assembly or parts plants were either wholly or largely underground at the end of the war.

b. A few of the underground developments present in Japan were identified from photographs as "areas of tunnel activity", but only one or two were described in published reports, and none was recognized for its true function. Short tunnels were widely used as air raid shelters. Unfortunately, however, there was little indication on aerial photographs as to whether a tunnel entrance opened into a shelter or was an entrance to an underground factory. The clues ordinarily present according to standard training doctrine, namely extent of spoil and track activity, were found to be generally unrelated to the function of the tunnel.

c. The tunnel entrance portrayed in Photo 35 has nothing distinctive about it to indicate that it opened into a machine shop. Similarly, although the spoil visible in Photos 36 and 37 indicates extensive tunneling apparently not intended for air raid shelters, there is no clue to suggest that the tunnels in Photo 36 were planned for aircraft component machinery, or that those in Photo 37 were being built to house the mine producing units of a Naval arsenal.

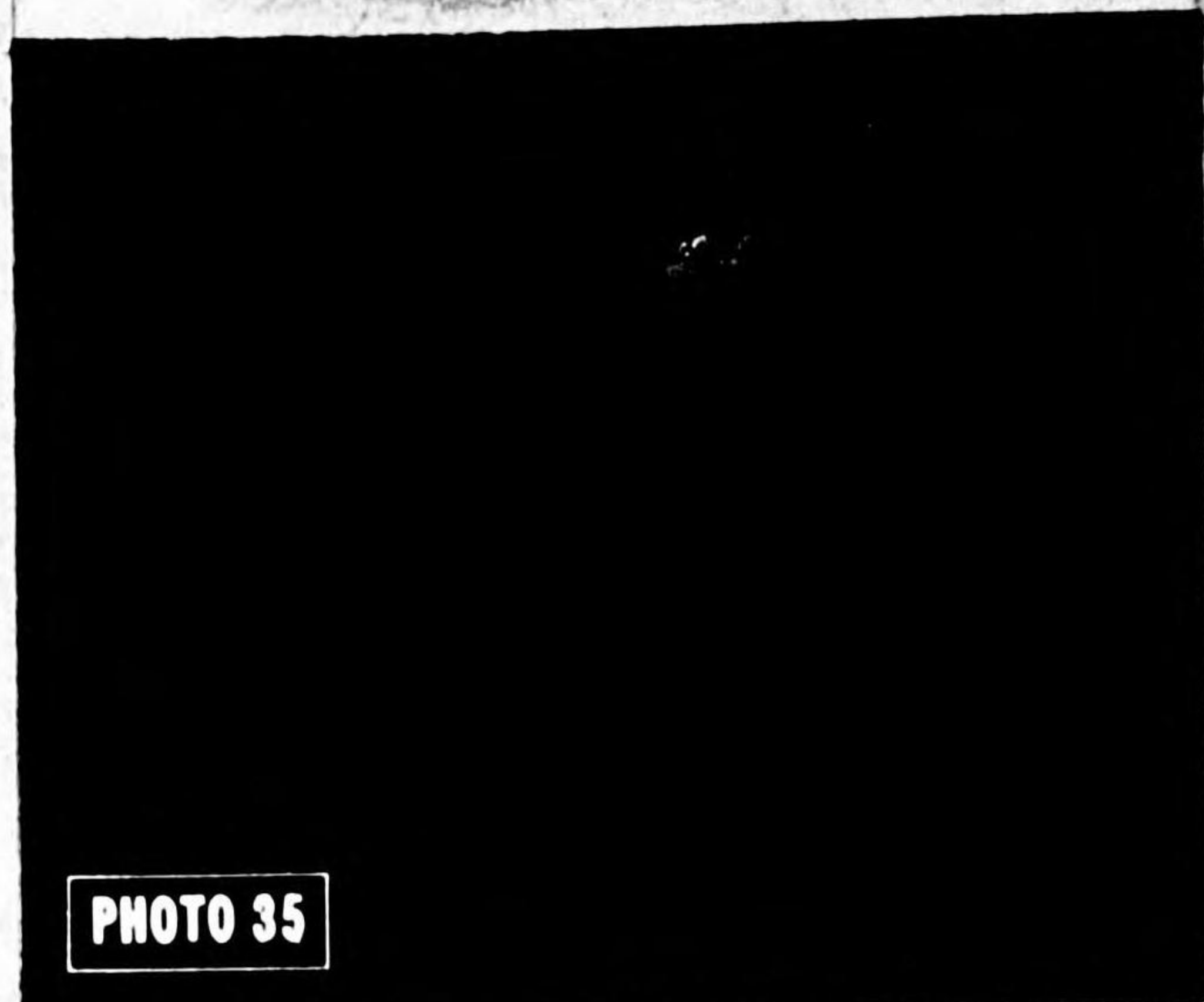


PHOTO 35

Machine shop entrance near Takahagi.



PHOTO 36

Tunnel entrances and spoil, Kukuri Aircraft Engine Plant.



PHOTO 37

Two levels of tunnel entrances (note spoil), at Ofuna Naval Mine Arsenal.

II CAMOUFLAGE



PHOTO 38

Diagram showing extent of tunnels at the First Technical Naval Air Arsenal, Yokosuka.

II CAMOUFLAGE

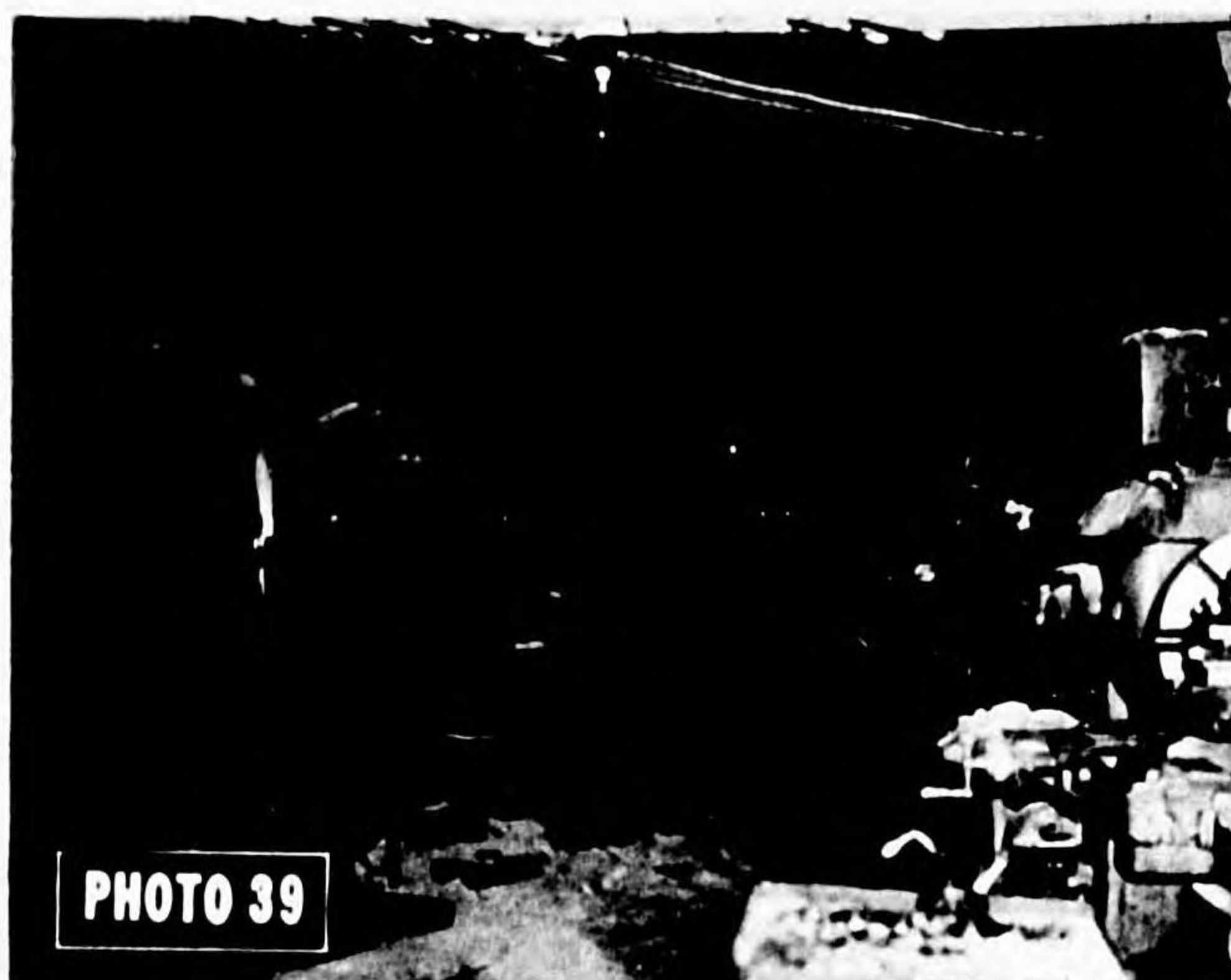
Furthermore, the presence of spoil is usually an identifying factor only during plant construction and not always then, for careful spoil disposal eliminates tell-tale evidence. In short, during the attacks on the Japanese Homeland, the combination of ground information and photographic intelligence provided the only reliable evidence in regard to subterranean dispersal of industry.

