The standard dispersed plant (used primarily in the aircraft industry) consisted of a number of low arched wooden buildings varying in size up to 50 x 75 feet. The buildings 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 many instances their roofs were sodded. Although plants of this type were often used to assemble aircraft, there were rarely more than unimproved roads or narrow gauge railways 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.

e. The most extensive Japanese camouflage effort was directed toward the hiding of Naval units in the Kure area, where most of the carriers, a cruiser, and a few destroyers were anchored near land, and were partially concealed by nets strung between their decks and the shore (Photo 10). All such ships were successfully located and identified. Target photographs prepared for US carriers familiarized pilots with ship locations and nullified the potential effectiveness of camouflage during the Kure strikes of late July 1945.

f. Another fairly general use of netting and garnishing was in the covering of A/C revetments and anti-aircraft emplacements. Garnished bamboo framing over A/C revetments, although it did not conceal the revetment itself, made detection of a plane within difficult if not impossible. Few efforts to camouflage anti-aircraft batteries were successful, first because the battery layout was still evident,

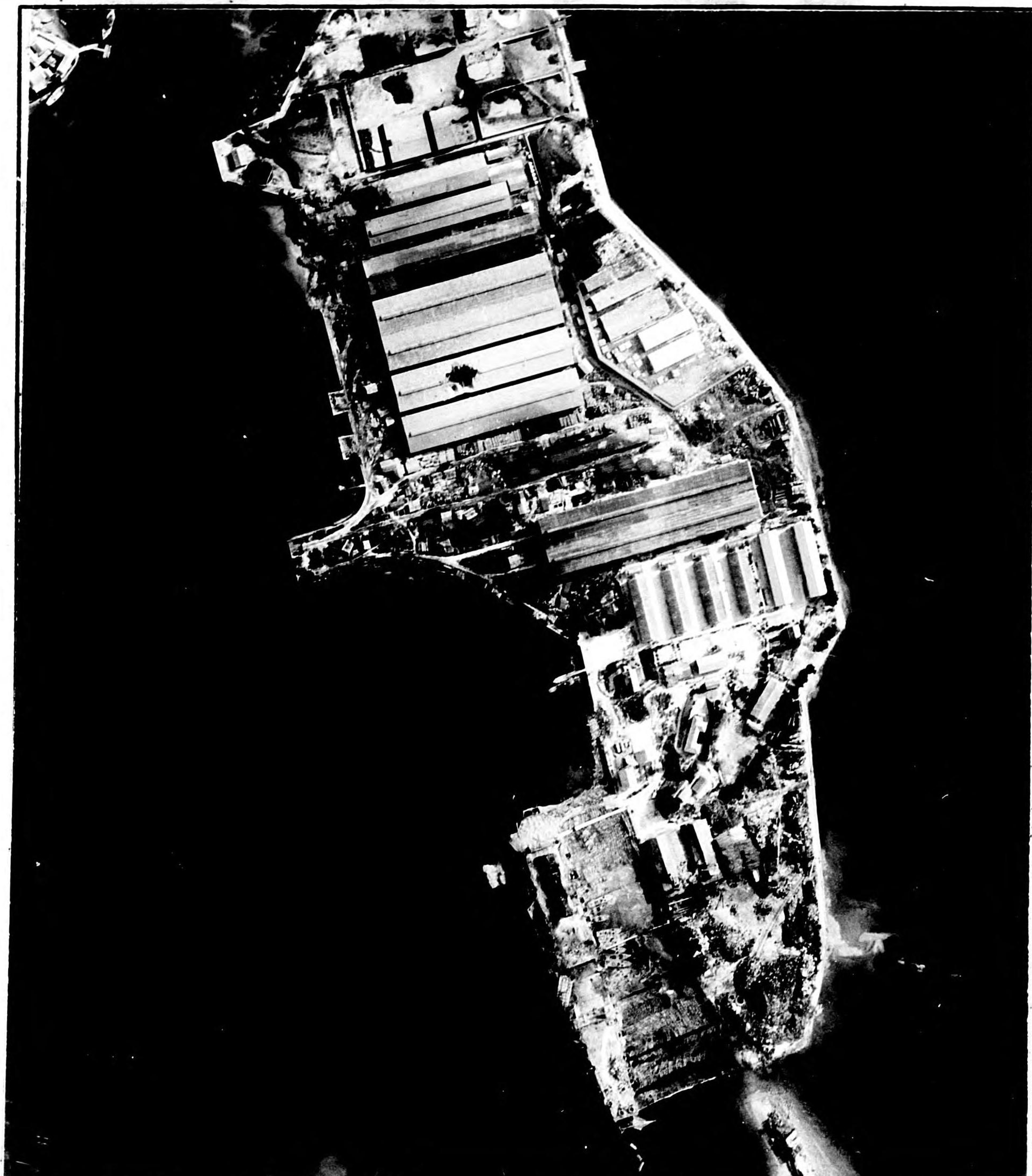

Photo 10
Camouflaged CV Katsuragi at Mitsuko Jima near Kure. This is typical of the extensive camouflage of naval shipping in the Kure area during the latter months of the war.

and secondly because AA positions were often uncovered to permit firing at the time of photography.

g. Wooded areas fronting on existing roads were used very effectively by the Japanese for dispersal storage of oil drums, aircraft fuselages, ammunition, and other types of light military supplies. Only at large storage dumps where the natural tree covering was thin, and where extensive track activity was visible on photographs was storage of this kind detected.

h. As was true at outlying Pacific Islands, the most effective camouflage in the home islands was of small installations. Thus coast defense guns, unrevetted searchlights, mobile radar, small military buildings, and other installations of similar size often escaped detection. Much of the difficulty in locating coast defense guns was due to the Japanese practice of emplacing them in caves and casemates. In several instances casemated positions were approached by tunnels entered on the opposite side of a hill.

i. Easily the most effective Japanese technique used, and potentially the greatest threat to photo intelligence was the practice of hiding 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 proportions (Photo 11). Given a few more months an important percentage of Japan's essential war industries might have been operating underground. The trend toward subterranean

TITLE :

Photo 11
Diagram showing extent of tunnel system at the First Technical Naval Air Arsenal, Yokosuka. This plant possessed a total tunnel floor space of 350,000 sq ft. The principal entrances were built to open into pre-war highway tunnels.

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dispersal of industry was particularly evident in the aircraft industry. Altogether 97 aircraft assembly parts or plants were either wholly or partially underground at the end of the war.

(1) 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.

(2) Short tunnels were widely used as air raid shelters. On aerial photographs there was little indication whether a tunnel entrance opened into a shelter or whether it 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. 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.

j. In the difficulties it caused photographic interpreters, the Japanese use of dummy installations was second only to theuse of underground installations. The two types of equipment most often simulated by dummies were AA weapons and aircraft (Photo 12). Makeshift fabrications were often detected by the photographic interpreters, but dummies which had been carefully copied in detail were quite frequently misinterpreted as real. 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% of the

(DOUBLE SPACE PRELIMINARY DRAFT)

Photo 12
Dummy installations similar to this dummy AA battery at Kamaishi looked amazingly realistic when viewed from high altitudes.

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 though it is obvious that once the enemy understands this mehtod of interpretation he can easily nullify its effectiveness. Gun positions which show no track activity or no evidence of firing week after week are also likely to be dummies.

k. Other less widely used dummies should also be noted. At Sasebo in areas of inadequate coverage excellent reproductions of radar installations had been erected. Some of them were misinterpreted. At Atada Island 3½ miles from the Otake oil refinery a decoy tank farm had been constructed. 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 rechecked, and it was found that they left no doubt as to the classification of this installation as a decoy.

l. One final practice of the Japanese which, although perhaps not intended to create deception, did work against the photographic interpreter was the 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. This probably was due more to an acute shortage of building space as a result of urban and industrial raids than to an effort to conceal, yet the fact remains that most dispersal of this kind was not located by photographic intelligence.

11. Roads and Railroads

a. The interpretation of roads, railroads, and bridges was probably the least developed of any phase of the work on the Japanese Homeland. Although scheduled for attention at the time the war ended, land transportation was not an important target in the Homeland during the war. It was not until commencement of detailed planning for the invasion of Southern Kyushu that any significant work on transportation was started. Published material available for evaluation on Southern Kyushu consisted of 1:50,000 maps which purported to show the road and rail network. These maps were checked against similar maps prepared by the Japanese Government at the request of the USSBS.

b. The interpretation of railroads and railroad bridges was generally thoroughly satisfactory. As a result of standardized construction methods used throughout the world, little difficulty was experienced by interpreters.

c. The interpretation of roads and road bridges, while possibly adequate for planning interdiction of the road transportation network, was entirely inadequate as a basis for estimating load carrying capacities. Reports gave an entirely too optimistic picture of both roads and road bridges. The consistency of error in regard to road surfacing and bridge construction is attributed (1) to a lack of realization on the part of the interpreters involved of the vast difference between the road systems of Japan and those of the United States, and (2) to the inherent difficulty in recognizing various types of road and bridge construction on vertical photographs at the scale available.

d. Ready access to compiled ground information, low oblique photography, and interpreters experienced in transporation construction would have been invaluable in the work done on this subject. Any future work should, therefore, take these factors into account.

12. Beach Intelligence

a. Beach intelligence was one of the most important phases of photographic intelligence throughout the war. Although, fortunately, it was not necessary to complete the beach intelligence program for the Japanese Homeland, considerable material on the subject was published prior to V-J Day. A ground check of one of the most important areas studied was made by a Bombing Survey photographic intelligence team, assisted by the Japanese Hydrographic Department.

b. Comparison of the field data with published PI reports reveals that the published material was accurate in all important respects. There was little difference between the descriptions of beaches made by the field team and those contained in photographic intelligence reports. Reported and actual offshore depths were as much in agreement as could be expected since a number of storms had made minor changes in the profile in the interval between the taking of photography from which depth determinations were made, and the taking of lead line soundings by the Japanese.

c. These checks, together with those made at Okinawa and elsewhere in the Pacific, prove conclusively that, given adequate photography, photographic interpreters can furnish detailed accurate information, vital to the success of an amphibious operation, and seldom obtainable in any otherway, on the nature of a beach, depths offshore, beach defenses, beach exits, and most other factors coming under the heading of beach intelligence. The fact that this information was not always obtained was partly due to a failure to exploit photographic intelligence fully. Thorough acquaintance of command and staff officers with the potential utility of photographic intelligence in amphibious operations is essential to full exploitation.

V Conclusions

1. Contribution of Photographic Intelligence in the Pacific Phase of World War II

a. Photographic intelligence made a very important contribution to the efficient prosecution of the Pacific phase of World War II. It was the basic source of information in such fields of intelligence as the identification and location of enemy defenses, the preparation of beach intelligence, the structural analysis and damage assessment of industrial targets, the assessment of damage to non-industrial targets, the evaluation of Army bombing results to provide data for the appraisal of accuracy and tactics, and the delineation of aircraft dispersal areas. In other fields, although basic information was collected from other sources, photo interpreters supplied a very important part of the total intelligence used. The latter group included the reporting of ship movement, construction, and repair; the counting and identification of aircraft at enemy airfields; the pre-strike analysis of urban areas; and the detailed functional analysis of industrial plants. Finally, photo interpreters working from photographs covering areas of unidentifiable activity (e.g. areas of underground development), although not always able to provide the initial source of intelligence, frequently were able to confirm or deny doubtful reports from other sources.

b. In all of the important fields of photographic intelligence checked by ~~Bombing~~ Survey teams in Japan the techniques for gathering data from photographs proved to be basically sound, and the intelligence collected to be, with but few exceptions, correct within the limits of accuracy required. Fortunately, the principal shortcomings - the misinterpretation of dummy aircraft and other dummy installations, the overestimation of airfield and road surfacing, and the failure to detect important underground plants - did not greatly effect the course of Allied operations. Had the Japanese fully realized the effectiveness of cleverly constructed dummies and expanded their use, or had Japanese engineers been able to put in operation a substantial number of the underground factories which were under construction, the inadequacy of photographic intelligence on these subjects could easily have assumed much greater significance.

c. One of the most significant contributions of photographic intelligence was the quantity reproduction of target and briefing charts and photographs showing the situation of enemy installations. These illustrated simply and completely information which no amount of written material could have conveyed so well, and were in no small way responsible for the effectiveness of Allied air, sea, and ground attacks.

2. Photographic Intelligence and the Future

a. It is almost universally accepted that atomic power together with other recent scientific developments such as rocket and jet propulsion and electronically controlled missiles have revolutionized warfare. The question naturally arises: How have these developments affected photo intelligence? On the basis of observations at Nagasaki and Hiroshima as well as a consideration of other factors likely to affect the use of photo intelligence in the future, it appears that photo intelligence has not been made obsolete. These factors have, however, caused the emphasis to be shifted in the direction of greater concentration on urban and industrial analysis.

b. In pre-attack analysis for an atomic raid the concept of a "target" is similar to that employed for an urban area raid. The methods used for evaluating economic vulnerability (consideration of integrated industry, utilities, transportation, housing, population, and other economic factors) and physical vulnerability of a target (consideration of the diverse structural types of buildings and the extent that each will be destroyed by a particular distribution of destructive agent) are basically the same as those used to prepare for fire raids. The primary difference between planning for an atomic bombing and for an ordinary "area attack" is the change in principle from the distribution of many weapons (HE or IB) over a wide area to the selection of a single aiming point for a single weapon which will affect the same area.

c. Although revision of the target concept from individual installations or plants to large urban and industrial areas greatly augments the worth of urban area analysis, it in no way reduces the value of industrial analysis. Detailed F/A, S/A, and D/A reports will still be required for important targets and target systems within city areas, and for important military and economic targets which fall outside city limits.

d. In the preparation of future pre- and post-attack urban area analyses it is felt that the existing methods used by JTG will provide, with the few modifications recommended in "Urban Area Analysis" (Part Four of the Photo Intelligence Section Report), a nearly complete picture of the economic and physical characteristics of city areas. Because of the considerable time required for preparation, it is strongly recommended that urban area analyses be started immediately on all militarily important foreign cities, using such aerial photography and ground information as is available. Studies of this type, even though incomplete through lack of data, would be invaluable in the event of an outbreak of hostilities, since it appears unlikely that there would be time for such work subsequent to that time. It is also recommended that analyses be made of all important American cities to determine their vulnerability and thus insure an adequate basis for planning counter measures.

e. A less revolutionary factor than atomic power or rocket propulsion, but one also likely to have a profound effect on the future of photo intelligence, is the growing practice of placing vital industrial and military facilities underground.

