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THE UNITED STATES  
STRATEGIC BOMBING SURVEY

*Reports. Pacific War. 1947*

ARMY AIR ARSENAL  
AND  
NAVY AIR DEPOTS

CORPORATION REPORT NO. XIX  
(AIRFRAMES AND ENGINES)

Aircraft Division

February 1947



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THE UNITED STATES  
STRATEGIC BOMBING SURVEY

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CORPORATION REPORT NO. XIX  
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Aircraft Division

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This report was written primarily for the use of the United States Strategic Bombing Survey in the preparation of further reports of a more comprehensive nature. Any conclusions or opinions expressed in this report must be considered as limited to the specific material covered and as subject to further interpretation in the light of further studies conducted by the Survey.



## FOREWORD

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

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

Franklin D'Olier, *Chairman*.  
Paul H. Nitze, Henry C. Alexander,  
*Vice Chairmen*.  
Harry L. Bowman,  
J. Kenneth Galbraith,  
Rensis Likert,  
Frank A. McNamee, Jr.,  
Fred Searls, Jr.,  
Monroe E. Spaght,  
Dr. Lewis R. Thompson,  
Theodore P. Wright, *Directors*.  
Walter Wilds, *Secretary*.

The Survey's complement provided for 300 civilians, 350 officers, and 500 enlisted men. The

military segment of the organization was drawn from the Army to the extent of 60 percent, and from the Navy to the extent of 40 percent. Both the Army and the Navy gave the Survey all possible assistance in furnishing men, supplies, transport, and information. The Survey operated from headquarters established in Tokyo early in September 1945, with subheadquarters in Nagoya, Osaka, Hiroshima, and Nagasaki, and with mobile teams operating in other parts of Japan, the islands of the Pacific, and the Asiatic mainland.

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

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

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## THE DEPOTS AND THEIR IMPORTANCE IN THE AIRCRAFT INDUSTRY

### INTRODUCTION

The Japanese Army and Navy air depots were similar to those of this country in that they handled repair, modification and distribution of aircraft. However, one Japanese Army arsenal and four naval depots were also producers of aircraft and together accounted for 3.8 percent of all Japanese aircraft production and 4.4 percent of all combat aircraft production over the years 1941 through 1945.

In addition to airframe production, the Army arsenal and two of the naval depots produced 5 percent of all airplane engines made in Japan from 1941 through 1945.

The depots were widely scattered geographically over the home islands from the island of Kyushu to the Tokyo area (Appendix A).

The Army Air Arsenal at Tachikawa, and later partly at Kanazawa, produced both airframes and engines, as did the Eleventh Naval Air Depot at Hiro and the Twenty-first Naval Air Depot at Omura. The First Naval Air Depot at Kasumigaura produced aircraft and the rocket-propelled suicide bomb, Baka; and, the Koza Naval Depot near Atsugi produced aircraft only.

In addition to these primary military producers, the First Naval Air Technical Depot at Yokosuka conducted experiments in aircraft construction and built prototype aircraft.

In November 1944, the Army Air Arsenals had a total of 8,570 employees of which 60 percent were civilians, and the Navy depots had a combined civilian employment of 88,554.

Detailed reports on the operations of the individual depots have been prepared from information obtained from Japanese Army and Navy sources (USSBS, Aircraft Division Reports No. XIX-1 through 5).

### DISPERSAL

Dispersion of the depots followed the usual pattern except that it came somewhat earlier than was the case with private producers. For

instance, the engine section of the Army Air Arsenal was transferred from Tachikawa to Kanazawa, starting in August 1944 before any air attacks in the vicinity. The Twenty-first Naval Air Depot dispersed in the Omura area beginning in October 1944, following an attack by China-based B-29s. And although the Eleventh Naval Air Depot at Hiro did not actually commence dispersal until January 1945, elaborate plans for such a move had been made a year earlier.

Except for the transfer of the engine production functions of the Army Air Arsenal from Tachikawa to Kanazawa, all dispersals of the depots were in the same general location as the original plants.