2. First Technical Naval Air Arsenal, Yokosuka

a. One of the best examples of a Japanese underground aircraft plant, and one of the few that were actively in operation during the war was the First Technical Naval Air Arsenal at Yokosuka. This plant possesses a total tunnel floor space of 350,000 square feet (Photo 38) and was complete with offices, laboratories, machine shops (Photos 39 and 40), power supply, and storage facilities (Photo 41). Since the terrain around Yokosuka was quite rugged, with steep low hills and narrow valleys, it was ideally suited to the construction of a plant of this type. To assist in concealment, the principal entrances to the arsenal had been built to open into pre-war highway tunnels of which there were a great number in the area.

b. Photographic interpreters working on the Yokosuka Naval Base were aware of the existence of some of the tunnel entrances, had noted some evidences of spoil, and had detected instances where roads led directly into hillsides. There was no indication of the use of the tunnels, however, and it was the prevailing opinion that they contained stores. The extent and function of the different tunnels were not realized nor was it understood that all were connected to form a single system.

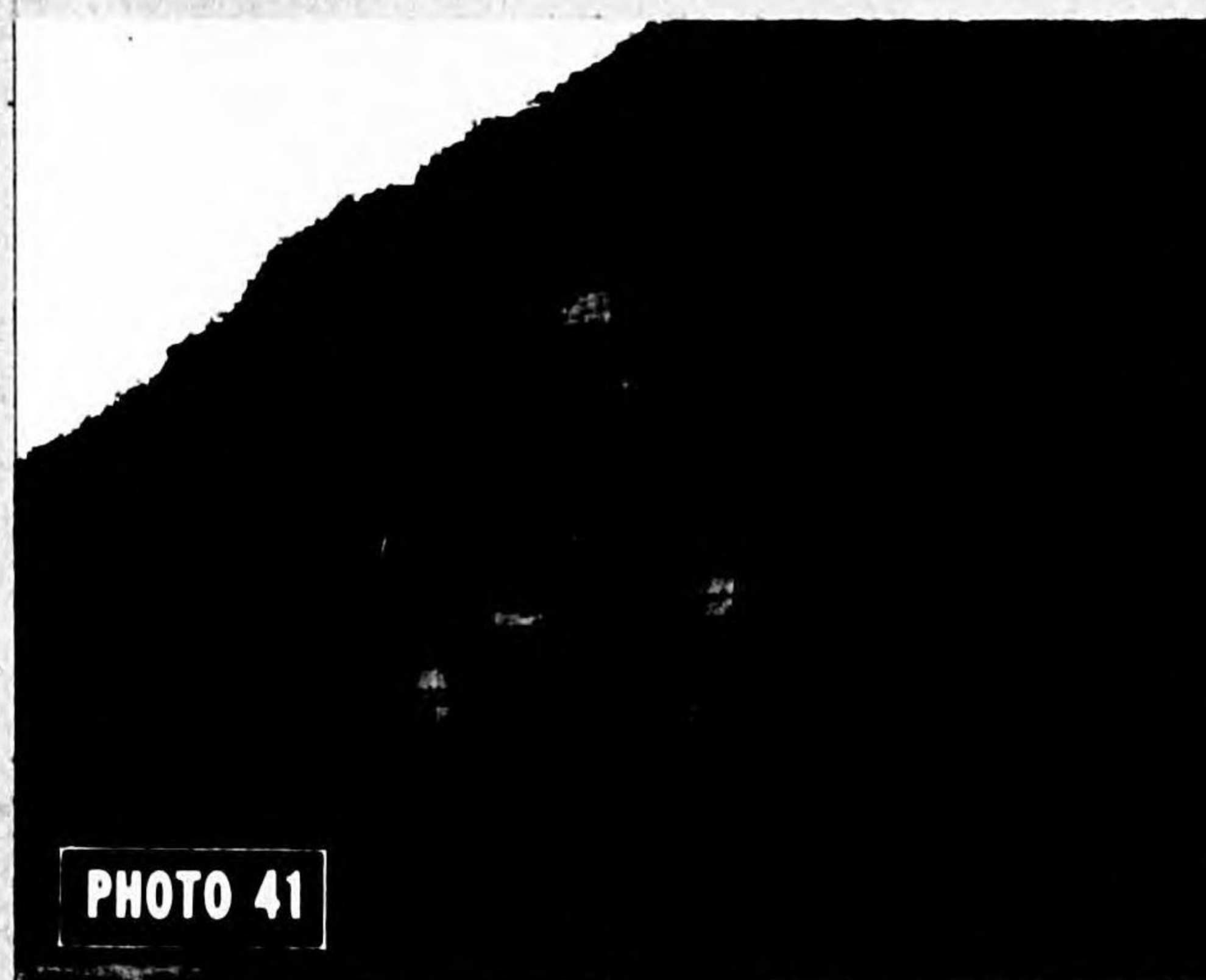
c. At the Yokosuka Naval Air Station (Exhibit A) which was adjacent to the First Technical Naval Air Arsenal, hangars (Photos 42-44), storage vaults (Photos 45 and 46), repair facilities, schools, and barracks were all housed in tunnels. As in the case of the air arsenal the presence of entrances and spoil on photographs of the air base was noted but the purpose of individual tunnels could not be determined. Consequently, these facilities were reported only as "evidence of underground activity".



Underground machine shop, Yokosuka Naval Arsenal.



Machine shop entrances, Yokosuka Naval Arsenal.



Storage tunnel entrance, 1st Tech. Naval Air Arsenal, Yokosuka.