(1) A well executed program of underground factory construction could virtually nullify the effectiveness of photographs as a source of intelligence on industries so constructed, particularly if terrain was suitable for digging tunnels and concealing their entrances. Under such conditions it is doubtful that the interpreter would be able to detect more than a small percentage of the entrances to underground plants. Even where he did note entrances and track activity, he could not be sure that they led to a factory, nor if it

were a factory could he make more than a very rough guess of its 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 concentrations of workers' housing, the only reliable assistance the photographic interpreter can provide at present is the photographic confirmation of underground plants reported from other sources.

(2) Despite the potential effectiveness of subterranean war plants from a security standpoint it seems unlikely that more than a small fraction of 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, basis industries such as iron and steel, alumina, and copper are not well fitted for underground production because of their tremendous quantities of raw materials, 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 the war plants are dependent will continue to remain on the surface.

(3) Other types of underground installations such as airfield hangars, storage dumps, rocket launching sites, and coast defense positions might occasionally be detected by photographic inter-

prepers, but if cleverly constructed, they could be easily concealed. To a great extent the success or failure of photo intelligence in cases of this kind would depend upon the availability of photo coverage during construction.

f. The effectiveness of photo intelligence in the future will depend not only on the factors mentioned above but also on the degree to which the lessons concerning the operation of photo intelligence learned in World War II are heeded. Therefore, no report would be complete without an evaluation of photo intelligence organization, of the personnel, training, and research programs, and of the adequacy of photography. Since this evaluation is believed to be of less interest to the general reader than the main body of the report, it has been included as Exhibit A and is merely summarized here.

(1) Organization - The organizational framework within which photo intelligence worked in the Pacific war was not satisfactory. It led to duplication of effort between the Army Air Forces and the Navy, lack of coordination between photo intelligence and other phases of intelligence, and inefficiencies in the production of photo intelligence material. To eliminate these shortcommings it is recommended that one photo intelligence system be established for all the services as an integral part of a unified intelligence system combining all phases of intelligence in the U.S. Armed Forces.

(2) Personnel - The basis for selection of personnel for both Army Air Forces and Navy photo intelligence during World War II was sound. The change in warfare brought about by new weapons makes

it advisable that city planners, urban geographers, architects, and industrial engineers predominate in any future selection of personnel. The administrative procedures for the distribution and assignment of personnel was not satisfactory, particularily in the Army Air Forces. Although the total number of personnel was probably adequate the number assigned to the operating commands in the Pacific frequently was not so. It is recommended that the assignment of photo interpretation personnel of all services be controlled by the headquarters of the proposed unified intelligence system.

(3) Training - Basic training in both the Navy and the Army Air Force school was adequate although the Navy tended to keep much more nearly abreast of the changing requirements of the Pacific war. Advanced training in specialized fields of photo intelligence was not satisfactory. The Army Air Forces had no such training, and much of the Navy advanced training either lagged considerably behind requirements or was in the less important fields of specialization. It is recommended that a single school for all services be established as part of the proposed unified intelligence system and that the curriculum of this school be reviewed frequently in the light of the current political and military situation.

(4) Research - The research program was generally adequate in conception but inadequate in execution, primarily because of delays in the preparation, publication, and distribution of the results of the research. It is strongly recommended that research be continued and directed particularly to the problems raised by the newer

weapons. It is most important that those engaged in research have access to all sources of information on the development of militarily important installations in this and other countries.

(5) Photography - Considered in the light of flying difficulties and minimum operational requirements the job of photographing Japan was well done. However, from the standpoint of the photo interpreter and by comparison with standards in the ETO, photography could have been considerably better in scale, quality, and frequency of coverage. It is assumed that research and development in aerial photography are being directed toward the obvious goals of large scale, clear photography which may be easily processed and duplicated, and high performance, very long range photographic planes.

g. In summary, unless it becomes operationally impractical to take aerial photographs during wartime, photographic intelligence can supply vital information concerning the enemy, much of which can be obtained in no other manner. Not all of the diversified and specialized fields and techniques of World War II will be applicable, and some new techniques will be necessary, but it appears that at least two existing fields of specialization, namely industrial analysis and urban area analysis will be even more essential adjuncts of efficient military operations than they have been during the past war. It appears also that photo intelligence cannot achieve its maximum effectiveness without fundamental changes in its organization and modification of its personnel, training, and research programs. The solution to its most pressing problems appears to lie in the establishment of a single photo intelligence system for all the services as part of a unified intelligence system combining all phases of intelligence in all the services.

EVALUATION OF PHOTOGRAPHIC INTELLIGENCE ORGANIZATION, OF PERSONNEL, TRAINING, AND RESEARCH PROGRAMS, AND OF THE ADEQUACY OF PHOTOGRAPHY

1. Purpose

a. In order that photographic intelligence can operate at maximum efficiency in the future it is imperative that its history during World War II be examined in a critical light, and that a course of action be proposed which would appear likely to correct shortcomings.. The following sections present conclusions and recommendations on photographic intelligence organization, on the personnel, training, and research programs, and on the adequacy of photography.

2. Organization

a. Both at Guam and in Washington the Army and Navy maintained separate photo intelligence organizations with overlapping functions. Despite some efforts toward coordination on the part of the lower echelons, this parallel structure made a great deal of duplication unavoidable.

b. At Guam the Central Interpretation Unit and Interpron Two both issued despatches and reports on shipping and aircraft, both wrote airfield reports, both did damage assessments on important industrial targets, both did flak interpretation, and for a time both issued reports on urban area damage. In all of this work the subject matter of the reports of the two units was taken from the same photographs and contained about the same information. Unfortunately, however, reports not infrequently differed in significant details.

This caused confusion and made for less confidence in the effectiveness of photo intelligence. Many of the discrepancies between the two units are attributed to the fact that both were undermanned, and both were under constant pressure to get work completed quickly. It was obvious that more and better work would have been produced had all photo interpreters available to the two units been consolidated into one organization. This was not, of course, a revolutionary idea, for the same conclusion had been reached at Guadalcanal, at Brisbane, and at Adak, where photo intelligence services had also been duplicated.

c. No combination of units was effect on Guam because there was no single commander with the authority to integrate the overlapping units and insure that the resulting organization provided adequate photo intelligence to all branches of the service attacking the Japanese Homeland. Consequently each service commander found it necessary to maintain a photo intelligence organization under his own control. Nevertheless, a few less drastic efforts to gain closer coordination were attempted. Largely through the endeavors of the Advanced Intelligence Center under CinCPac, some division of work was accomplished in the interpretation and reporting of Flak. Other unofficial cooperation was carried on in the publication of airfield, shipping, radar, and damage assessment reports. The primary result of this increased coordination, however, was only to make the reports of AAF and Navy units more nearly consistent. Duplication of effort continued until the end of the war.

d. In Washington the overlapping of function between the

AC/AS Photo Evaluation Section and PIC was not so great as that between CIU and Interpron Two. Only when PIC went beyond its primary purpose of training and research to operational work, or when the Photo Evaluation Section forsook operational work for research did duplication become evident. Even then, through a program of liaison and joint work started in 1944, most outright duplication was eliminated. Joint work was attempted in two ways: (1) by assigning Naval officers directly to the Photo Evaluation Section for work with Army and Royal Airforce Officers, and (2) by joint publication of research handbooks with the work divided between AC/AS and PIC. In the first case working results were good; in the second divided authority led to delays due to disagreement over style, layout, and contents of handbooks.

e. In addition to the difficulties caused by separation of Army and Navy photo interpretation units, additional inefficiency resulted from the separation of photo intelligence from other intelligence. Not only was this true in Washington where duplicating and uncoordinated intelligence agencies thrived, but it was also true in the theaters of operation. The individual officer engaged in combat intelligence, radio intelligence, photographic intelligence, air technical intelligence, flak intelligence, radar intelligence, and language intelligence was too often ill-aware of the problems and the contributions of those in specialties other than his own. As a result, intelligence reports issued by different specialized units tended to give a fragmentary view of the overall intelligence picture.

In addition, the physical separation of files belonging to separate intelligence units caused delays in gathering material from widely scattered sources, and necessitated the constant use of many liaison officers - especially in Washington. The only true example of an organization in which the various intelligence specialties of both services were combined was the Joint Intelligence Center Pacific Ocean Areas at Pearl Harbor. Interpron Two and CIU both attempted to overcome the handicap of separation and occasional isolation from other sources of intelligence by establishing unofficial liaison with other agencies. They achieved only partial success in this endeavor, and this at the expense of considerable effort and the loss of much valuable time.

f. A final source of inefficiency was the organizational relationship between photo intelligence, photo reconnaissance, and photo laboratory facilities. Photo intelligence in the field was generally organized as part of photo reconnaissance which also included the photo reconnaissance squadron and the photo laboratory. The photo laboratory was generally either a part of the aircraft squadron or a separate unit in the photo reconnaissance organization. There were two fundamental disadvantages to this method of organization:

(1) Photo intelligence was not directly related to other intelligence by the chain of command. To photo intelligence this meant that immediate superiors of those in charge of photo intelligence units were generally not sufficiently cognizant of either the problems of producing photo intelligence or its relation to other forms of intelligence. To the whole field of intelligence it meant that one of its most important components was not easily coordinated with the other components.

(2) The photo intelligence unit had only indirect control of photographic laboratory facilities. Complete operational and administrative control of these facilities should have been in the hands of those in charge of photo intelligence units, since only they were in a position to exercise intelligent control of production priorities, a key factor in the production of photo intelligence.

g. To insure greater efficiency in the performance of photo intelligence in the future it is recommended that:

(1) The photo intelligence of all services of the U.S. Armed Forces be consolidated.

(2) Photo intelligence be integrated with all other intelligence through establishment of a unified intelligence system with intelligence centers at those major commands where such service is needed.

(3) Technical and administrative control of photo intelligence be a function of the headquarters of the unified intelligence system.

(4) Control of photographic reproduction facilities in each intelligence center be a function of the photo intelligence section of the center.

3. Personnel

a. The basis for the initial selection of personnel in both Army and Navy photographic intelligence was generally sound. Most officers were from the professions of geology, architecture, forestry, photogrammetry, geography, and soil conservation. As had been expected, their experience with terrain, with plan view appearance, and with aerial photographs, proved valuable, particularly in the training stage of the work. However, except where previous training was specifically applicable, as in structural analysis or in the study of beaches and terrain, it was found that officers with civilian backgrounds other than those mentioned above could be trained to do equally well. The vastly increased use of urban and industrial analysis in the closing stages of the war, and the specialized training needed in those phases of photographic intelligence have changed this. In any future selection of personnel, city planners, urban geographers, architects, and industrial engineers should predominate.

b. At the outset neither the Army Air Forces nor the Navy established any plan for supervising the assignment of qualified photographic interpreters, nor were any central files kept listing the billets to which officers were assigned. As a consequence of this and the lack of liaison between schools and field units, the assignment of graduates and the establishment of training quotas were often out of line with requirements.

(1) Late in 1943 the Navy took steps to rectify this situation. The Photographic Intelligence Center was made responsible

for the central control of all Navy photographic interpretation officers. Subsequently a marked improvement took place in the rotation and distribution of officers, but the fluctuating demands of war were so great, and the Photographic Intelligence Center was so far removed from and so out of touch with field units, that at no time were all personnel properly distributed. During the first two years of the war Navy photographic intelligence units were usually greatly overstaffed. By early 1944 the initial job of selling photographic intelligence to its potential users had been accomplished, and photography was being secured at a greatly increased rate. From this time on the need for personnel increased rapidly, and before the year was out photographic interpreters were at a premium. From December 1944 until the end of the war there was a distinct shortage of Navy photographic intelligence personnel in the Pacific despite frequent urgent requests to Washington for more. It is questionable if this shortage would have existed, or at least if it would have been as severe, if there had been a more realistic personnel policy. In the representative month of April 1945, although the vast majority of all Navy photographic intelligence was done in the Pacific, 175 interpreters were permanently assigned in Washington (not including students at the school) as compared with a total of 281 in the entire Pacific Area.

(2) At no time during the war was there central control of all AAF photographic intelligence assignments. Orders for those sent to the AAF school were initiated at first by the Training Plans Division, AC/AS$_2$ and later by the Requirements Division of the

Reconnaissance Branch AC/AS$_3$, both located in Washington. After training, officers were assigned to duty in the various echelons of the Air Forces and from that point on were under the administration of the Theater. Often upon arrival in the Theater, graduates found no photographic interpretation billets open and were assigned to other jobs. Despite this the Training Command continued to assign large numbers of officers to photographic interpretation training. Those who were assigned photographic interpretation duties in the field found Table of Organization provisions for rank low, and found that they were often used as clerical assistants to intelligence officers. The lack of promotional opportunities together with a lack of opportunity to work as photographic interpreters led many qualified and industrious officers to request changes in classification so that they could be assigned to more rewarding types of work. Since many of these requests were granted there was a continual exodus from photographic interpretation, but the rate of training was such that there were always sufficient personnel to keep organizations up to authorized strength. Unfortunately, however, the Tables of Organization themselves were not always adequate and Army administrative procedures made it very difficult to change a T/O within a reasonable period of time. For example, it became obvious early in 1945 that the number of interpreters at the Central Interpretation Unit of the Twentieth AF was grossly inadequate for the job ahead. Although an official request to increase the number of interpreters from 36 to 100 cleared Twentieth AF Headquarters in April, it was not until a few weeks before the end of the war that this request was approved, despite the fact that the additional officers needed were available in Washington several months prior to the end of the war.

c. Generally speaking the officers selected for AAF and Navy photographic intelligence duties were competent, but as is inevitable in the selection of large groups for professional work, some of those chosen were not. Unfortunately, once they were accepted for training little effort was made to weed out those who were unsatisfactory.

d. Serious errors in personnel management were also made in the assignment of officers. In a number of cases officers who lacked either leadership or professional knowledge, or both, were assigned to positions of responsibility, and although their incompetency was soon common knowledge the mistakes in assignment were seldom rectified. Units unfortunate enough to suffer from these personnel difficulties were generally notable primarily for their low efficiency.

e. To insure the most efficient use of photographic intelligence personnel, the following is recommended.

(1) Central control of all photographic intelligence personnel of the US Armed Forces should be vested in the headquarters of the unified intelligence system proposed in section 2 g above.