### THE AIR ATTACKS

The Twenty-first Naval Air Depot was the first aircraft plant in Japan to be attacked. It was struck on 7 July 1944 during the second B-29 attack on the Japanese homeland. No damage resulted from this early attack, but the next, on 25 October 1944, resulted in heavy damage to the plant and touched off dispersal operations which, coupled with an effort to produce newer types of aircraft, crippled aircraft production by this depot for the remainder of the war. Production never exceeded eight aircraft in any 1 month thereafter, and engine production ceased entirely after the October attack.

Koza was attacked by carrier-based aircraft on 10 and 18 July and 13 August 1945, but damage was slight. Aircraft production at the First Naval Air Depot had ceased by the time it was first attacked on 16 February 1945. The Eleventh Naval Air Depot suffered three attacks on 19 March, 5 May, and 2 July 1945, which destroyed most of the arsenal and many machines. Production, however, for the most part had been dispersed or moved underground prior to the attacks, so that production losses might be attributed as much to dispersal as to the attacks themselves.

The Army Air Arsenal was hit on 4 April, 10 June, and 2 August 1945, but most of the arsenal had been dispersed prior to the air attacks. Production then also suffered more from dispersal than from direct attacks.

## PRODUCTION STATISTICS

From January 1941 through August 1945 the Army and Navy Depots produced a total of 2,706 aircraft and 5,821 engines, accounting for 3.8 percent of total Japanese airframe production and 5 percent of total engine production.

Airframe production at the depots was low at the start of the war, totaling 9 in December 1941, but rose during 1942 and 1943, reaching a peak of 138 in December 1943 (Figure 1). The December 1943 production constituted 6 percent of the production of the entire industry for that month. Thereafter until the end of the war, the trend was downward.

The trend of production was downward throughout 1944 as a result of changes of aircraft types in production at the Eleventh Naval Air Depot (USSBS Aircraft Division Report No. XIX-2) and the Twenty-first Naval Air Depot (USSBS Aircraft Division Report No. XIX-3). Slowdown caused by type change-over and loan of employees to Mitsubishi by the Army Air Arsenal contributed to the decline.

Combined with an air attack on the Twenty-first Naval Air Depot and a poor production record at the Eleventh Naval Air Depot, these factors caused a 2-year low point in production in October 1944, with a total production of only 23 aircraft. Production gained thereafter until February 1945, when the effects of air attacks and dispersal resulted in a downward trend which was halted in June with further recovery in July. Only 2 aircraft, however, were produced during August 1945, the closing month of the war.

On the basis of total production from 1941 through 1945, the Army Air Arsenal was the most important military producer, with a production of 1,005 aircraft. The Twenty-first Naval Air Depot was the most important Navy producer (966 aircraft), followed by the Eleventh Naval Air Depot (532), Koza (128), and the First Naval Air Depot (75) (Appendix B).

Engine production was limited to 3 of the military producers: the Army Air Arsenal, and the Eleventh and Twenty-first Naval Air Depots. In the number of engines produced from 1941 through 1945, the Eleventh Naval Air Depot led with a total of 2,320 engines, followed by the Twenty-first Naval Air Depot with 2,132 and the Army Air Arsenal with 1,369.

The trend of total engine production by Army and Navy air depots rose gradually from 20 percent in January 1941 to the peak of 301 in May 1944. Thereafter, with minor resurgences, the trend declined sharply to 51 in August 1944 (Figure 2). The peak of 301 engines constituted approximately 10 percent of the total Japanese aircraft engine production for the month of May.

Engine production declined sharply during the last half of 1944 as a result of defects in the Ha 4 (Homare) engines produced by the Eleventh Naval Air Depot, the transfer of engine production of the Army Air Arsenal from Tachikawa to Kanazawa and the cessation of production at the Twenty-first Naval Air Depot following air attacks and dispersal.

Production was on the increase in November and December 1944, but again fell off and was generally low in 1945 due to air attacks on the Eleventh Naval Air Depot and the change-over to production of the Ha 45 engine at the Army Air Arsenal.

## EVALUATION OF PRE-ATTACK INTELLIGENCE

Intelligence figures on production at the depots and the types of aircraft produced were generally accurate, although the First Naval Air Depot was not known to be a producer.