III CONCEALMENT

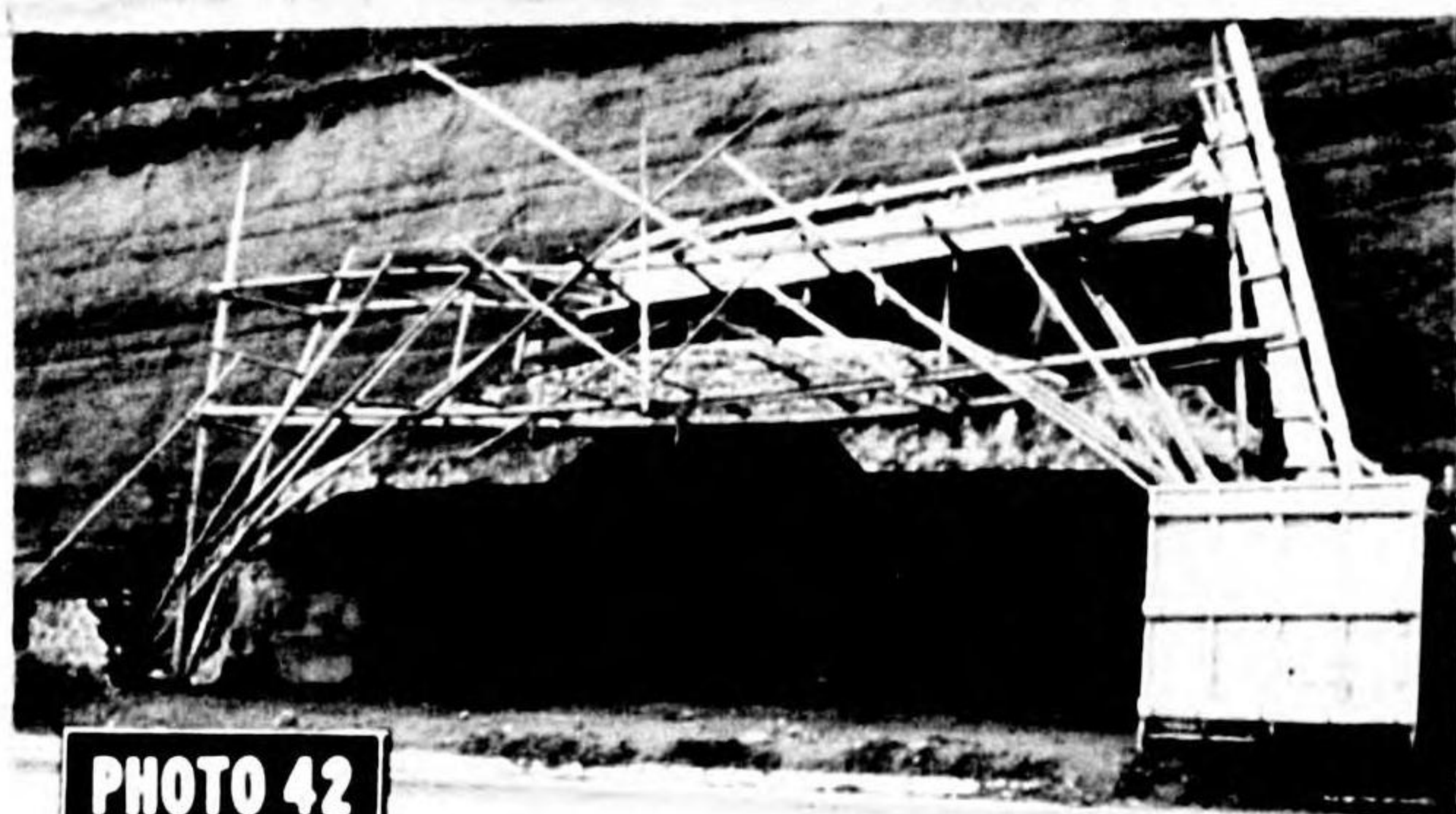


PHOTO 42

Nearly completed underground hangar, Yokosuka Airfield.

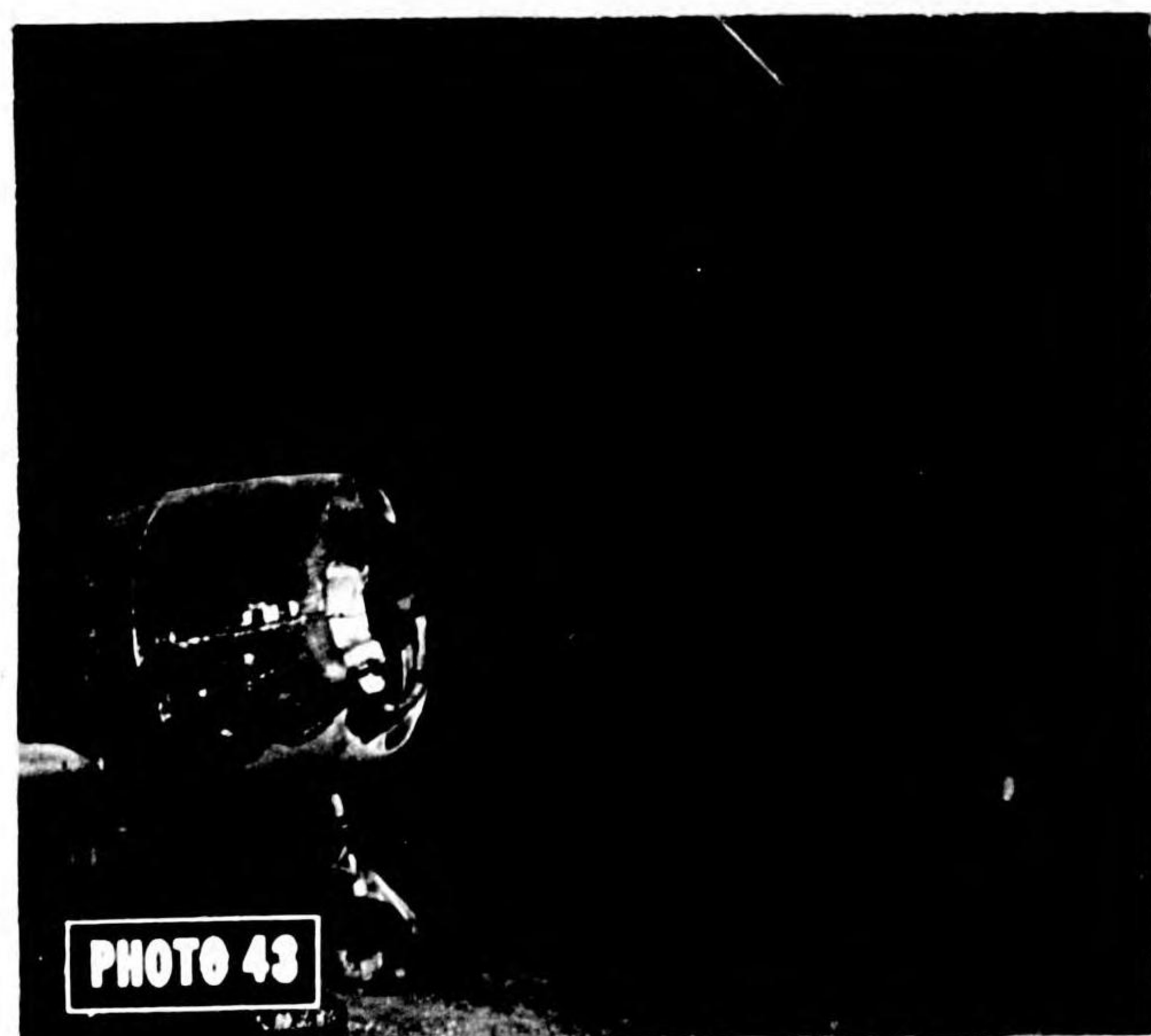


PHOTO 43

Interior of underground hangar, Yokosuka Airfield.