(2) Theater intelligence centers should control personnel in the theater, supervising assignments in forward areas and at the same time maintaining close liaison with Washington.

(3) Careful study should be made of the qualifications of officers assigned to positions of responsibility and a periodic

check should be made upon their performance of duty. This, of course, applies to any type of organization, but it is particularly important in the case of photo intelligence.

(4) Photographic intelligence specialists should be recruited from civilian fields closely allied with their specialty.

4. Training

a. Photographic intelligence training during the first year of the war, both at the AAF school in Harrisburg and at the Navy school in Anacostia, was almost entirely based on British experience in Europe. Consequently early curricula included much that was inapplicable to the Pacific war, and omitted certain subjects that would have been most valuable. To correct this situation in the Navy school, beginning in the spring of 1943, experienced officers were returned from the Pacific as instructors, and the curriculum was subsequently completely revised to prepare interpreters for duty in the Pacific. A rotation program for Navy PI officers, initiated the following fall, insured a flow of officers from various parts of the Pacific and made it possible to keep the school curriculum somewhat abreast of Pacific problems and requirements. Although a few officers were similarly returned from overseas to serve as instructors in the AAF school, few changes were made in curriculum. Part of the reason for this was the fact that school classes were so large and the work load on teachers so great that there was little time available for planning new courses. As a result, while Navy interpreters arriving at field units were were relatively familiar with Pacific operational reporting methods and interpretation procedure, AAF interpreters often needed further training. Both schools would have profited greatly by direct liaison with field units.

b. The original conception of photographic intelligence in the US Forces was that each photographic interpreter should be able to do all types of photographic intelligence required by his branch of the service. This was a necessity in the early days since no one could predict the type of work required of any individual interpreter and thus each had to be trained to meet all contingencies. As the complexity of interpretation increased, a continuation of this policy would have required each interpreter to be a jack of too many trades, and much of the potential value of photographic intelligence would not have been realized. Specialization was the only answer and it was a spontaneous development. Individual interpreters began to specialize, due to circumstances of assignment or on their own initiative, in such fields as beach intelligence, shipping, aircraft, and flak. Later some officers received additional training to prepare them for specialization.

c. The Army Air Forces Intelligence School, since it was not concerned with photographic interpreters after their initial training, confined its duties to the teaching of a general photographic intelligence course. Although it did not keep up to date on changes in operational practice, the school did provide a well administered program which gave students a good background for operational training. One of the unfortunate results of the unchanging AAF curriculum was that training was largely confined to the type of work encountered at a large photo intelligence unit, despite the fact that at no time were more than 60 per cent of the AAF interpreters assigned to this type of organization. In the spring of 1943 more than 60 per cent of those trained were being assigned to combat units where their principal duty was to supply air unit commanders with an assessment of bombing results. In this work the Air Intelligence School's training was inadequate. AAF instructors gave some thought to the establishment of specialized post graduate courses which would be more in line with operational duties, but no such courses were established. Also, the suggestion of publishing manuals to aid photographic interpreters in school and in the field never materialized because such work was not considered to be an Air Intelligence School function.

d. Because the Navy school at Anacostia, in addition to teaching a basic course to new photographic intelligence officers, was also concerned with photographic interpreters on rotation from overseas, its staff developed a refresher course and a number of post graduate courses. The refresher course was well conceived to train photographic interpreters in new techniques and refresh them in old ones. It was a mistake, however, to use the refresher course as a pool for newly returned officers for whom there were no other assignments. Such training should have been given just before officers were returned overseas at which time they would have been more receptive to training and would soon have been in a position to apply it.

e. Post graduate courses at PIC were begun to meet the increased trend toward individual specialisation noted above. The idea was a good one, but in most cases the courses were begun too late, and in some instances considerable time and effort was devoted to subjects of relatively minor operational importance.

(1) The earliest special course attended by photographic interpreters was concerned with terrain model making. Subsequently, 285 Army, Navy, and Marine officers attended this course. In practice, terrain models were of rather limited operational use, and photographic intelligence training was not essential to their construction. The time and manpower spent in model training would have been better utilized in training officers in specialties of greater operational application.

(2) The second major post graduate course attended by photographic interpreters dealt with training in photogrammetry. Although 68 PI officers were trained and sent to field units before the end of the war, few ever had an opportunity to apply their training. In practice, the photogrammetry lectures in the basic photographic intelligence course provided photo interpreters with sufficient general training in this field.

(3) Two other special courses, one in industrial analysis, and the other in underwater depth determination, prepared officers for very important duties in the field, but the few graduates of these courses who reached field units before the end of the war arrived too late to be of maximum usefulness. Other photographic interpreters, who had done most of the research on water depth deter-

mination, electronics installations, and shipbuilding, did arrive in the Pacific soon enough to be of great assistance and to prove the value of specialized training.

f. With greater foresight and a more direct liaison with field units AAF and Navy schools might have introduced specialization at an earlier date in such fields as shipping and shipbuilding, raid assessment for air unit commanders, aircraft and airfields, carrier work, amphibious work, and industrial analysis. Earlier specialization would have permitted more thorough training, and would have made specialists available when needed.

g. Although it would be foolish on the basis of existing knowledge to recommend a specific curriculum for future PI training, there is sufficient basis for making certain general recommendations.

(1) A joint photographic interpretation school should be established for training all photographic interpreters of the US Armed Forces. This school should operate as part of the unified intelligence ~~organization~~ system recommended in part 2 g of this Exhibit.

(2) Initial training should correspond roughly to the basic courses which were being taught in AAF and Navy schools at the end of the war, giving a summary view of the importance, uses, and techniques of PI, and including a complete survey of other types of intelligence with emphasis on the interdependency of all intelligence.

(3) Following basic training, students should be assigned to more detailed courses in such specialties as the current military and international situation suggests.

(4) Because the use of the atomic bomb has shifted the concept of a target from single installations or industrial plants to entire urban and industrial areas, comprehensive lectures in urban area analysis should be incorporated into both basic and advanced training curricula. It is felt that the JTG methods developed for pre- and post-raid analysis of urban areas will, with the modifications developed by the Photographic Intelligence Section, USSBS, meet the requirements of urban area analysis for atomic bombing attack.

(5) Those in charge of training should constantly review curricula in the light of the current situation, and should, therefore, be permitted to establish direct liaison with agencies responsible for war plans and weapons development.

5. Research

a. In the fall of 1943 Navy photographic interpreters from widely different theaters began returning on rotation to the Photographic Intelligence Center at Anacostia, D.C. They reported that field units were in need of handbooks which would (1) explain concisely the standard methods used in all types of photographic interpretation, (2) present the evaluated experiences of men who had used these methods in operational theaters, and (3) provide background information, not available to interpreters in the field, on important specialized studies. Accordingly, PIC began the publication of material on such subjects as Japanese Guns, Anti-Aircraft and Coastal Defense; Beach Interpretation; Japanese Camouflage.

b. In early 1944 AC/AS Intelligence and PIC collaborated on the publication of the "Photographic Interpretation Handbook," a complete revision of the Navy PI handbook published in mid-1943, and shortly thereafter began work jointly on a series of Photo Industrial Studies (The Petroleum Industry; The Coke, Iron and Steel Industry; The Aluminum Industry; The Aircraft Industry; The Explosives Industry; etc.). Although the earliest work at PIC involved only the revision and assembly of existing written and photographic material, later PIC studies (e.g. Underwater Depth Determination), and studies prepared jointly with the AAF, required considerable research.

c. The role of Washington photographic intelligence organizations as research centers was correctly conceived, because field units had no time for this work however necessary, while units in Washington had access to central files of aerial photography and to files of other intelligence and research agencies not available elsewhere. In practice, however, the Washington research program was inadequate. The publications themselves were in most cases technically sound, but delays in preparation, publication, and distribution, together with the occasional choice of operationally unimportant subjects made them much less useful than they might have been.

d. Although some of the delays were unavoidable, the majority could have been eliminated. Among the avoidable delays were those caused by undue concern with style and appearance of publication, by lack of coordination in gathering source material, by dissipation of available manpower and publishing facilities on unnecessary projects, by apparent lack of realization of the urgency of the task, and even by purely personal differences of opinion between Army and Navy personnel on questions of form. Even after publication, receipt in the field was delayed from one to two months by the use of regular instead of airmail, although intelligence material from other Washington agencies was received by air. The net result of these delays is illustrated in the case of the Photo Industrial Studies prepared jointly by PIC and AC/AS Intelligence. Eleven of these studies were started from 8 to 14 months before the end of the war. Four of the eleven were never completed, two arrived in the field at the end of the war, and only three of the remainder arrived in time to be of any use. The information contained in many of these publications was urgently needed as early as November 1944. Due to their nature these publications need not have been delayed while awaiting additional intelligence on enemy industry.

e. As to the publications themselves, some such as the Photographic Interpretation Handbook, Shipbuilding, The Coke, Iron and Steel Industry, The Aircraft Industry, Japanese Guns, Anti-aircraft and Coastal Defense, Japanese Electronics, The Petroleum Industry, and Underwater Depth Determination were, when received in time, very useful. Others such as Japanese Aircraft Shelters, Japanese Military Buildings, and Ships' Speeds from Aerial Photographs, were either obsolete or unnecessary even before they were published.

f. Any analysis of Washington research work on photographic intelligence done during the war can lead to but one conclusion, namely that field units were supplied with but a small fraction of the material with which they should and could have been supplied.

g. In view of recent revolutionary developments in warfare it is certain that the military value of photographic intelligence in the future will depend to a large extent on the efficiency of research in photography and photographic interpretation. Whereas research in photography can be continued easily in time of peace, many subjects of study in photographic interpretation, since they are the results of complex economic, political, and military developments, lend themselves much less readily to peacetime research. Although some ideas of lasting value will be gained from a study of the past war and logical extension of existing techniques into the future, most useful research in photographic interpretation will depend on a knowledge of the future development of militarily important installations in this and other countries. It is, therefore, imperative that those responsible for research have access to all sources of such information.

6. Photography

a. It is a basic photographic intelligence axiom that as the regularity, scale, and quality of photographic coverage on a particular target increases, the accuracy of interpretation also increases. Complete, regular coverage is absolutely essential if accuracy is to be achieved consistently in the interpretation of airfields, shipping, defenses, and electronics. For example, without frequent coverage of airfields, plane counts may be misleading, and A/F use and importance may change without being detected. Similarly, if gaps occur between dates of coverage over harbors, reporting of ship movements necessarily becomes fragmentary; and without regular coverage of important defense areas, changes in the disposition of flak will go undetected. In the interpretation of radar installations complete cover over otherwise unimportant peninsulas and headlands is mandatory. Finally, in the techniques developed for the assessment of bomb damage the nearness of pre- and post-attack photography to the time of the raid bears a direct relationship to the reliability of assessment.

b. Obviously, accuracy in the assessment of damage and in the identification of aircraft, naval and merchant vessels, and industrial plants will increase with the scale of photography. Yet even on small scale photographs some useful work can be done on these subjects. For successful identification of electronics installations and defenses, however, good quality photography with a scale of 1:10,000 or better is ordinarily essential.

c. Photography taken of Japan came from two sources: the first and major source, was B-29 reconnaissance photography, the second, was Navy and Marine photography flown by land- and carrier-based aircraft. The adequacy of B-29 photography was limited by the distance between Allied bases and Japan, by the altitude at which photographic planes flew (28,000-32,000 feet), by the predominant reliance on 24 inch focal length cameras, and by the low lying cloud banks frequently encountered over the Japanese home islands. Considerable photography of primary importance was secured by Navy and Marine aircraft, particularly in connection with amphibious operations, and the tactical photography taken by carrier based aircraft in support of their own operations was invaluable, but the greater part of Naval photography of the Japanese homeland was largely supplemental to that flown by B-29s.

d. Considered in the light of flying difficulties and minimum operational requirements, the job of photographing Japan was well done and photographs taken were a tremendously important source of intelligence. From the standpoint of the photographic interpreter, however, photography could have been considerably better. Although the 40 inch focal length camera was used and gave a reasonable scale (approximately 1:9,000), 40 inch coverage was incomplete even in important industrial areas. Consequently the majority of photographic intelligence work had to be done from 24 inch focal lenth photography at an average scale of 1:15,000. This scale is too small to permit the photographic interpreter to do a consistently complete job on the identification of aircraft, electronics installations, and defenses, and on the assessment of damage. Some areas of Japan in which there were important underground plants and radar installations were never adequately photographed, and many other areas which included large airfields and industrial plants were not covered with sufficient regularity. Finally, an unnecessarily large percentage of the photography secured was poorly processed, rendering indistinct otherwise excellent coverage.

e. Control of the planning and ordering of photography was frequently in the hands of those with inadequate knowledge of photographic intelligence, and therefore not in a position to know what photography would be most valuable from an intelligence standpoint. Steps taken near the end of the war tended to reduce this difficulty, but at no time was the arrangement thoroughly satisfactory.

f. Since much has been said and written during the war on the great advantages of color, infra-red and other special films, it is believed that a few comments on their use are appropriate. From the photographic interpreter's point of view, whatever the potential value of these films might have been, their contribution to photographic intelligence during the Pacific war was insignificant. Color photography in particular was seldom put to any constructive use when secured, and it was at times secured at the expense of additional, more useful panchromatic photography. The greatest stumbling blocks in the way of capitalizing on the potential advantages of color have been the great difficulties of processing, duplicating, and handling it as compared with panchromatic photography. When these technical difficulties are overcome, and photographic interpreters are sufficiently trained in the use of color photography, it appears likely that it will entirely supplant black and white photography.

g. Since the efficiency of photo intelligence is so dependent on adequate photography it is essential that both the technical and organizational phases of aerial photography be geared to the needs of photo intelligence.

(1) Research and development in aerial photography should be geared toward the goals of large scale, clear photography which may be easily processed, duplicated, and utilized, and toward high performance, long range aircraft.

(2) The translating of requests for photography into orders for photography which will yield the intelligence requested should be a responsibility of photo intelligence.

(3) Future photographic reconnaissance should be better coordinated and on much larger scale than in the past.