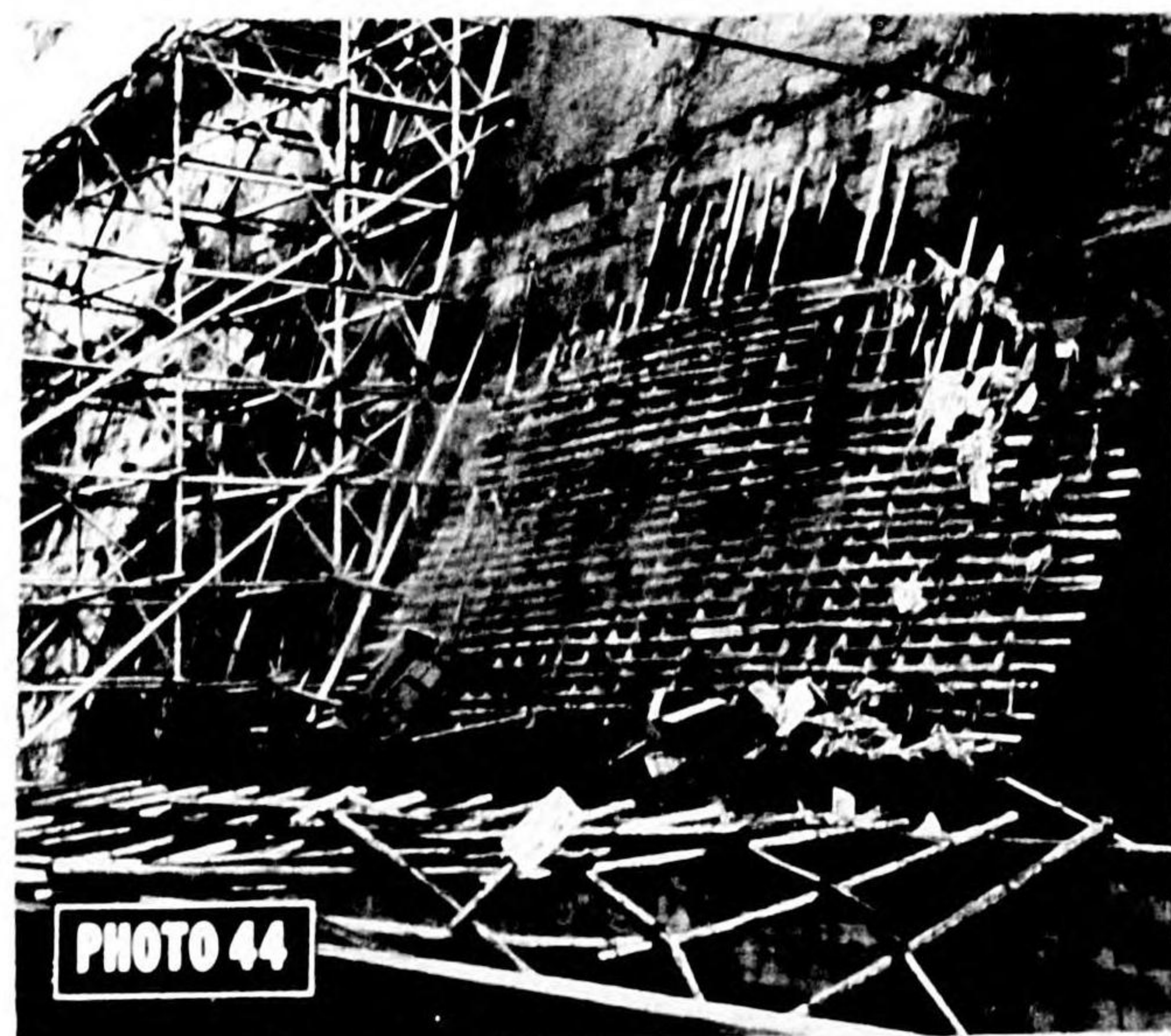


PHOTO 44

Rear entrance to hangar, Yokosuka Airfield.

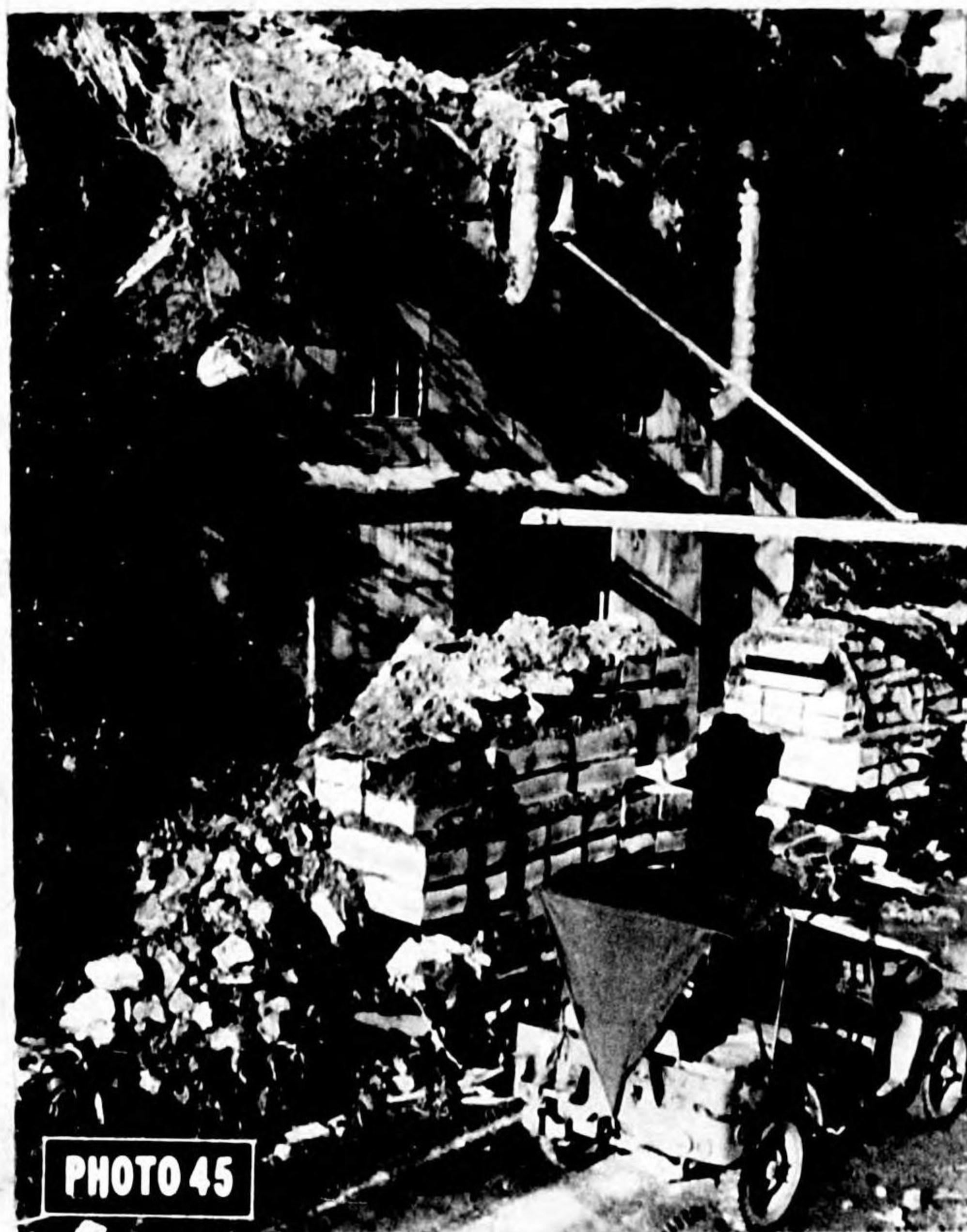


PHOTO 45

Ammunition storage, Yokosuka Airfield.



PHOTO 46

Interior of ammunition storage, Yokosuka Airfield.

III CONCEALMENT**3. Miura Peninsula Midget Submarine Base**

a. In the hills of Miura Peninsula north of Misaki the Japanese had constructed a complete midget submarine base (Exhibit B) which consisted of five submarine shelters (Photo 47), torpedo and torpedo tube storage, a battery charging station, and repair workshops. All facilities were located in tunnels with the exception of quarters which were in earth-covered barracks on a plateau above the base.

b. As long as photographic coverage of the Miura Submarine base was limited to small-scale verticals, its existence was not detected. When large scale obliques became available, however, observation of a midget submarine in the bay near the peninsula led to discovery of the base itself. At no time, however, was there any conception of the completeness of base facilities.

4. Coast Defense Guns

a. Because coast defense positions were ordinarily either casemated or emplaced in caves, very few of those checked by USSBS field teams had been located from the plan-view afforded by vertical aerial photographs. It should be noted, however, that no ground check was made of coast defense batteries in Southern Kyushu where the greatest effort to locate CD positions in the Home Islands had been made. Photo 48 illustrates the character of casemated positions and indicates the difficulty of detecting the location of such guns on vertical photographs. In several instances casemates were served by tunnels entered on the opposite side of a hill. Where this is true, or where emplacements are carved out of cliffs, it is probably easier to discover apertures on oblique photographs rather than on verticals (Photo 49).



Cave storage for two man subs, at submarine base, Miura Peninsula.

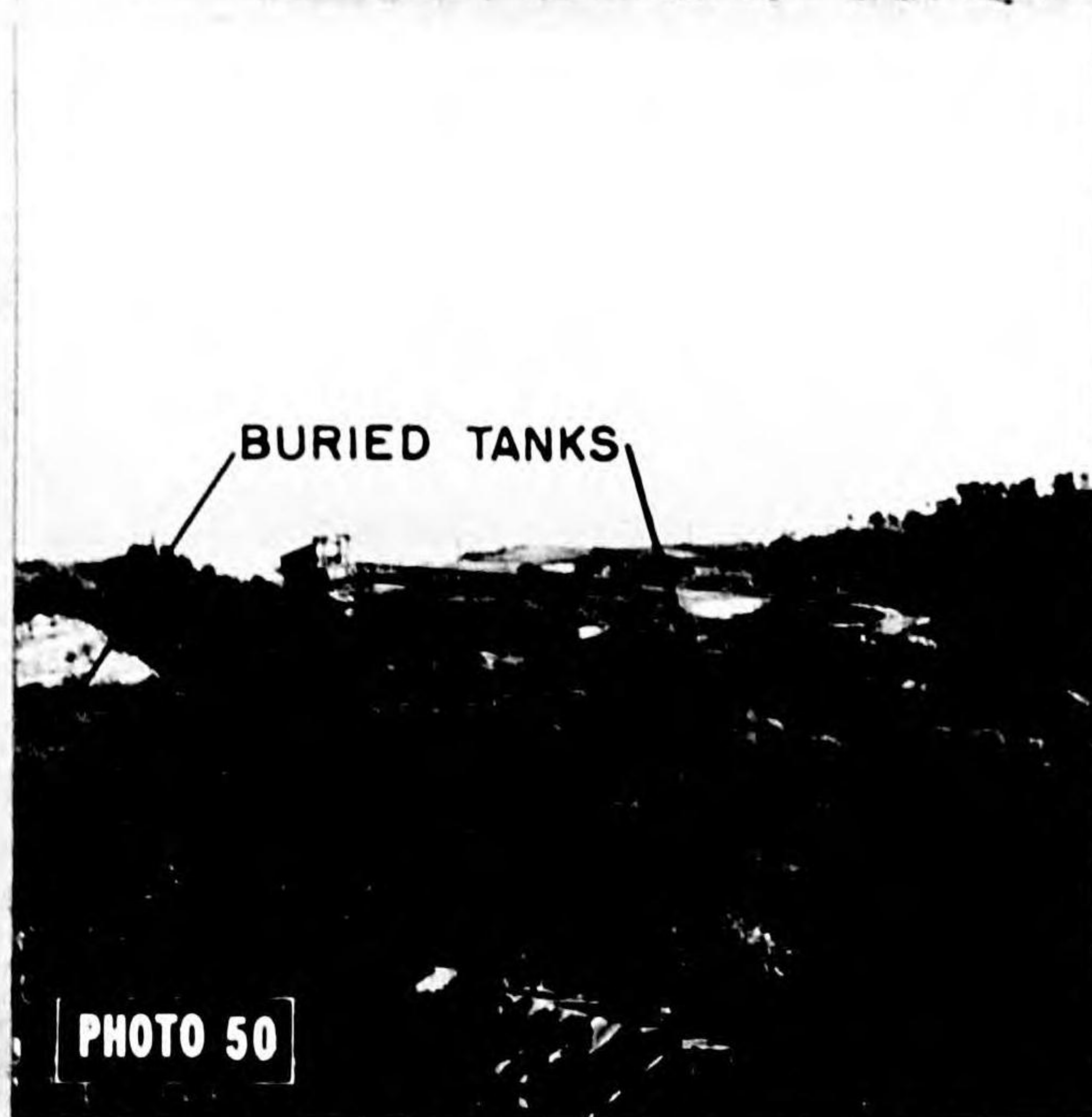


Casemated 75 mm CD gun, Kamakura.



Hillside apertures of three 5 inch CD gun emplacements under construction, Katase.

III CONCEALMENT - IV DECEPTION



Looking SW across Koshiha Pt., oil storage. Note buried tanks in foreground.



Oil storage, Tomioka Seaplane Base

5. Buried Oil Storage

a. In nearly all of the cases checked in Japan buried fuel tanks had been correctly reported by photographic intelligence. A great many small dumps of oil drums, however, escaped detection.

b. The tanks at Koshiha Point on Tokyo Bay (Exhibit C) are a typical example of buried oil storage. At this location seven large tanks had been completed, while others were still under construction (Photo 50). Both the buried tanks and the tanks under construction were reported correctly, but oil drums stored in tunnels at the base of the hill were not reported.

c. Fuel at the Tomioka Seaplane Station (Photo 51) was stored in horizontal tanks covered by a reinforced concrete roof which was then sodded over. For this reason the dump looked like a highly camouflaged building. Nevertheless, the tanks were correctly identified on the basis of their logical location and the presence of a servicing road connecting them with the Seaplane Station.

IV DECEPTION

1. Principal Japanese Uses of Dummies

a. In the difficulties they caused photographic interpreters, Japanese dummy installations were second only to underground installations. The two types of equipment most often simulated by dummies were AA weapons and aircraft. Makeshift fabrications (Photo 52) were often detected, but dummies which had been carefully copied were quite frequently misinterpreted as real (Photo 53). The identification of aircraft was further confused by the Japanese use of inoperative planes as decoys. It is estimated that together decoys and dummies made up about 25 per cent of the total apparent aircraft at Japanese fields. The most important technique photographic interpreters can use to interpret well made dummy planes is a careful study of their positions on successive photographic coverages. Planes which are in the same position week after week are likely to be dummies although it is obvious that once the enemy understands this method of interpretation he can easily nullify its effectiveness. Gun positions which week after week show no track activity or no evidence of firing are also likely to be dummies.

IV DECEPTION

2. Other Uses of Dummies.

a. At Sasebo in areas of inadequate photographic coverage excellent reproductions of radar installations were erected. Some of them had been misinterpreted. At Atada Island, 3½ miles from the Otaki Oil Refinery, a decoy tank farm had been constructed (Photo 54). The tanks were built of bamboo poles and slats, but possessed no simulated pipe lines or protective fire walls. This installation was erroneously reported by photographic intelligence as a tank farm because of carelessness rather than because of any inability to recognize it as a decoy. Photographs taken prior to the end of the war were re-checked, and it was found that they left no doubt as to the classification of this installation as a decoy (Photo 55).

3. Dispersal of War Industry in Unorthodox Buildings

a. One final practice of the Japanese which, although perhaps not intended to create deception, confused the photographic interpreter was the Japanese use of small

factories and public buildings for industrial dispersal. Schools, theaters, shrines, and economically unimportant mills were all used for light machining of aircraft and ordnance parts. Examples of this type of dispersal were the repair shops at Kasumigaura Airfield which were dispersed in sheds and barns five miles from the field, the parts machinery of the Tachikawa Air Arsenal which was set up in a museum several miles distant, the light machine tools of the Aichi Aircraft Company, Nagoya, which were moved to small pottery mills in Seto 12 miles away, the innumerable examples of small textile mills converted to aircraft parts, and the dispersal of Mitsubishi Electric Company equipment from Nagoya to an elementary school approximately thirty miles distant along the Chuo Railroad line.

b. It is likely that much of this uneconomical dispersal was due to an acute shortage of building space resulting from urban area fire raids rather than to an effort to conceal, yet the fact remains that practically none of the dispersal of this kind was detected by photographic intelligence.