UNITED STATES STRATEGIC BOMBING SURVEY
PHOTOGRAPHIC INTELLIGENCE SECTION

EVALUATION OF PHOTOGRAPHIC INTELLIGENCE IN THE JAPANESE HOMELAND

PART ONE
OVERALL REPORT

DATES OF SURVEY: 7 OCTOBER - 29 NOVEMBER 1945

DATE OF PUBLICATION

TABLE OF CONTENTS

TITLE: Photographic Intelligence - Japanese Homeland

(DOUBLE SPACE PRELIMINARY DRAFT)

Foreword

1. During World War II intelligence extracted from aerial photographs supplied a tremendous amount of invaluable data concerning the industrial and military activities of the enemy. Until warfare develops to the point that the fate of nations is decided by tremendous mechanical battles between self-propelled, radio-controlled weapons it seems likely that photographic intelligence will continue to be militarily important.

2. With this thought in mind, a group of Army and Navy Photographic Intelligence Officers was assigned to the G2 section of the United States Strategic Bombing Survey for the purpose of checking the accuracy of photo interpretation work done on the Japanese homeland, and of making recommendations for the improvement of photographic intelligence organizations, methods and techniques.

3. The overall report describing the results of this photographic intelligence evaluation follows.

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TITLE: Photographic Intelligence - Japanese Homeland

(DOUBLE SPACE PRELIMINARY DRAFT)

I Development of Photographic Intelligence in the Pacific

1. Origins

a. At the beginning of World War II the importance of using aerial photographs for military intelligence was recognized by only a few, and as a result the techniques of photo reconnaissance and photo interpretation were largely undeveloped. This lack of interest was sharply reversed during the summer of 1940, when Germany overran all of western Europe and threatened to engulf England. The British, with their regular continental intelligence channels thus sealed, were desperate for information concerning the massing of German invasion forces, and therefore turned to aerial photography. An organized network of photographic reconnaissance squadrons and photographic intelligence units was established throughout the British Isles, and was for a long time the source of most military intelligence in the European theater.

b. Early in 1941 representatives of the U.S. Armed Forces were sent to England to observe this newly developed photo intelligence system. Upon their return to America they became responsible for establishing a Navy school of Photographic Interpretation at the Air Station in Anacostia, D.C., and an Army Air Force school originally at the University of Maryland and later at Harrisburg, Pennsylvania.

c. Much of the effort in these early stages of American photographic intelligence was necessarily devoted to the organization of course curricula, but by far the greatest problem at this time was to "sell" old line Army and Navy officers on the operational usefulness

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of photographs and photographic interpretation. Too often progress in this necessary indoctrination program was slow and discouraging. In case after case during the early months of 1942 enthusiastic photo interpreters reported to operational commands anxious to demonstrate the value of photo intelligence only to find superiors indifferent, photographs scarce, and themselves often assigned to other types of duty. Yet, slowly, as the American counter offensive gained momentum in the operations at Guadalcanal, New Guinea, the Marshalls, the Gilberts, and Attu, the situation improved and the work of individual PIs or groups of PIs was recognized as an important factor in the planning and executing of a successful operation. Following these first successes, the trend toward increased understanding and use of photographic intelligence continued.

2. Uses of Photographic Intelligence

a. The initial use of photographic intelligence in the Pacific was largely tactical -- aircraft counts and identifications, plotting of defenses and electronics installations, analysis of terrain, ship identification, immediate damage assessment, and summarizing of enemy construction activity (A/Fs, military bases, supply depots, etc.). As more photographs became available, and as operations planning officers gained confidence in photographic intelligence, the scope of the work done was broadened to include longer range and more specialized studies.

b. The first, and consistently one of the most important of these, was concerned with the analysis of beaches and their defenses, exits, and underwater approaches in preparation for amphibious landings. Other specialized interpretation jobs included the preparation of huge quantities of air target and briefing material, the selection of sites for airfields and other installations on Japanese-held territory in advance of occupation; the mapping of strategic areas hitherto inaccurately charted; the plotting of bomb falls for assessing accuracy of bombing; and the preparation of gridded charts and photographs for support of ground troops from the air and from surface ships.

c. Although RAF and US Army photographic intelligence officers in England developed highly specialized techniques for the analysis of individual industrial targets - reporting on function, structure, bomb damage, and post-raid repair - it was not until late 1944 with the beginning of B-29 raids from the Marianas that similar reporting was begun in the Pacific. At no time did industrial analysis in the Pacific reach the near perfection it had attained in Europe.

3. Growth of Photographic Intelligence

a. With the broadening in scope of photographic interpretation, and with the increased recognition of its importance, the demand for trained personnel increased greatly. As a consequence original training quotas were increased as were the number of schools where such training was offered. From an initial class of 27 officers the total number trained by the Navy school at Anacostia grew to 831. Similarly, from small classes at the University of Maryland, PI personnel trained by the Army Air Forces at Harrisburg and Orlando mushroomed to a total of 2,348, including approximately 200 from other branches of the services. Other AAF schools were established for enlisted men at Salt Lake City, Tampa, and Mitchell Field, N.Y., and about 200 additional AAF officers were trained in the British Central Interpretation Unit at Medmenham, England.

b. Both the Marines and the Army Ground Forces had their own photo intelligence schools, primarily for enlisted men, in which several thousand men were trained for interpretation work with ground troops. Because the war ended several months prior to the invasion of Japan, little or no photographic intelligence on the Japanese homeland was produced by the ground forces; consequently no evaluation of their work has been made by the USSBS. Ground force interpretation is mentioned here merely to illustrate the widespread use of photographic intelligence.

c. Because there was no central administrative agency for AAF PI personnel and, consequently no systematic check on their assignment and distribution, no exact figures on this subject can be cited. It has been estimated, however, that approximately half were eventually assigned to lower echelon combatant organizations, i.e. squadrons, groups, and wings, where their principal duty was to supply their commanding officers with assessments of bombing results, and the other half to Air Force headquarters, where they worked in Central Interpretation Units. The majority of initial assignments were to the Continental Air Forces and to other AAF assignments within the Zone of the Interior, which in addition to their regular PI billets maintained pools of photographic interpreters for assignment overseas. The remainder were assigned directly overseas. Because some types of assignment offered more opportunities for advancement and the assumption of responsibility than did PI many qualified and industrious officers had their classifications changed to Combat Intelligence Officer, Administrative Officer, or other ground assignments, and as a consequence there existed a shortage of AAF PI officers even at the end of the war.

d. Of the 831 officers graduated from the Navy school at Anacostia, 661 were Navy including 13 Waves, 167 Marines, and 3 Army; 120 of the 661 Naval officers were assigned to other specialties (photography, ACI, etc.) and were never active in photo interpretation. Army photographic intelligence officers were fairly evenly distributed between European and African, and Pacific theaters of operation, while Navy PI officers were assigned predominantly to Pacific theaters. At the time of the Normandy invasion roughly 10% of the total available PI personnel trained by the Navy were stationed in European or Mediterranean Theaters, but never before or after Normandy was the figure approached again. In June of 1945 the percentage distribution of the 515 active Navy photographic interpreters was approximately as given in Table 1.

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(DOUBLE SPACE PRELIMINARY DRAFT)

Table 1

DISTRIBUTION OF NAVY PHOTOGRAPHIC INTERPRETERS

United States		35%
In Washington	28%	
Special Assignments (Pilot training centers, amphibious school, photography school.)	7%	
European Theater		0.8%
Pacific Theater		63.2%
Photographic Intelligence Centers (Interpron Two, JICPOA, AIC-NORPAC, etc.)	34%	
Amphibious (Group and Force Staffs)	10%	
Carriers (Task Force and Task Group Staffs, and Ships)	12%	
Special Assignment Overseas (FAirWings, Navy and Marine Staffs, and P.H. Model Shop)	7.2%	
Hospitalized		1%
		100%

II <u>Photo Intelligence Organizations Responsible for Work on Japanese Homeland</u>

1. Because of the changing intelligence needs in war theaters, the organizational framework within which photographic intelligence officers and photographic intelligence units worked changed frequently during the war. To attempt to describe all changes would require much

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more space than is available here. It is important, however, in order to evaluate the photographic intelligence done on the Japanese homeland to know which organizations did the work, what their exact function was, and how they were related to one another.

2. Photographic Interpretation Units at Guam

a. The units most directly concerned with photographic intelligence work done on Japan were located at Guam - the Army's Central Interpretation Unit to supply intelligence to the XX AF, and the Navy's Photographic Interpretation Squadron 2 to supply similar data to the carrier task forces and surface fleet, the amphibious and ground forces under CinCPOA, and the advanced headquarters of CinCPac - CinCPoa.

b. The Central Interpretation Unit combined photographic interpreters from the 3rd Photographic Reconnaissance Squadron and the 35th Photographic Technical Unit into a single group which was organized internally according to interpretation specialties - i.e., airfields and aircraft, radar, flak, industry, damage assessment, and shipping. Other internal sections were concerned with filing, editing of reports, drafting, and photographic reproduction; and a final section, with the preparation of survey reports on daily photographic missions, listing and describing the targets covered.

c. Interpron 2 was concerned for the most part with the same type of specialties as CIU. In practice, although some liaison was maintained between the two organizations, each tended to duplicate the work of the other. Part of this is due to the fact that both used photography taken by the 3rd Photographic Reconnaissance Squadron.

Interpron 2 was also responsible for the interpretation of all photography from Navy and Marine Photographic Squadrons and from photographic planes attached to carrier forces.

d. In addition to the photographic interpreters at CIU and Interpron 2, other PIs on Guam worked with group and wing headquarters of the XX AF, and with Advanced Intelligence Center of CinCPac - CinCPOA. Their jobs were highly specialized, and seldom included the preparation of widely disseminated photographic intelligence reports.

3. Joint Intelligence Center at Pearl Harbor

a. At Pearl Harbor intelligence for the headquarters of CinCPac - CinCPOA was prepared by the Joint Intelligence Center Pacific Ocean Areas and its immediate subsidiaries. Internally JICPOA was organized into air, geography, translation and interrogation, operations intelligence, and reproduction sections. Photographic intelligence officers worked in the geographic section, incorporating pertinent data taken from photographs into overall intelligence reports. Theoretically JICPOA combined the intelligence forces of both the Army and Navy. Actually, however, Naval personnel greatly outnumbered Army personnel. This was particularly true of Navy photographic interpreters, for only a few Army PIs worked with JICPOA, and they on a temporary basis; whereas a complete Navy interpretation unit formerly known as PRISIC (Photographic Reconnaissance and Interpretation Section, Intelligence Center Pacific Ocean Areas) had been consolidated into the geographic section. In addition to this the Pacific pool of Navy photographic interpreters was located at JICPOA. The Advanced

Intelligence Center at Guam was a forward area branch of JICPOA.

4. Photographic Intelligence Units in Washington

a. Army Air Force photographic intelligence in Washington was carried on in the Evaluation Section of the Assistant Chief of Air Staff for Intelligence; Navy PI was established in the Photographic Intelligence Center under the Air Intelligence Group, Division of Naval Intelligence. The Evaluation Section, AC of AS was concerned primarily with operational and semi-operational duties, whereas PIC was occupied mostly with training and research work.

b. In practice the Evaluation Section worked with the Joint Target Group, also a subsidiary of AC of AS, providing JTG personnel with all requisite photographic intelligence. For this reason Army, Navy, and RAF personnel were included in both organizations. Photographic interpreters with AC of AS analysed industrial plants to determine: (1) their type (aircraft engine, iron and steel, aluminum, etc.), (2) the function of individual plant structures, (3) the framing and materials of construction of specific buildings, (4) damage to buildings following air raids, and (5) the extent of repairs to damaged facilities. Photographic interpreters also assisted in the analysis of urban areas to determine pre-raid fire vulnerability and economic importance, and post-raid damage.

c. The Navy's Photographic Intelligence Center grew out of the School originally established at NAS Anacostia. It was realized in mid 1943 that the education of photographic interpreters must not cease as soon as they finished their formal schooling, but must be continued through the dissemination of the consolidated field experience of interpreters throughout the world as well as the latest techniques resulting from research and experimentation within the United States. From then on a major part of the effort of the PIC was devoted to the production of training and reference material and to research. Among the publications produced are the "Photographic Interpretation Handbook, U.S. Forces", produced jointly with AC/AS Intelligence, reports on AA, electronics, underwater depth determination, and industry. Some of the industrial reports were done in conjunction with AC/AS Intelligence. Beyond these training and research functions, a very important duty of the PIC was that of the assignment of photographic interpretation personnel throughout the Navy.

5. Other Pacific Photographic Intelligence

a. No review would be complete without some mention of the photographic interpreters who served on carriers and worked with amphibious commands. Their work was of primary importance throughout the war. However, because little carrier or amphibious work was available for checking by ground teams attached to the Bombing Survey, no further reference to such work will be made in this report.

b. Similarly photographic intelligence reports written by interpreters with the Far Eastern Air Forces are not evaluated because their concern with the Japanese Home Islands from a photo intelligence standpoint did not develop until very late in the war and was even then primarily of a tactical nature.

III Organization of Photographic Intelligence Survey of Japan

1. Function of Photographic Intelligence Section - G-2 USSBS

a. During the earliest stages of the war, photographic intelligence officers were seriously handicapped by an incomplete knowledge of the Japanese installations and equipment they were attempting to identify on photographs. Realizing that much of this ignorance could be eliminated by careful ground surveys of newly occupied islands, PI field teams were sent to Kiska, Munda, Tarawa, and elsewhere. These surveys aided tremendously in improving the accuracy of photographic interpretation; so it became established policy to check work wherever possible by ground surveys of captured territory.

b. When the Japanese suddenly capitulated in August 1945, it was felt that the photographic intelligence job should be completed by an on-the-spot evaluation of PI work done on the Japanese homeland. Important checks could thus be made on some of the more complicated types of photographic intelligence (including industrial and urban area analysis) which had not been produced in the smaller less settled islands of the Pacific. Further, it was felt that such a ground check would produce recommendations concerning the future of photographic intelligence which, if heeded, would help to build a realistic post-war photographic intelligence program.

c. Accordingly, when advanced echelons of the United States Strategic Bombing Survey arrived at Guam, the Commanding Officer of Interpron 2 and his counterpart at CIU offered the services of their personnel in whatever capacity the Survey might find them most valuable.

At the time it was generally contemplated that photographic interpreters would serve as field team guides, leading team members who were largely unfamiliar with Japan to targets selected for study. While serving as guides, it was felt that PI officers could also check the accuracy of photographic intelligence reports on the areas in which they were operating.