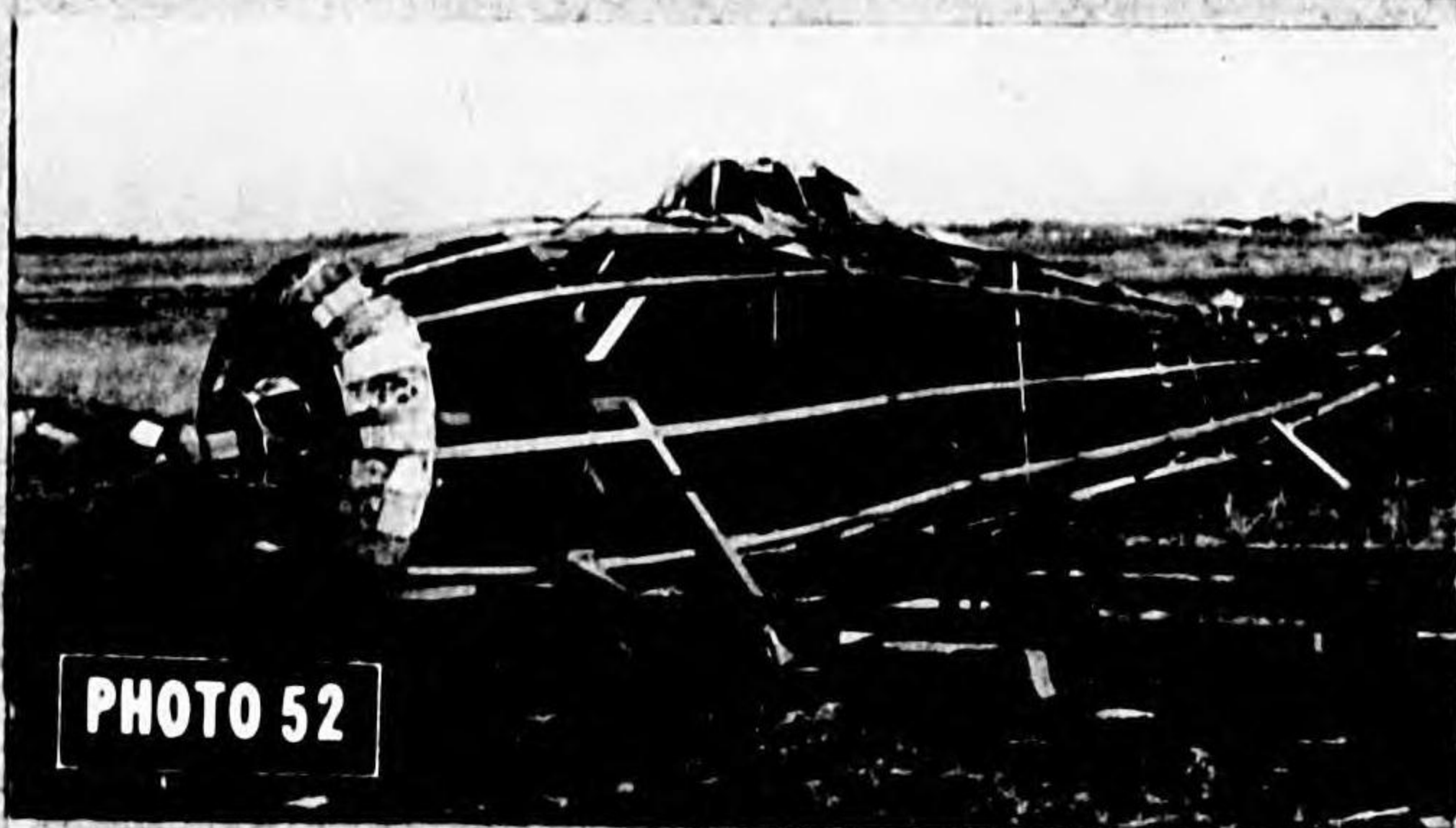


PHOTO 52

A typical Japanese aircraft dummy easily interpreted by photographic intelligence.



PHOTO 53

Small plane in foreground illustrates a well made dummy of the type that could seldom be distinguished on photographs from real planes.



PHOTO 54

Decoy tank storage, Atada Island.



PHOTO 55

War time aerial view of decoy tank farm, Atada Island.

V CONCLUSIONS AND RECOMMENDATIONS

V CONCLUSIONS AND RECOMMENDATIONS

1. The camouflage media most widely used by the Japanese, in terms of area covered, was paint. Much of this painting work was apparently undertaken by amateur camoufleurs who had little technical knowledge or comprehensive understanding of its applications. Consequently, results, especially on large installations, were often uncoordinated and inexpert, and caused photographic interpreters very little difficulty. It is believed that in the future whenever stereoscopic aerial photography is taken of installations camouflaged with paint alone, unless amazing new paint properties are developed, little difficulty in interpretation will be experienced.

2. Japanese use of garnished nets and frames was spotty. There were few attempts to conceal large installations with garnished material, and although some small installations were very well camouflaged by nets and frames, many more were inadequately hidden. Some garnished cover of small installations, such as radar or automatic weapons positions, made interpretation difficult, but generally speaking, nets and garnishing were not successful in concealment.

3. In areas of adequate photography many concentrations of tunnels were detected but in the few instances in which reports were made the significance of the activity noted was underestimated. When evaluating the effectiveness of PI work on underground installations it should be remembered that no concentrated effort was made to locate and determine the significance of such activity. Most work on the Japanese Homeland was necessarily devoted to the task of meeting specific requests for information on airfields, shipping, industry, bomb damage, etc. No requests were made for specific data on underground activity, hence in an already full schedule only cursory attention was given to this work.

a. A well executed program of underground factory construction in the future could greatly reduce the effectiveness of photographs as a source of intelligence on industries so constructed, particularly if

the terrain was favorable for digging tunnels and concealings their entrances. In such cases it is doubtful that the photographic interpreter would be able to detect more than a small percentage of the entrances to underground plants. Even when he did note entrances, spoil, and track activity, he could not be sure that they indicated the presence of an underground factory, nor could he make more than a rough guess of factory size and function. In fact, although it is possible that methods may be developed for detecting underground plants from the location of associated facilities such as otherwise unexplained housing for workers, the only reliable assistance the photographic interpreter can provide in this field at present is the photographic confirmation of underground plants reported from other sources.

b. Nevertheless, despite the desirability from a military standpoint of concealing subterranean war plants, it seems unlikely that all future industry essential to war production will be placed underground. During World War II most industries vital to war had also been important in peace. To place these industries underground now would greatly compromise their peacetime efficiency. Furthermore, although the assembly plants and light machining units built underground in this war were relatively easily adapted to such production, basic industries such as iron and steel, alumina, and copper, are not well fitted for underground production because of their tremendous quantities of raw material, wastes, noxious fumes, and heat. In short, although many important war plants of the future may be placed underground, it is likely that the majority of industry, including basic industries upon which war plants are dependent, will continue to remain on the surface.

c. Other types of underground installations such as airfield hangars, storage dumps, rocket launching sites, and coast defense positions might occasionally be detected, but if cleverly constructed, they could be concealed. To a great extent the success or failure of photographic intelligence in this respect would depend upon the regularity of photographic coverage and the

V CONCLUSIONS AND RECOMMENDATIONS

care taken to prevent detection during construction.

4. In the difficulties it caused photographic interpreters, the Japanese use of dummy installations was second only to the use of underground installations. Dummies of small equipment such as automatic AA and aircraft were a constant source of trouble, but decoys of larger installation such as oil tanks were too clumsily made to be successful. It seems likely that in the future carefully constructed copies of aircraft, guns, radar, rocket launchers, and other types of small equipment will be indistinguishable on aerial photography from real equipment regardless of photographic scale. With relatively good photography, however, dummies of large installations such as tank farms or factories should be easily distinguished.