2. Field Operations of Photographic Intelligence Section - G-2 USSBS

a. When USSBS personnel arrived in Tokyo, the mechanics of the photographic intelligence program were not completely crystallized. However, it was soon decided that the Photographic Intelligence Section should gather field data of its own and make a full fledged USSBS report evaluating the accuracy of PI and making recommendations for its improvement.

b. With this definite reporting responsibility and with requests for PI officers coming from a number of other Survey teams - particularly Physical Damage Teams - it became apparent that 39 photo interpreters (11 Army and 20 Navy from Guam, plus 3 Army, 3 Navy, 1 Marine, and 1 RAF from Washington) were insufficient to fill all needs. For this reason a careful analysis of requests for PIs was made to insure that each was placed in a position where he could be of maximum usefulness. The resultant distribution of personnel was as shown in Table 2.

Table 2 - DISTRIBUTION OF SURVEY PERSONNEL

	Officers	Men
Tokyo Central Office (Administration, Target Information Section, Files, and liaison)	9	8
Tokyo Central Office (Tokyo Field Team)	2	
Physical Damage Teams (Special Assignments)	7	
Regional Offices	4	
Special PI Field Teams (Industrial, Bomb Fall Plot, Urban Area Analysis, Shipping, Electronics, and Defenses)	16	
Naval Bombardment Team (Officers on temporary loan from other assignments)	(2)(counted elsewhere)	
Truk Team	1	
Total	39	8

c. In order to get complete industrial information for checking PI reports, three special photographic intelligence teams (including both Army and Navy Officers) were organized to analyze targets in terms of building function, building structure, and building damage. These teams selected targets not being considered by the Physical Damage Division and made thorough building by building studies that included detailed functional, structural, and damage diagrams. Responsible Japanese plant officials worked with team members supplying complete data on the raid history and function of all structures. Another team made a special field check upon Joint Target Group methods of urban area analysis. Photographic intelligence personnel attached directly to Physical Damage Division teams had in most cases been trained in damage assessment and were therefore assigned special team jobs.

d. Because the work of Interpron 2 had been divided geographically as well as by specialty with one or two officers responsible for studying all photos within a specified area, so called "area interpreters" became very familiar with the cities, targets, railroads, roads and terrain in their spheres of study. When transferred to the Survey these officers were well prepared to do ground work on the same areas in Japan. Officers with area backgrounds were therefore selected for assignment to the USSBS regional offices at Nagoya, Osaka, Hiroshima, and Nagasaki, and to the Tokyo and Naval Bombardment Field Teams. Their duties were twofold: firstly, as a part of the regional office intelligence staff, or as team members they were responsible for briefing team personnel (with maps and photographs) on the name, number, locations, raid history, and physical features of all targets of team interest as well as the best routes to the targets. Secondly, they were responsible from a strictly PI standpoint for checking selected A/Fs, gun batteries, electronics installations, underground developments, and industrial targets in their areas.

e. Additional evaluation assignments dealing with shipping, airfields, electronics installations, AA defenses, beach intelligence, camouflage, and underground developments were given to individual interpreters who in most cases had specialized in these subjects at

Guam. Finally, a group of Army officers who had been working with the computation of bomb fall plots for the XX AF formed a special team to check selected plots in the field.

IV Evaluation of Published Material

1. For purposes of detailed evaluation each of the following specialized fields of photographic intelligence has been made the subject of a separate report: Airfields; Shipping; Industrial Analysis; Urban Area Analysis; Computed Bomb Plotting; Photographic Intelligence and the Atomic Bomb; Coast and Anti-Aircraft Artillery; Electronics; Camouflage, Concealment, and Deception; Roads and Railroads; and Beach Intelligence. This section is largely a summary of these reports but also includes a section on the relation of photographic intelligence and the atomic bomb, which summarizes observations of photographic interpreters attached to PDD teams at Hiroshima and Nagasaki.

2. Airfields

a. Airfield reports from all photographic intelligence units, although differing in form, contained essentially the same type of information, normally including:

(1) Location, both descriptive and geographic

(2) Classification by branch of service, by potential capabilities, according to a method of classification developed in the ETO, and by actual use.

(3) A brief description of the physical characteristics of the field including number, length, width, orientation, and surfacing or runways; number, types, conditions, and disposition of planes;

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delineation of dispersal areas; description of hangars and other facilities; and identification and location of defenses and electronics installations.

b. With the exception of facilities and dispersal areas, on which checks cannot be very easily presented in tabular form, the percentage of accuracy of the airfield information reported on Japan, based on an examination of 69 air facilities, is shown in Table 3.

Table 3
PERCENTAGE OF ACCURACY, AIRFIELD INFORMATION

	% of Accuracy	No. of fields on which % was based	No. of fields lacking proper data
Classification ETO Designations	66	69	0
Size of runways	82	55	14
Orientation of runways	92	49	20
Field and Runway surfacing	74	57	12
Classification by use	95	37	34

(1) Of the 69 air facilities considered, two were mistakenly identified. One of these was a plot of agricultural land that looked like an Emergency Landing Ground; the other was a boatyard whose marine ways were misinterpreted as seaplane ramps. Except for these, however, all fields were identified correctly as fields, and within areas of adequate photographic coverage no fields were omitted.

(2) A few errors in the classification of airfields by ETO standards, in which fields were classified into such categories as MAD (Medium Air Drome), FLG (Fighter Landing Ground), etc., on the basis of dimensions, surface, and facilities, were attributed to mistakes in field measurement, but the great majority were caused by a misinterpretation of field surfacing. In 80 per cent of the cases where surfacing was in error, the field had a fair-weather rather than an all-weather surface. In practice, fields claimed as potential medium or heavy airdromes by the European system were often used for fighters or trainers only. Similarly, fields claimed as fighter dromes were sometimes used for heavier types of planes. In short, the ETO field potential classification seldom gave a true identification of actual field use.

(3) In the evaluation of runway and field measurements it was felt that a tolerance of error of approximately 5% could be allowed without changing the operational effectiveness of the report. Of the 55 airfields checked, 41 were measured correctly within 1 per cent of actual dimensions, 45 were within 4 per cent, and 4 of the remaining 10 were within 10 per cent. The major cause for error was found to be inaccurate definition of field and runway limits.

(4) Although 74 per cent of the 51 airfields checked for surfacing were reported correctly, glaring errors were made in the identification of surfaces at several major fields. In all cases of error, field serviceability was overestimated. Gravel, packed earth, and even grass runways were misinterpreted as paved surfaces, and

inadequately drained fields were not always so reported. Errors in runway surfacing are explained principally by the fact that gravel, packed earth, and closely cropped grass surfaces reflect about the same amount of light as paved surfaces and as a result have nearly the same appearance on photographs. Had more research been devoted to a comparison of photographs showing fields of known surface with those of unknown surface, some of this difficulty might have been eliminated. Use of infra-red film would have eliminated identification of cropped grass runways as surfaced runways.

(5) Airfield identification by use (training, combat, reconnaissance, test and assembly, etc.) when employed to supplement and check ground information was 95 per cent accurate for the fields on which it was attempted. However, identification was attempted on only 50 per cent of the fields surveyed, for without the assistance of ground data, it was seldom possible to make any conclusive statement concerning airfield use. This was particularly true near the end of the war when the tactical situation forced the Japanese to convert many fields to purposes other than those originally intended.

c. A thorough ground check of hangars, control towers, shops, and other Japanese airfield facilities proved to be impractical. American forces had occupied many fields and had remodeled facilities to serve their own uses; at other fields the Japanese themselves had removed structures that were important during the war; and at nearly all fields, hangars and buildings had been emptied of their contents. At the few fields which were relatively untouched, facilities were approximately as reported, although some standard type buildings which had been converted from their orthodox use were not identified correctly.

d. A complete ground analysis of dispersal areas was also impractical because of the time involved in making an accurate check of unpaved taxiways that wound for miles over the Japanese countryside. In place of a ground check, Japanese officials were interrogated and maps with dispersal areas plotted were obtained for several airfields. These checks indicate that most areas in which planes had been parked were detected. Only in a few cases had Japanese camouflage succeeded in concealing hardstands or revetments from the photographic interpreter.

e. The success of photographic intelligence officers in locating and identifying defenses and electronics installations associated with airfields is considered in section 9 below.

f. Aircraft counts were included as integral parts of airfield reports and were also disseminated by despatch and as aircraft reports. These listed totals for each field by A/C types, and by operational and non-operational status.

(1) Although aircraft counts were a very important phase of photographic intelligence, and are therefore a worthy subject for evaluation, very little evaluation is possible. No reliable ground checks were made because they would require records of Japanese planes present at the time of photography, and no such records were available. Although Japanese officials were requested to estimate the average

number of planes present during certain periods, these estimates are very much subject to personal error and even if accurate would not necessarily indicate the status at any particular time.

(2) Inspite of the insufficiency of ground check, certain conclusions can be reached. Most important of these is that there are certain factors inherent in the location and identification of planes which make errors inevitable. The most important factor is the truism that aircraft have to be seen to be identified and therefore counts will be low wherever hangars and covered revetments are used. A second factor is that most items affecting the operational status of a plane (lack of fuel, lack of parts, etc.) cannot be seen in an aerial photograph, and therefore operative aircraft will be overestimated. The same type of difficulty applies to the identification of dummy aircraft which generally defied identification at the photographic scales available, and which can be built to defy identification at almost any scale. Yet, despite these inherent potential inaccuracies, plane counts were invaluable in determining fluctuation in plane movements, the importance of operational fields, the location of parked planes for attack by our forces, the appearance of new types of aircraft, the potential threat of Japanese strikes, and occasionally the location of aircraft test and assembly works.

3. Shipping

a. From the earliest days of the Pacific war information concerning Japanese naval and merchant shipping was of tremendous importance to the allied forces. Photographs were a major source of this intelligence. In general photographic interpreters reported on: (1) naval and merchant ship movements, (2) general activity within harbors, including shipbuilding and repair, and (3) recognition features of new naval classes and merchant types as developed. Both Army and Navy units issued shipping reports, but the work done by the Navy was more extensive, more specialized, and more generally used.

b. Although the contents and form of shipping reports naturally varied with changes in the course of the war, almost all reports fall into one of three basic categories: flash reports, general shipping reports, and special reports.

(1) Flash reports, in the form of despatches, were sent whenever photographs revealed ships or ship concentrations of any significance. Reports included name and class of naval units present, gross tonnages of operational and non-operational merchant shipping, and extent of cover.

(2) General shipping reports described ship movement and activity (shipbuilding, repairing, outfitting, etc.) for the major ports and naval bases in Japan. Reports listed name and length of each naval unit; and type, length, and gross tonnage of each merchant vessel. A separate column outlined briefly the activity observed for each ship (building, unloading, beached, damaged, etc.).

(3) Special reports included: (1) comprehensive shipbuilding studies of specific yards, (2) damage assessment reports, (3) target photographs and harbor diagrams showing the exact location of naval units, (4) photographs and sketches of new naval classes and

types, and (5) reports issued in conjunction with the B-29 minelaying program, describing Japanese sweeping measures and listing location and types of sunken vessels.

c. When American forces occupied Japan, the gaps and confusion in shipping records and the general destruction at all ports and naval bases made it very difficult to obtain any complete ground check of photographic intelligence reports. Sufficient information is available, however, to conclude that the accuracy of all phases of shipping interpretation was high, certainly well within the limits usually required by those using the reports.

(1) Prior to B-29 photographic reconnaissance of Japanese home ports, lack of photography made it impossible for shipping interpreters to give any adequate report on the disposition of the Imperial Navy. By the beginning of 1945, however, it was possible to keep a close check on the fleet which was largely confined to home waters. It became apparent at that time, through study of the photographs, that the fleet was not being groomed for action. Most major units remained in about the same locations, and as photographic coverage increased, checks could be made not only on the position of all units, but also on changes in profile due to alterations and camouflage. Warship movement was largely confined to smaller units - destroyers, submarines, and escort vessels- whose frequently changing positions and concentrations were recorded in shipping reports. Indications obtained from the few Japanese Navy documents available, although admittedly incomplete, indicate that the identification of