5. If any large measure of success in the interpretation of underground activities and dummy installations is to be achieved in the future, regular, good-quality photography at scales of 1:10,000 or larger is believed essential.

6. In addition to the need for regular photography two other recommendations which have an important bearing on the adequacy of intelligence in the future should be mentioned.

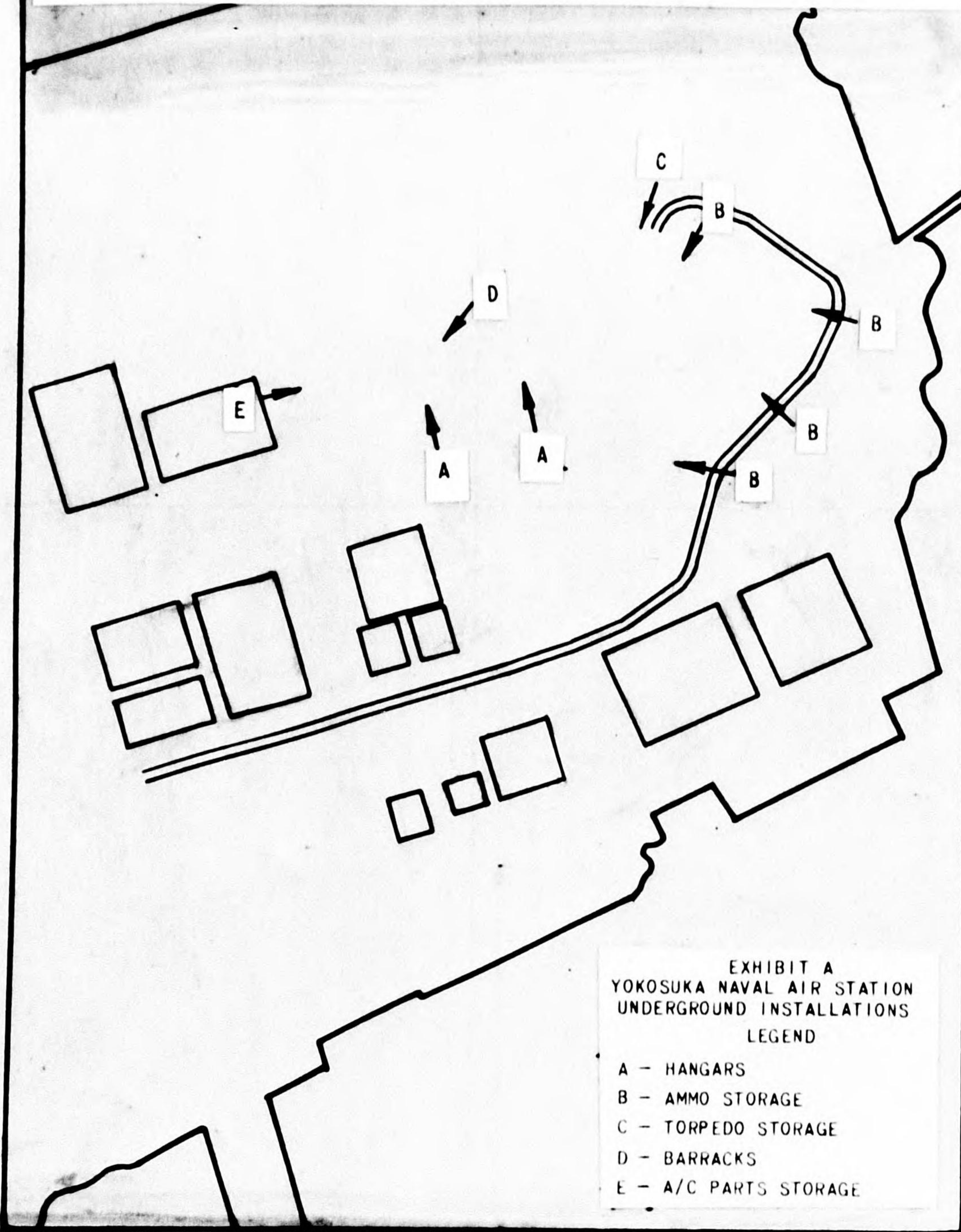
a. It is certain that more complete knowledge of enemy underground activity will result from closer liaison between the different branches of intelligence. If there had been better procedures for channeling information, and a greater knowledge of the problems confronting the various types of intelligence officers during the Pacific War, many underground plants which were either unreported or only suspected probably would have been confirmed. Unless the scraps of information gained from all intelligence sources are well coordinated, intelligence on underground plants in the future may be woefully inadequate. Photographic interpreters can supply an important percentage of these "scraps".

b. To insure that all possible intelligence on enemy camouflage, concealment, and deception may be supplied, it is recommended that research in this phase of photo intelligence be intensified during peacetime. This research should include (1) keeping abreast of new developments in camouflage technique, (2) detailed studies of facilities associated with industrial plants in the different countries of the world (i.e. housing, cooling facilities, waste dispersal, etc.) to determine whether these alone will indicate the presences of a plant when it is concealed underground, (3) the taking and study of photographs of areas of underground activity, and of experimental dummy installations.

EXHIBIT A

Underground installations of Yokosuka Naval Air station consisted of hangars, storage vaults, repair facilities, schools and barracks.

Tunnel entrances, track activity and spoil were observed by photographic interpreters but the purpose of the tunnels was not determined and the facilities were reported only as "evidences of underground activity."