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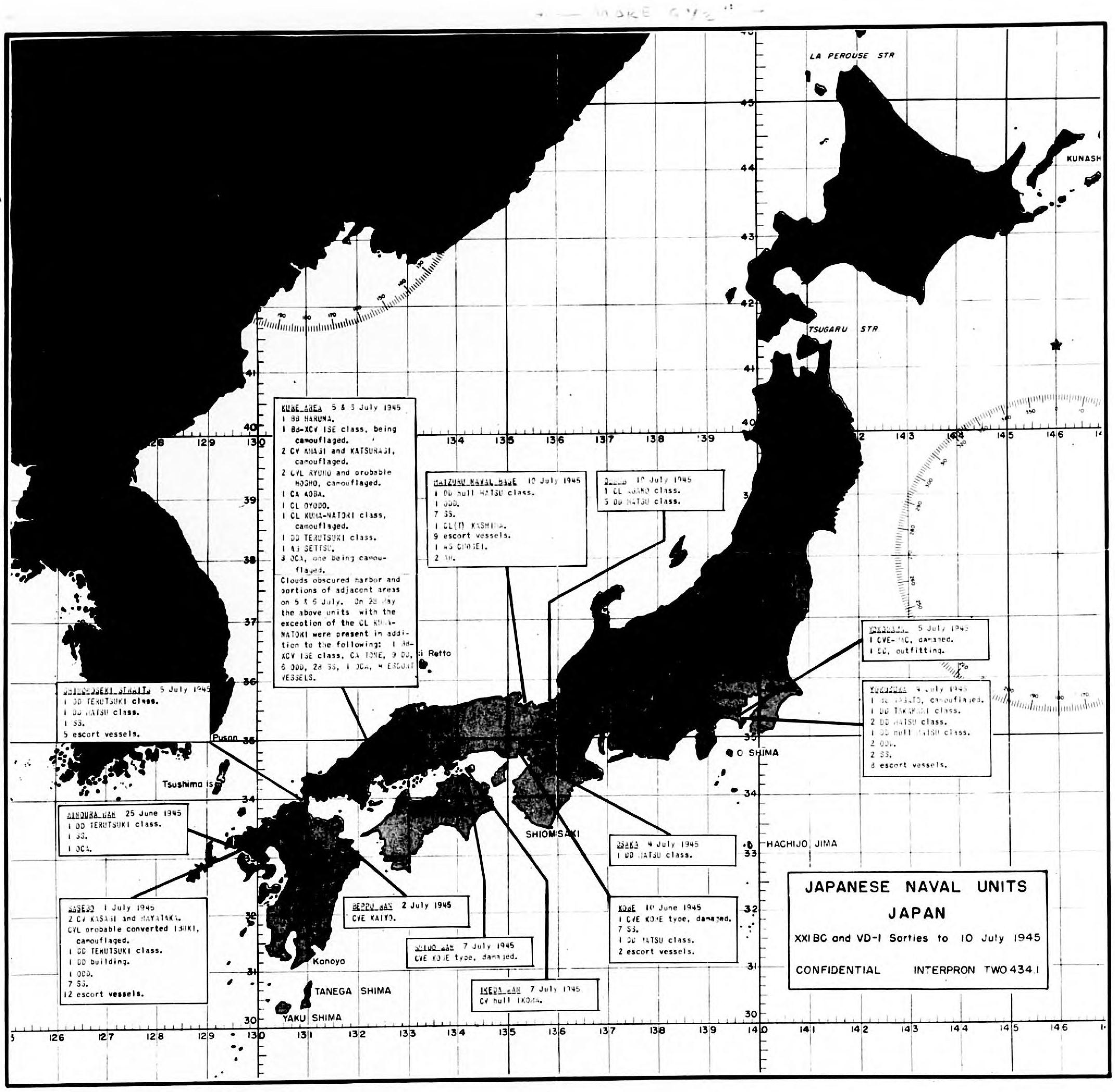
LA PEROUSE STR
KUNASH
TSUGARU STR
KURE AREA 5 & 6 July 1945
1 BB HARUNA.
1 BB-XCV ISE class, being camouflaged.
2 CV AMAGI and KATSURAGI, camouflaged.
2 CVL RYUHO and probable HOSHO, camouflaged.
1 CA AOBA.
1 CL OYODO.
1 CL KUMA-NATORI class, camouflaged.
1 DD TERUTSUKI class.
1 AS SETTSU.
3 OCA, one being camouflaged.
Clouds obscured harbor and portions of adjacent areas on 5 & 6 July. On 28 May the above units with the exception of the CL KUMA-NATORI were present in addition to the following: 1 BB-XCV ISE class, CA TONE, 9 DD, 6 ODD, 28 SS, 1 OCA, 4 ESCORT VESSELS.
MAIZURU NAVAL BASE 10 July 1945
1 DD hull MATSU class.
1 ODD.
7 SS.
1 CL(T) KASHIMA.
9 escort vessels.
2 SH.
10 July 1945
5 DD MATSU class.
5 July 1945
1 CVE-TAC, damaged.
1 DD, outfitting.
4 July 1945
1 DD TAKANAMI class.
2 DD MATSU class.
1 DD hull MATSU class.
2 ODD.
2 SS.
8 escort vessels.
SHIMONOSEKI STRAIT 5 July 1945
1 DD TERUTSUKI class.
1 DD MATSU class.
1 SS.
5 escort vessels.
Pusan
Tsushima Is
Retto
AINOURA WAN 25 June 1945
1 DD TERUTSUKI class.
1 SS.
1 OCA.
SASEBO 1 July 1945
2 CV KASAGI and HAYATAKA.
CVL probable converted IBUKI, camouflaged.
1 DD TERUTSUKI class.
1 DD building.
1 ODD.
7 SS.
12 escort vessels.
BEPPU WAN 2 July 1945
CVE KAIYO.
7 July 1945
CVE KOBE type, damaged.
IKEDA WAN 7 July 1945
CV hull IKOMA.
OSAKA 4 July 1945
1 DD MATSU class.
KOBE 10 June 1945
1 CVE KOBE type, damaged.
7 SS.
1 DD MATSU class.
2 escort vessels.
O SHIMA
SHIOMISAKI
HACHIJO JIMA
Konoya
TANEGA SHIMA
YAKU SHIMA
JAPANESE NAVAL UNITS
JAPAN
XXI BC and VD-1 Sorties to 10 July 1945
CONFIDENTIAL INTERPRON TWO 434.1

FIGURE I

warships, discovery and classification of new types, description of new design features, and the location of fleet units - all performed by photographic interpreters - was almost entirely accurate. Figure 1, prepared entirely from photographic intelligence, indicates the completeness of information furnished by this source. Locations of all major units have been confirmed.

(2) Daily records of entrance and clearance of merchant shipping at most Japanese ports were fragmentary and in most cases had been destroyed by the Japanese. In fact, Yokohama is the only harbor for which comparatively accurate entrance and clearance records of all classes of ships were kept. Table 4, listing operational tonnages at Yokohama, is believed to be indicative of the accuracy of photographic intelligence reports on ship movement.

Table 4
OPERATIONAL TONNAGES, YOKOHAMA

Date	Reported (G. T.)	Actual (G.T.)
28 January 1945	34,120	36,200
14 February 1945	65,500	66,161

(3) One of the most significant contributions made by photographic interpreters to shipping intelligence, and one which permitted quick, accurate estimates of enemy shipping tonnages, was the development of the JMST (Japanese Merchant Shipping Tonnage) coding system. Its use permitted immediate conclusions as to type and tonnage and was undoubtedly of great assistance in achieving the kind of accuracy indicated in the reports on Yokohama. Data now available on the Japanese merchant ship program and design features also illustrate

V DAMAGE ASSESSMENT

BB-XCV ISE

REPORTED DAMAGE	KEY	ACTUAL DAMAGE
Ship low by the bow probably resting on bottom.		After 24 July attack ship settled by bow. Ship abandoned 1800 28 July after settling on bottom - 15° list to starboard.
Hole in staging deck extending aft of mainmast for 50 feet and from centerline starboard side of ship.	1	Report correct
20 x 20 foot hole on port side at edge of staging deck 130 feet from stern.	2	Report correct
No report	3	Direct hits on #1 & #3 turret roofs failed to penetrate 6 inch armor.
No report	4	Numerous hits on main deck
Maindeck awash		Maindeck awash at high tide
Camouflage destroyed		Report correct
No report		Serious fire below decks around #1 turret caused considerable damage.

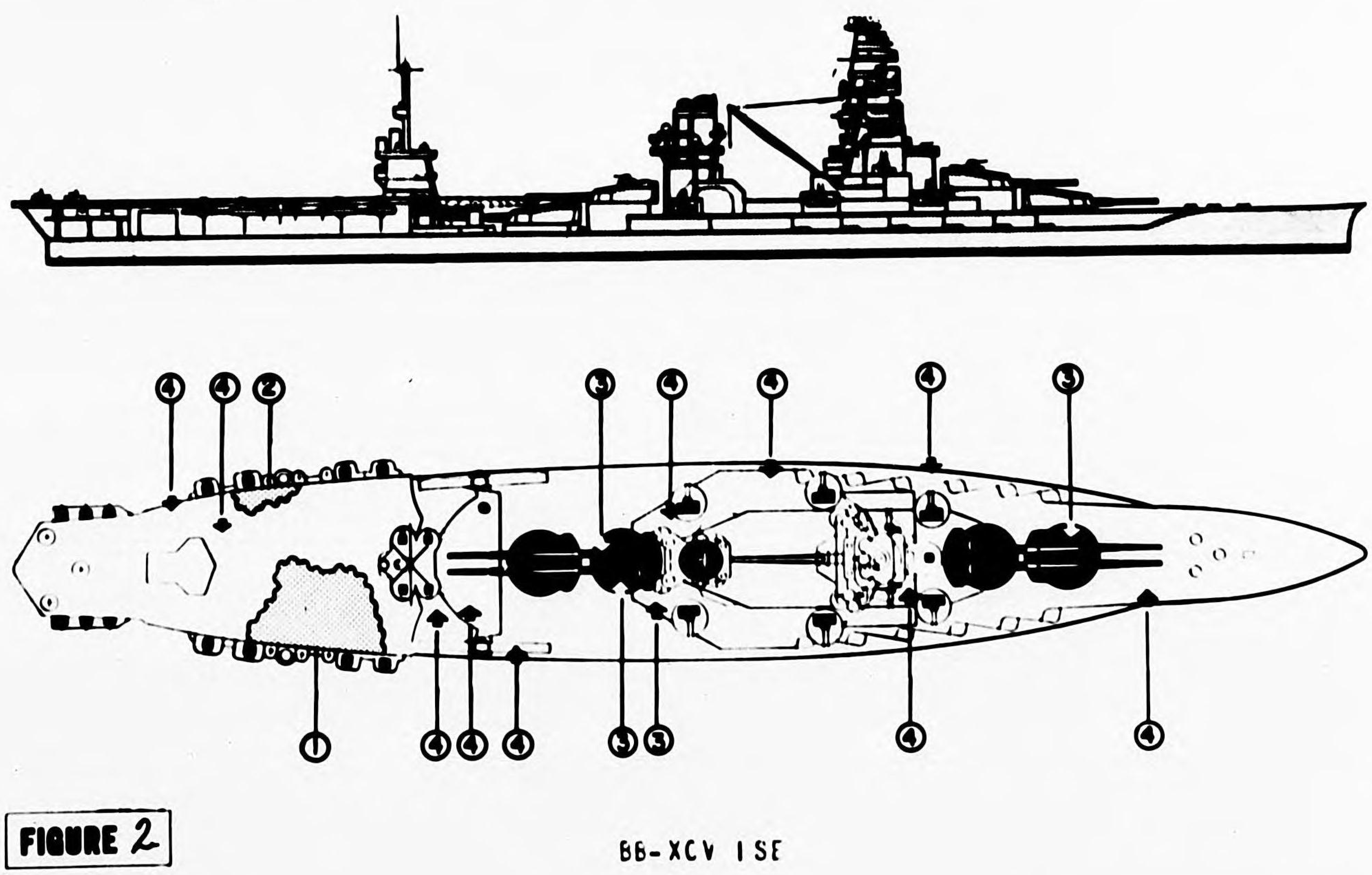

FIGURE 2

the effective use of the JMST system in correctly interpreting the dimensions and capabilities of various new ship types.

(4) The most comprehensive damage assessment study of naval vessels was made after the crippling raids on the Japanese fleet on 24 and 28 July 1945, when major warships in Kure harbor and vicinity were attacked. Prior to the attacks, target photographs and an area diagram indicating the exact disposition of the Japanese units were furnished to the carrier task force. This information proved to be highly effective, both for briefing pilots and as an aid in finding targets during the raids. Comparison of the damage assessment report with Japanese reports of damage together with an examination of the ships themselves reveals that the report was accurate, except for the understandable omission of underwater and internal damage. Figure 2 illustrates the correctness and detailed nature of the reporting. Since the Kure damage assessments were made from considerably better photography than was usually obtained, they are not typical with respect to accuracy and completeness of all damage assessment work, but they do demonstrate conclusively the high degree of accuracy obtainable with adequate photography.

(5) Although considerable information on Japanese commercial shipyards was available from Allied engineers and tourists who had visited them before the war, very little was known concerning the size, facilities, and production schedules of the home naval bases until photography was secured late in 1944. During most of the last year of the war it was possible to keep adequate records and progress

schedules of enemy steel ship construction and repair from photographic intelligence alone. Information was furnished on the physical layout and facilities of shipyards, discovery of new yards, types of ships under construction, progress of construction on particular ways, and extent and type of repair work. As in the case of other phases of shipping interpretation, Japanese shipbuilding records were not complete enough to provide a comprehensive check of PI reports, yet enough data was available to evaluate photographic intelligence on the major part of shipbuilding activity known as "progress on the ways". This information indicates that PI reports on shipbuilding activity were remarkably accurate. Of the four ships checked at Ishikawajima Shipyard, requiring an average of 86 days from keel laying to launching, the launching date estimated by photographic interpreters preceded the launching date shown in Japanese records by an average of 5½ days. This tendency to overestimate Japanese progress was due to the fact that estimates were based upon American procedures of ship construction.

4. Industrial Analysis

a. Four types of industrial analysis reports were written by photographic intelligence units in the Pacific and in Washington, namely: survey reports, functional analysis (F/A) reports, structural analysis (S/A) reports, and damage assessment (D/A) reports.

(1) Survey reports were prepared by CIU, Interpron 2, JICPOA, and AC of AS Intelligence. Their primary purpose in the comparison of photographs with ground data prepared prior to photographic reconnaissance of the Homeland was, first, to ascertain if reported targets existed, and secondly, to determine their exact location and extent. Survey reports also listed any unreported targets and attempted to classify them functionally.

(2) Functional analysis reports were prepared by CIU, AC of AS Intelligence and, to a much lesser extent, Interpron 2. Wherever possible, each report contained an analysis of a single target in terms of plant function, and of specific function of each component unit. Analyses were based upon a consideration of plant size, location, and services (transportation, power, etc.); and upon a study of building size, shape, and position in relation to adjacent structures. In addition to giving the basic identification of a target and its individual units, reports of this type provided a standard numerical referencing system for all component parts.

(3) Structural analysis reports were prepared by AC of AS Intelligence. To the extent possible, reports listed the size, height, and number of floors, the structure and materials used in construction,

and the combustibility and vulnerability classification of each building within a plant area. These studies were subsequently used in making recommendations concerning force and weapon requirements for bombings.

(4) Damage assessment reports were prepared by CIU, Interpron 2, and AC of AS Intelligence. These reports, prepared from a careful study of pre-raid and post-raid photographs, listed the extent and severity of damage to plant roof area in terms of specifically defined damage categories, and, wherever possible, the cause of the damage, i.e., HE or fire. The form of D/A reports was designed to permit an effective economic evaluation of production loss.

b. Photographic intelligence industrial teams made a detailed field study of a carefully selected group of targets with the specific objective of checking F/A, S/A, and D/A reports. Targets were chosen according to (1) the number of F/A, S/A, and D/A reports which had been written on each, and (2) the industry they represented. It is believed that the targets studied represent a cross section of Industrial Japan as well as a wide variety of the problems of analysis encountered. Altogether a total of 34 plants were analysed for function; 21 of these were checked for building construction, and 15 were checked for damage assessment. Of the total, 18 were aircraft or aircraft engine works, 7 were munitions or armament plants, 3 were steel plants, 4 were oil refineries or chemical works, one was a heavy industry plant, and one was a nonferrous metals works. Aircraft and aircraft engine factories predominated because of the top priority assigned to the destruction of these target systems.

c. From the data gathered in Japan and from the experiences of those who wrote F/A reports, it is evident that despite certain limitations photographic intelligence can do a relatively complete and very useful job in the functional analysis of industrial targets. For a certain group of industries in which individual structures possess easily recognized characteristics, photographic interpreters working from photographs alone can identify with reasonable certainty the function of both the plant and its component units. Iron and steel works, railway repair shops, hydro-electric and steam power plants, explosive works, aluminum and alumina plants, oil refineries, and shipyards fall in this category. Other industry types such as aircraft engine plants, airframe assembly plants, certain chemical plants, magnesium plants, and fertilizer plants can ordinarily be identified and analysed but are sometimes built in such a manner as to make identification difficult or impossible. In this second group are industries (e.g., airframe assembly plants) in which structures are of a design common to several industries, but where buildings are laid out in a logical pattern to accommodate the flow of processes and can therefore be identified if the process is known. In a third class of industries (e.g., aluminum rolling mills, ordnance factories, automobile works, wire and cable mills, and textile mills) the function can seldom be identified exactly without ground information, but once that is known, the function of primary buildings can often be determined. Even without ground information, plants in this third category can be given such general classifications as heavy industry, light industry, or chemical industry.

(1) Individual interpreters cannot be expected to be familiar with the building design and processes used in all industries, so it is usually necessary for each man to specialize in a certain type or group of industries. Knowledge of the appearance of buildings is not enough for a functional analyst to do a consistent job; he must also be familiar with specific industrial processes. When interpreters at the AC/AS Photographic Evaluation Section did not have an intimate knowledge of processes, trained industrial experts working in the economics branch of JTG were called in to assist. This assistance probably accounts for the 10 per cent greater accuracy of F/A reports produced in Washington over those produced at Guam.

(2) Ground information on Japanese industrial plants, expecially those built before the war, was relatively extensive and aided immeasureably in supplementing the photographic intelligence F/A program with specific details. Yet in the future, even if ground information is extremely limited, as long as plants are built above ground and in accordance with standard design, photographic interpreters should be able to report a substantial amount of valuable information on the basic industries belonging to an enemy nation.

d. Field data gathered in Japan indicates that the analysis of industrial building structures from aerial photographs is a sound method for determining plant vulnerability to fire and high explosives. The success of S/A reporting is explained by the fact that modern industrial building construction is generally standard all over the world. Where construction deviates from the norm, because of limitations in material supplies (lack of lumber, steel, etc.) or because of peculiarities in design dictated by the prevalence of earthquakes or other natural phenomena, differences are usually known from the experiences of architects and engineers who have worked in the nation where the deviation occurs, from architectural magazines published in that country, or from maps of plants within the country prepared for international insurance companies. In Japan these sources provided only a meagre amount of information. Yet with this limited material, photographic interpreters were able to identify the construction of industrial buildings with an average accuracy of 78 per cent. Most errors were in the estimation of crane size within buildings, and in the interpretation of multi-storied load bearing wall and earthquake resistant frame buildings.

e. Damage assessment was the most accurate of the three types of industrial analysis in terms of both total damage and structural and superficial damage. It was felt by some in command positions that physical damage to targets was considerably more than reported by photographic interpreters. In a few instances it was true that the type of construction and the fusing of bombs combined to cause little visible damage to roofs while at the same time causing extensive damage to building interiors. The outstanding example of this was the Nakajima Aircraft Co., Tama-Musashino plant. Here 1,282,800 square feet of damage was reported, whereas actual damage was 1,710,200 square feet, a difference of 25 per cent. Two buildings were three to four stories in height and of heavy earthquake-proof reinforced concrete construction. In these 37,700 square feet of roof damage was reported by photographic interpretation. The field check showed actual damage to roof and floors of 569,770 square feet. Additional major damage which was not visible from the air occurred in other Japanese plants when fires from adjacent combustible buildings spread through the windows of reinforced concrete buildings and gutted their interiors without affecting the roofs.

(1) Fortunately for the accuracy of reporting, multi-storied reinforced concrete buildings represented a very small fraction of the total roof area of buildings in the average Japanese plant. Therefore, such instances of hidden damage did not materially affect the overall percentage differences between photographic interpretation reports of damage and damage established by field checks.

(2) It should be further noted in appraising damage assessment reports that the photographic interpreter reported the extent of visible damage only. He ordinarily could not estimate damage to utilities or to machinery within buildings, nor did he attempt to estimate production loss or to describe the post-raid operational status of a plant. Estimates of production loss were the responsibility of economists with long experience in industry who used the damage reports as the basis for their estimates. Production loss was frequently considerably underestimated largely because the Japanese made little effort to repair damage, even when only superficial. In this

connection, the differentiation of damage (structural vs. superficial), although accurate, proved to be much less important in Japan than it had been in Germany. Once Japanese plants received widespread total damage of any kind they were usually largely abandoned. As a result of these factors, the impression of damage was often more intense than the true physical damage warranted, and thus D/A reports appeared less accurate to some than they have actually proved to be.

f. Accuracies of each of the three types of industrial analysis reports are shown statistically in Tables 5 and 6 below.

Table 5

INDUSTRIAL P.I. ACCURACY AS A WHOLE

ALL BUILDINGS

"A" F/A	"B" S/A	"C" D/A	"D" F/A	"E" S/A	"F" D/A
68%	78%	(-)93%	83%	78%	(-)98%

PRIMARY BUILDINGS

"A" F/A	"B" S/A	"C" D/A	"D" F/A	"E" S/A	"F" D/A
85%	80%	(-)86%	89%	82%	(-)95%

Table 6

INDUSTRIAL P.I. ACCURACY BY INDUSTRY

ALL BUILDINGS

INDUSTRY	"A" F/A	"B" S/A	"C" D/A	"D" F/A	"E" S/A	"F" D/A
Aircraft	72	84	(-)85	86	73	(-)96
Armament & Munitions	69	71	(/)87	80	80	(/)94
Miscellaneous	57	79	(-)95	67	83	(-)98
Oil & Chemicals	69	None	(/)80	46	None	(/)98
AVERAGES	67%	76%	(-)87%	70%	79%	(-)97%

Table 6 (Cont.)

PRIMARY BUILDINGS

INDUSTRY	"A" F/A	"B" S/A	"C" D/A	"D" F/A	"E" S/A	"F" D/A
Aircraft	87	79	(/)89	90	81	(/)96
Armament & Munitions	82	71	(-)51	86	77	(-)90
Miscellaneous	79	84	(-)94	90	84	(-)99
Oil & Chemicals	68	None	None	None	None	None
AVERAGES						
	79%	78%	(-)78%	89%	81%	(-)95%

g. To arrive at the figures presented in these tables it was necessary to establish certain arbitrary methods of scoring since reports were not always completely right or completely wrong.

(1) Reported building functions were grouped in four categories: (a) building function correct, (b) building function similar, (c) building function unidentified, and (d) building function wrong. The figures in the F/A columns of Tables 5 and 6 are the sums of the percentages reported in the first two categories. Although an effort was made to select "pure" targets on which all information reported was gathered by photographic intelligence, this effort was not completely successful since ground intelligence was sometimes incorporated into reports without specific reference to its source. It is believed, however, that the accuracy or inaccuracy of most of the F/As checked is largely attributable to photographic intelligence.

(2) The most important feature of a structural analysis report is the accuracy with which buildings are classified in terms of vulnerability to blast and fire. Vulnerability to blast (HE vulnerability) is indicated by a system of "HE vulnerability classes"

established on the basis of building structures. Vulnerability to fire is indicated by the classifications combustible, non-combustible, and fire-resistant. The S/A columns in Tables 5 and 6 are a composite of the accuracy of both types of vulnerability ratings.

(3) The accuracy evaluations of functional and structural analyses listed under columns headed "A" or "B" in Tables 5 and 6 were computed by the following formula.

$$\frac{C}{T} \times 100 = \% \text{ accuracy}$$

C = Number of installations of correct or similar function

T = total number of installations.

(4) The accuracy evaluation of functional and structural analyses listed under columns headed "D" or "E" were computed by the following formula.

$$\frac{CA}{TA} \times 100 = \% \text{ accuracy}$$

CA = total area of installations of correct or similar function

TA = total area of all installations.

(5) Damage assessment reports listed damage in three categories: structural damage (requiring the replacement of major structural members), superficial damage (repaired without replacing major structural members), and total damage (sum of the first two categories).

(6) The accuracy evaluation of damage assessments listed under the columns headed "C" were computed by the following formula.

$$40(TQ) \neq 30(SQ) \neq 30(UQ) = \% \text{ accuracy}$$

TQ = quotient less than unity between reported and actual total damage.

SQ = quotient less than unity between reported and actual structural damage.

UQ = quotient less than unity between reported and actual superficial damage.

(7) The accuracy evaluation of damage assessments listed under the columns headed "T" were computed by the following formula.

$$40(1 - \frac{TD}{A}) \neq 30(1 - \frac{SD}{A}) \neq 30(1 - \frac{UD}{A}) = \% \text{ accuracy.}$$

A = total plan area of buildings.

TD = difference between reported and actual total damage.

SD = difference between reported and actual structural damage.

UD = difference between reported and actual superficial damage.

It is believed that this method gives a truer picture of the accuracy of D/A reports than does that of (6) above, since it represents the percentage of the total plant area correctly interpreted with respect to damage. The method of (6) represents only the ratio of reported to actual damage and thus gives the interpreter no credit for area correctly assessed as undamaged.

5. Urban Area Analysis

a. Photographic intelligence work on urban areas included pre-raid analysis of cities and post-raid assessment of damage. First phase urban area work was done by the CIU and to a much lesser extent by Interpron 2 on Guam, while more detailed studies were made by the Joint Target Group in Washington.

b. Urban area work at CIU Guam was largely limited to post-raid damage assessment. To prepare for an urban area strike CIU interpreters outlined the heavily built-up section of the target city on enlargements of pre-raid photographs. Sparsely built-up fringes of the city were not considered as part of the target. Following the raid, area damage was plotted directly from post-strike photographs on the pre-raid enlargements. Measurements of area damage were made with a grid.

c. The few area assessments published by Interpron 2 were made directly from contact photographs, using more precise methods of measurement than were employed by CIU.

d. JTG urban area work included both pre- and post-attack studies. Since it was realized at the outset that problems of analysis for Japan were much different from those encountered in the ETO, new procedures were developed. Most important of these was a quick visual method for assessing building density, as opposed to the tedious process of individual building measurement used in Europe.

(1) The pre-attack phase of the JTG urban area program was designed to produce information leading to a reliable economic

assessment and to the proper selection of weapons, aiming points, and force requirements. This information was obtained by analyzing each city in terms of 5 zones -- residential (sub-divided by density into R_1, R_2, and R_3 sub-zones), industrial, mixed (residential and industrial), storage, and transportation. Average building density, and ground and roof cover areas were determined for each zone. Roof cover was also determined for individual targets and groups of targets of similar activity (e.g. the aircraft industry). Finally, primary and secondary fire breaks were plotted.

(2) In the post-attack phase of the JTG program, the damage inflicted on the city was assessed to evaluate force requirements and weapons selection, and to determine city sections which might require additional area attacks. In post-attack assessments damage was located and plotted on controlled mosaics of the city area. From these the extent of ground and roof damage in each zone, and the areas of roof damage for individual targets or target systems were determined.

(3) Significant products of Joint Target Group analyses were the total area of roof cover before the attack and the total area of roof damage resulting from the attack. These roof area figures are more important than ground area in assessing the pre- and post-attack status of a city, because in addition to information which assists in the evaluation of weapons and aiming points, they can be translated into more accurate housing, population, casualty, and other economic terms.

e. The photographic intelligence team assigned the job of ground checking urban area reports confined its field work to the evaluation of JTG pre-attack studies on Tokyo, Kyoto, and Kobe-Osaka. No attempt was made to check post-attack damage assessments, because the limited size of the team and the limited time available made a complete ground study of large city areas impossible. Furthermore, it is believed that careful measurements of damage on controlled mosaics are at least as accurate as ground measurements and infinitely more practical.

(1) Ground checks on the untouched city of Kyoto and the unburned sections of Tokyo and Kobe-Osaka proved that the zoning concept of urban area pre-attack analysis adopted to meet JTG requirements was basically sound.

(a) Only in areas where roof cover was complex and not easily defined in photographs were errors made in visual assessment of density, and even in these areas errors were not significant.

(b) In general, residential zones were correctly delineated. Although area attack requirements were such that it had not been considered necessary to separate predominantly commercial and predominantly residential districts, ground studies showed that these districts had markedly different characteristics and could have been treated separately.

(c) Mixed residential and manufacturing zones proved to have been correctly defined, and in most cases to have been satisfactorily zoned.

(d) Storage areas were less accurately identified, because manufacturing was quite often carried on in storage type buildings.

(e) Industrial and transportation zones were easily identified and in most cases correctly zoned.

(2) Although ground checks of ground area damage were not made in any Japanese cities, it is interesting to compare the quick assessments of CIU and Interpron 2 with the more precise reports of JTG, since the latter are believed to be within the limits of accuracy of ground surveys. Where reports were written on the same raids, CIU consistently reported a larger ground area of destruction than JTG. The average difference in the reports of the two units for 9 raids was 17.8%. This discrepancy can be explained by a difference in the methods used by the two units. In most cases CIU interpreters included larger streets, canals, and open spaces between buildings in their calculation of destroyed areas; while JTG omitted them insofar as practicable. The Interpron 2 method was similar to that of JTG, and as a result reports were very nearly the same, being an average of 1.3 per cent higher for the 3 cities assessed.

(3) It is important to note that reports of damage on a ground area basis are not a reliable indication of actual damage since they include streets, canals, and open spaces, the extent of which cannot be determined by this method of analysis. Roof area of damage is the only accurate expression of actual damage. Ground area of damage figures are important, however, from a weapons analysis standpoint when they are considered in relation to the building density of the

ground area of damage.

(4) In the larger cities of Japan there was an element of unreported damage in the commercial areas consisting of gutted modern buildings whose roofs were undamaged and thus the damage remained undetected on vertical photographs. That the area which contained these damaged buildings is insignificant in the light of the total amount of ground area damage reported is made clear by the fact that this area represented a small percentage of a very small portion of the cities in question. There were also isolated undamaged buildings within the ground areas reported as damaged. These areas were also insignificant as compared to total ground area of damage, and both this factor and that of unreported damage in commercial areas are made even less significant by the fact that they tend to compensate for each other.