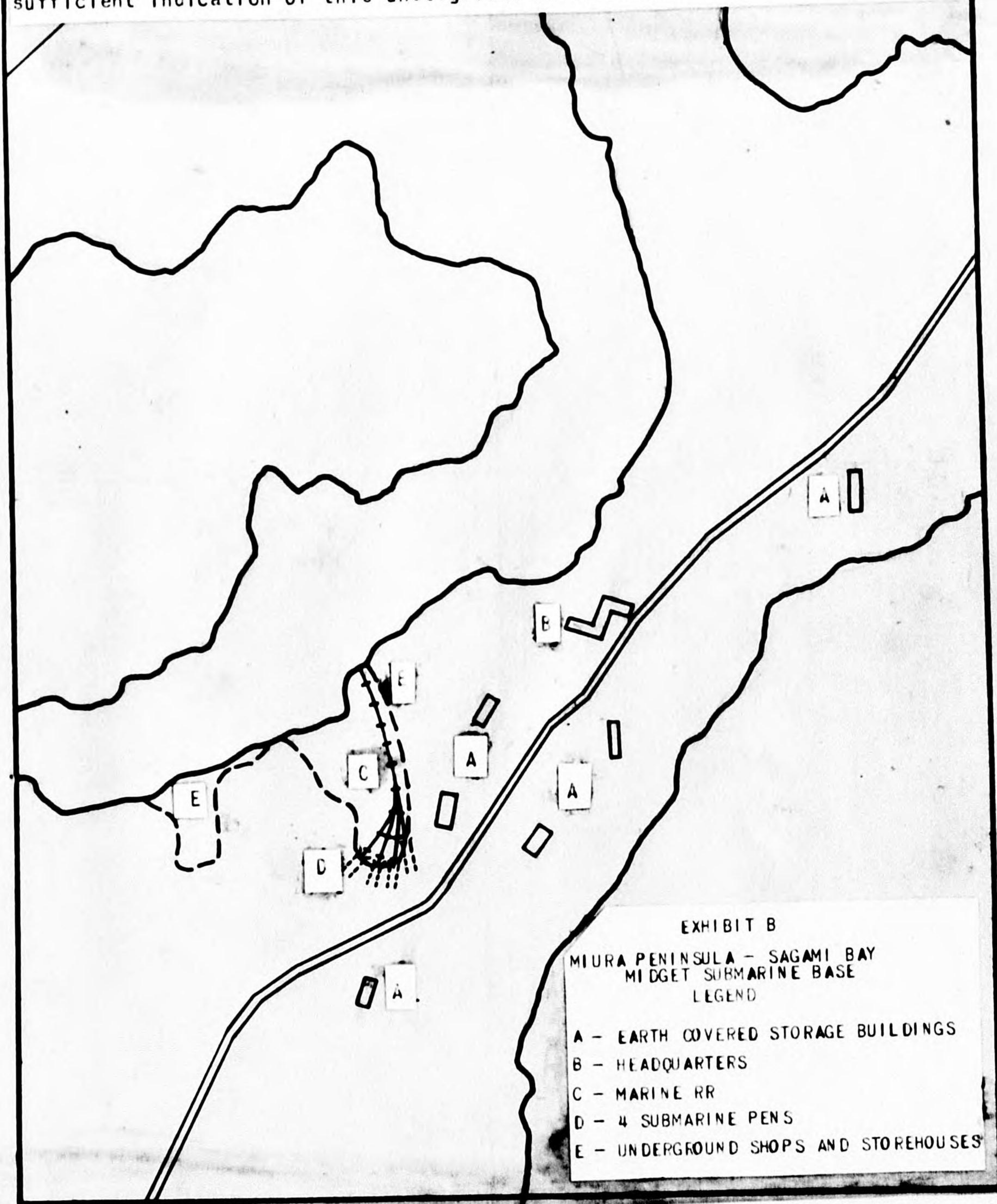


See vectograph Exhibit A in envelope attached to last page of this report.

EXHIBIT B

This midget submarine base was hidden in the hills of Miura Peninsula on Sagami Wan. Facilities included five submarine shelters, torpedo and torpedo tube storage, a battery charging station and repair workshops, all located in caves and serviced by a marine railway. Several earth covered barracks or storage buildings were located on the plateau above the base.

This base was discovered only after low altitude obliques revealed a midget submarine in the area. Previous high altitude photography failed to show sufficient indication of this underground installation.



See vectograph Exhibit B in envelope attached to last page of this report.

EXHIBIT C

EXHIBIT C
KOSHIBA POINT—TOKYO BAY
BURIED OIL STORAGE

LEGEND

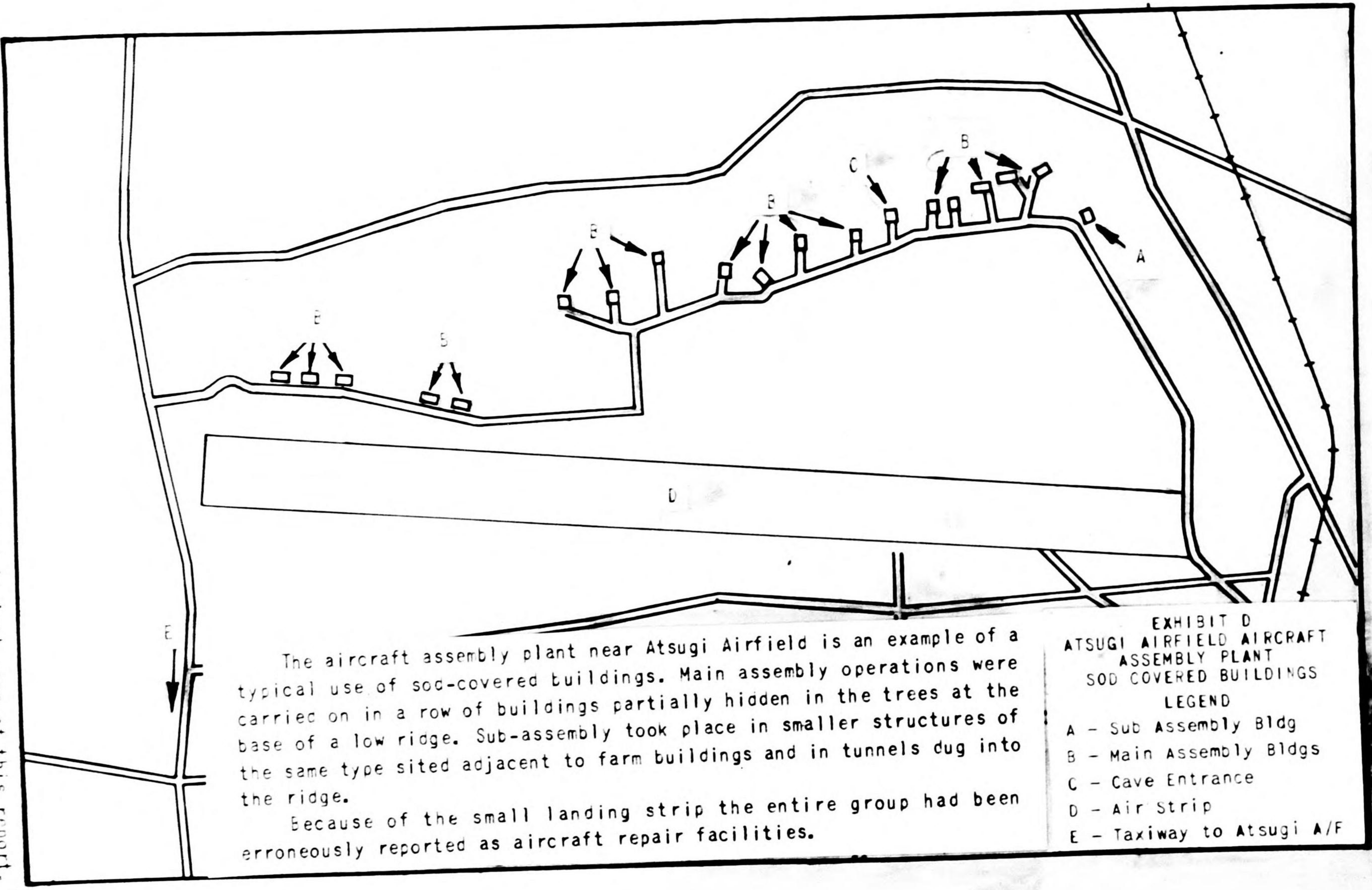
- A - GROUND PHOTO
- B - COMPLETED TANKS
- C - SMALL TANKS U/C
- D - LARGE TANKS U/C

The buried oil tanks at Koshiba Point on Tokyo Bay are a typical example of buried oil storage. This type of camouflage effort did not prevent detection by the photographic interpreter in most cases. A great many small dumps of oil drums did escape detection, however.

At this location seven large tanks had been completed, while others were still under construction. All were reported correctly, but oil drums stored in tunnels at the base of the hill were not reported.

See vectograph Exhibit C in envelope attached to last page of this report.

See vectograph Exhibit D in envelope attached to last page of this report.



The aircraft assembly plant near Atsugi Airfield is an example of a typical use of sod-covered buildings. Main assembly operations were carried on in a row of buildings partially hidden in the trees at the base of a low ridge. Sub-assembly took place in smaller structures of the same type sited adjacent to farm buildings and in tunnels dug into the ridge.

Because of the small landing strip the entire group had been erroneously reported as aircraft repair facilities.

EXHIBIT D
 ATSUGI AIRFIELD AIRCRAFT
 ASSEMBLY PLANT
 SOD COVERED BUILDINGS
 LEGEND
 A - Sub Assembly Bldg
 B - Main Assembly Bldgs
 C - Cave Entrance
 D - Air Strip
 E - Taxiway to Atsugi A/F

PHOTOGRAPHIC INTELLIGENCE - CAMOUFLAGE AND CONCEALMENT
EXHIBIT D

EXHIBIT E

The Japanese aircraft carrier "Katsuragi" is an example of the extensive camouflage effort the Japanese made to hide Naval units in the Kure area.

Garnished netting was strung between the decks and shore and the outlines of the ship further disrupted by false structures built over important elements of the superstructure.

All camouflaged ships were successfully located and identified by photographic interpretation.

VECTOGRAPH EXHIBITS