6. Computed Bomb ~~Fall~~ Plotting

a. For all bombing raids, both those directed against individual industrial targets and those directed against urban areas, it was important to determine accurately how many of the bombs dropped actually achieved hits on the target. Without this information no adequate analysis could be made of the effectiveness of the weapons, the adequacy of the force, or of the error responsibility between wings and groups; and consequently operational planning could not be as precise as was necessary for the efficient use of our forces.

b. From the earliest days of the war there was continual demand for the development of some method which would make possible the computation of bomb impacts when the target was wholly or partially obscured by clouds or smoke. In early 1943, the 6th PID of the XII AF started investigation methods for the determination of bombing results by relating ballistic characteristics of bombs to photographs of the bombs in flight. When the Joint Target Group was organized in October 1944, the work of the 6th PID was used in developing a solution to the bomb plot problem. An officer attached to JTG was assigned to the XX AF to continue the development of 6th PID methods. With the assistance of the Commanding General of the XX AF an organization was set up to continue tests on the JTG developed computation method, and the 314th Wing of the XX AF was indoctrinated in its use. Subsequently indoctrination of other wings was commenced, but the 314th was the only organization which used the method operationally.

c. The salient feature of the computation method used by the

XXI AF is that the position of an aircraft in relation to the ground can be determined by taking a photograph of the ground which also records the images of the bombs in flight. By having the camera automatically activated by the bomb sight the initial point in the trajectory of the bomb is established. These data permit accurate prediction of the mean point of impact of the bombs, even though the actual bursts cannot be seen. The only additional information needed for accurate computation is the correct altitude, ground sppd, drift angle, etc. of the plane. By using night cameras and photo-flash bombs, similar computation of bomb hits can be made for night raids.

d. When the Photo Intelligence Section of the Bombing Survey was organized, a special team consisting of the Army photo interpreters who had been responsible for bomb fall plot work with the XXI AF was set up to ground check the bombing pattern on several targets for which computation had been figured during the war. The raids selected for checking included four daylight attacks on industrial targets, three daylight attacks on urban areas, and three night attacks on urban areas. Results obtained from the field studies indicate that the bomb scoring technique is sound in theory and reliable in practice. Its accuracy depends, of course, upon accurate bomb data and adequate photography. Predictions are accurate in the HE precision attack, and reasonably accurate for incendiary clusters. A review of the original calculations made for the targets checked indicates that the accuracy and reliability of answers determined can be further increased by better coordination of bombardier's and photographer's data reports, by proper training, and by further research in the computation technique.

7. Photographic Intelligence and the Atomic Bomb

a. Atomic power used in conjunction with other recent scientific developments such as rocket power, jet propulsion, and radio or radar directional missiles has revolutionized warfare. As a result it is conceivable that photographic intelligence will become obsolete. However, due to the uncertanties of the future insofar as war is concerned it is not possible at this time to do more than describe the effect on photographic intelligence of the atomic bomb in its present state of development. The following observations are based on information gathered by photographic interpreters attached to USSBS field teams at Hiroshima and Nagasaki.

b. Intelligence required for the planning and execution of an atomic bombing attack, as in the case of conventional attack, falls into pre-raid and post-raid categories. In pre-attack analysis for an atomic raid the concept of a "target" is similar to that employed for an urban area raid. The method used for evaluating economic vulnerability (consideration of integrated industry, utilities, transportation, housing, population, and other economic factors) and physical vulnerability of a target (consideration of the diverse structural types of buildings and the extent that each will be destroyed from a particular distribution of destructive agent) are basically the same as those used to prepare for fire raids. The primary difference between planning for an atomic bombing and for an ordinary "area attack" is the change in principle from the distribution of many weapons (HE or IB) over a wide area to the selection of a single aiming point for a single weapon that will affect the same area.

e. Damage to Hiroshima and Nagasaki did not differ from damage caused by ordinary bombs insofar as its appearance on photographs was concerned. Blast damage possessed the same features as blast from HE , except that it was on a tremendously larger scale, and fires appeared much like those precipitated by IB. (although the primary cause of damage from an atomic attack is blast, fires can be expected from both primary and secondary causes). Consequently, no basically different techniques are yet required to make an accurate assessment of atomic bomb damage from photographs.

8. Coast and Anti-Aircraft Artillery

a. Photographic intelligence provided the vast majority of all information on the situation of enemy defenses throughout the Pacific war. During the island campaigns in the Central, South, and Southwest Pacific, intelligence on Japanese AA defenses, beach defenses, coast defenses, and other ground defenses was included in comprehensive PI reports or was placed on general enemy situation maps. These reporting media proved to be inadequate when dealing with the much larger areas and greater concentrations of anti-aircraft positions encountered in Japan Proper. Consequently, new methods of reporting were developed dealing exclusively with flak intelligence. This shift in emphasis was made (1) because until the last few months of the war all attacks planned against Japan were from the air, and (2) because other types of defenses were limited to a few areas.

b. Flak intelligence reporting on Japan Proper was accomplished in the following ways:

(1) By publication of 1/100,000 scale flak maps for all of Kyushu and for all major urban and industrial areas of Honshu and Hokkaido. These were used primarily for planning high level attacks.

(2) By publication of 1/25,000 scale flak maps for 18 major airfields (principally on Kyushu), covering a radius of approximately five miles from the target area. These were designed for planning low level, dive, and glide bombing attacks.

(3) By publication of target charts and photographs indicating flak in the area immediately adjacent to the target.

(4) By dissemination in despatch form of changes in flak made subsequent to publication of flak maps. At the end of each week despatch contents were tabulated and distributed as flak intelligence summaries.

c. The publication of 1/100,000 scale flak maps and dissemination of despatches was begun at Interpron 2 and later carried on by JICPOA, CIU, and Interpron 2 with each organization responsible for certain areas of Japan. Production of 1/25,000 scale maps, and preparation of flak annotated target photographs and target work sheets was done only at Interpron 2.

d. For all maps, charts, and photographs on which flak was plotted a standard set of classification symbols was established. In descending order of size the different AA classes used were dual purpose (100mm and over), heavy AA (75mm - 100mm), automatic weapons (13.2 mm - 40mm), and machine guns (7.7mm and under). Because machine guns are highly mobile, M/G positions were reported only as emplacements (revetments less than eight feet in diameter) with no indication as to whether they were occupied or empty.

e. When USSBS field teams arrived in Japan, Japanese anti-aircraft companies had already removed all but the largest AA guns from their revetments and collected them in central dumps for surrender to the Americans. For this reason only a few heavy batteries were actually ground checked by PI field teams. The remainder of the data on defenses was gathered from Japanese maps and from interrogations of AA company and battalion commanders. Unfortunately most of the

Japanese maps presented the defense picture as it was at the very end of the war, whereas the last pre-VJ Day photographic coverage of some areas was as much as three months old. Since changes in the flak pattern were frequent (65 changes in flak installations were made in the Oita area alone in 60 days), even flak intelligence 100% correct at the time of photography was likely to be incorrect in many particulars within a few weeks. Consequently only those areas covered photographically shortly before the end of the war were used for comparative purposes.

f. Table 7 compares defenses as reported by PI with those reported by the Japanese for Sasebo and Oita, Tsuiki, and Usa Airfields, and gives some indication of the effectiveness of photo intelligence in identification of AA defenses. Sasebo was selected as an example of a large urban defense area, Oita Airfield as a large target defense area, and Tsuiki and Usa Airfields as small target defense areas. All checking was done against flak maps of Kyushu published by CinCPac - CinCPOA, based upon interpretation by Interpron 2, CIU, and JICPOA, and subsequently revised by Interpron 2 as new photography became available.

g. When judging the accuracy of interpretation from the figures in this table, it should be noted that most errors of omission, or cases in which AA reported by PI was not shown on Japanese maps, were in areas lacking adequate or recent photographic coverage (principally parts of the Sasebo area), and that most errors of interpretation were in the identification of gun sizes.

TABLE NO. 3

COMPILATION OF DEFENSES

SASEBO AREA, OITA, TSUIKI AND USA AIRFIELDS

KYUSHU, JAPAN

GUN TYPES	SYMBOL	TOTAL POSITIONS REPORTED BY JAPS	TOTAL POSITIONS REPORTED BY U.S.	POSITIONS INTERPRETED CORRECTLY	ERRORS OF OMISSION	ERRORS OF INTERPRETATION	UNOCCUPIED POSITIONS REPORTED OCCUPIED BY JAPS	POSITIONS REPORTED BY U.S. NOT CONFIRMED BY JAPS
Heavy CD		4	4	0	4(b)	4(a)	0	0
Medium CD		19	4	0	19(a)	4(b)	0	0
Dual Purpose		67	43	40	27(c)	3(d)	0	0
Heavy AA		36	50	29	7(e)	11(f)	0	10
Total Heavy AA over 75mm		103	93	79(h)	24(h)	4(d)	0	10
Automatic Weapon		358	331	181	170(c)	21(g)	7	129

(a) 4 reported as medium CD on flak maps.
(b) 4 reported as heavy CD on flak maps.
(c) 12 DP and 31 AW in areas not covered by photography.
(d) 4 AW reported as heavy AA on flak map.
(e) 3 reported as DP on flak map.
(f) 7 reported as DP and 4 reported as AW on flak map.
(g) 17 reported as ammunition storage on Jap map and 4 reported as heavy AA on flak map.
(h) 10 errors in classifying DPs.

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h. It can be stated generally that most dual purpose and heavy anti-aircraft batteries were detected and, with a few exceptions, correctly identified by type. Standard battery layout for several types of dual purpose guns made identification easier, but it was sometimes difficult to determine whether D/P weapons were fitted with single or twin barrels.

i. Except at Sasebo where coverage was incomplete flak maps showed more automatic weapons (AW), than were present. Much of this discrepancy is accounted for by the size and mobility of AW. Being smaller and less complicated they were more easily and successfully simulated by dummies (for example, all 14 of the AW reported at Mito Airfield were bamboo dummies). Being quite mobile, AW were moved frequently and, unless complete coverage of a defense area was obtained often, were likely to be observed in new positions before coverage of the old positions was obtained, showing empty emplacements. Another important cause of error in reporting AW was the Japanese practice of storing ammunition in piles in the centers of standard AW revetments. At the scale of photography usually available these storage piles were often indistinguishable from gun mounts, particularly multi-barreled mounts.

j. No Japanese information concerning the location of AA machine guns (7.7mm and under) was available - partly because such weapons were completely mobile and partly because they were not greatly used. In any case it is believed that the best photo intelligence can do in regard to machine guns at the scale of photography usually available is to locate revetments of M/G size and suggest that such revetments may be used for AA machine guns.

k. Because coast defense positions ~~in the plan view afforded by vertical aerial photographs~~ were ordinarily either casemated or emplaced in caves, very few were located (in the plan view afforded by aerial photographs) by photo interpreters. Where permanently covered in this manner, the only way CD positions might be detected is from large scale aerial oblique photography on which firing apertures are visible. Even this technique would probably produce distinctly limited results.

9. Electronics

a. Electronics as defined by photo intelligence includes radar (both search and fire control types), radio stations, searchlights, and radio direction finders. The Japanese were firm believers in the military use of radar, and though neither as advanced in equipment nor as efficient in it's use as the Allies, had a large number of sets in operation throughout the Empire. Even before the war Japanese radio was well developed. During the war it continued to be used extensively with numerous new stations established on outlying Pacific islands. RDF installations were used in quantity for air navigation needs at Japanese airfields, and searchlights were extensively used. The efforts of photo interpreters in the field of electronics were devoted principally to the location and identification of search and fire control radar.

b. Electronics intelligence was disseminated through several media to satisfy varying operational needs.

(1) Target photos were distributed to provide a means of reporting and disseminating intelligence on particular electronics installations, and to provide necessary information for air strikes against those installations.

(2) All fire control radar and searchlight radar found in defense areas were plotted, together with AA and searchlight positions, on 1/100,000 and 1/25,000 scale flak maps.

(3) Similar information was plotted on situation maps of enemy defense areas prepared for amphibious operations.

(4) "Electronics Reports" were prepared describing newly discovered types of installations and their characteristics, and presenting the interpreter's idea of their appearance in the form of an interpretive drawing.

(5) Informal reports were made to radar counter measure units, listing RCM intercepts which had been confirmed on aerial photographs.

(6) Finally, information giving positions and types of electronics installations was incorporated in general PI reports written on geographic areas.

c. The earliest reporting of electronics in the South and Southwest Pacific was spotty principally because of the unfamiliarity of photographic interpreters with these installations. After the Marshalls and Gilberts campaigns, captured electronics equipment was thoroughly studied. The results of these studies were more widely disseminated than previously, and with this increased knowledge the accuracy of interpretation of Japanese installations in the Central Pacific, the North Pacific, and in the Philippines increased.

d. Enemy radar used in the Nampo Shoto, the Nansei Shoto, and the home islands of Japan Proper, since it was nearer the sources of experimentation and production, was more modern and often more difficult to identify than the installations encountered earlier. Fortunately this was more than offset by improved techniques of identification.

e. Data collected by USSBS personnel in Japan made it possible to check reports prepared on the Nanpo Shoto, the Nansei Shoto, and Southern Kyushu. Information on Japanese installations was gathered from interrogation of Japanese Army and Navy officers who prepared situation maps for the areas listed. Some difficulty was encountered in making an accurate comparison because of the confusion in Japanese radar designations, the tendency for Japanese radar officials to list installations planned or under construction as finished, and the complete lack of coordination between Army and Navy radar units. The results of the comparisons made are summarized in Table 8.

Table 8

COMPARISON OF INTERPRON 2 SEARCH RADAR INTERPRETATION WITH RADAR LOCATIONS REPORTED BY JAPANESE (1)

TEST AREA	NUMBER OF RADAR SETS		
	Reported by Japanese	Reported by Interpron 2: Number	Percent of Jap
NANPO SHOTO	24	13	54.2%
NANSEI SHOTO	17	8	47.0%
SOUTHERN KYUSHU & WESTERN ISLANDS	55	19	34.5% (2)
TOTAL	96	40	41.6%

TEST AREA	NUMBER OF RADAR DEFENSE POINTS (3)		
	Reported by Japanese	Reported by Interpron 2: Number	Percent of Jap
NANPO SHOTO	8	7	87.8%
NANSEI SHOTO	10	6	60.0%
SOUTHERN KYUSHU & WESTERN ISLANDS	18	10	55.5% (2)
TOTAL	36	23	63.9%