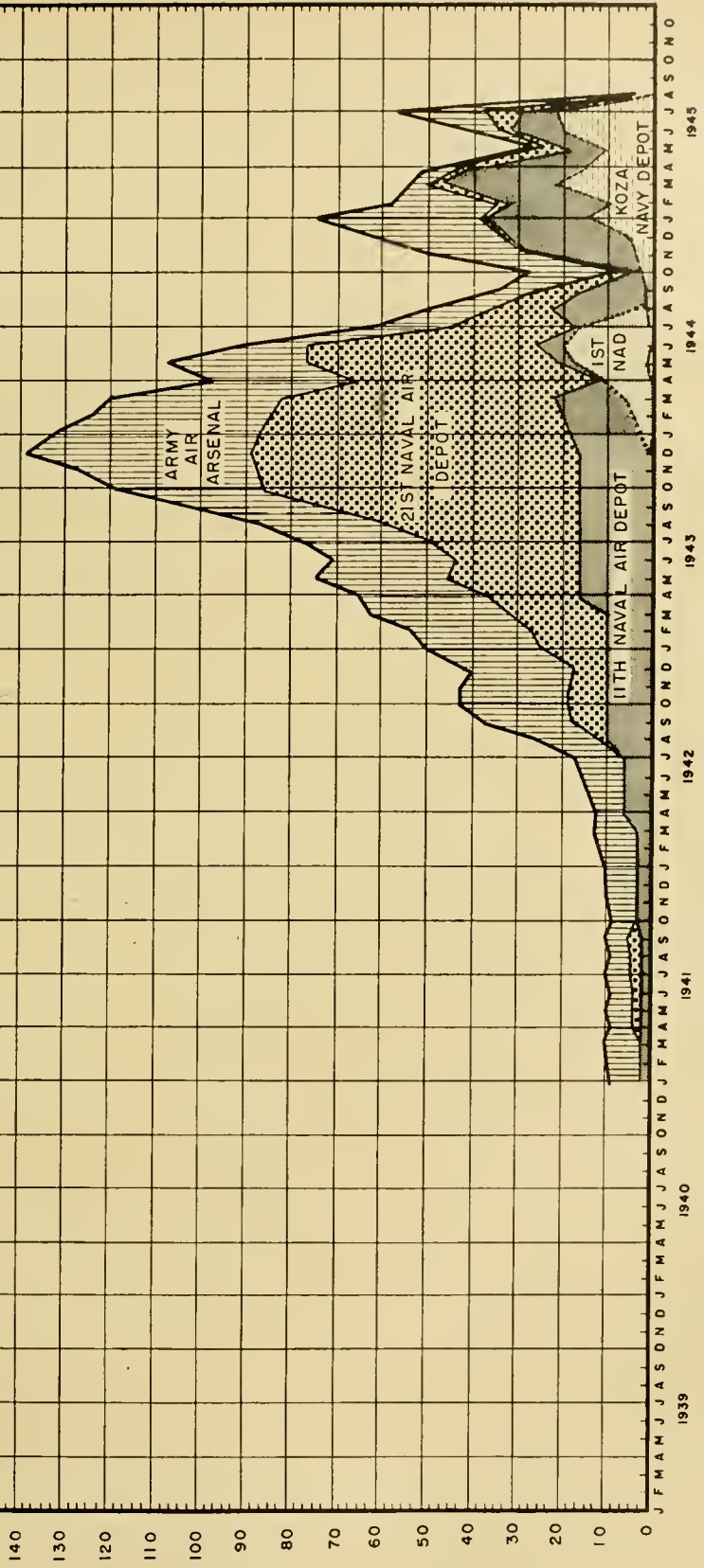
Intelligence only slightly overemphasized the importance of the depots as aircraft producers in November 1944 by estimating their contribution at 4 percent of total combat aircraft production. Actually, during 1944 the depots accounted for 3.4 percent of the total combat production, but this percentage rose to 4.4 on the basis of over-production from 1941 through 1945.

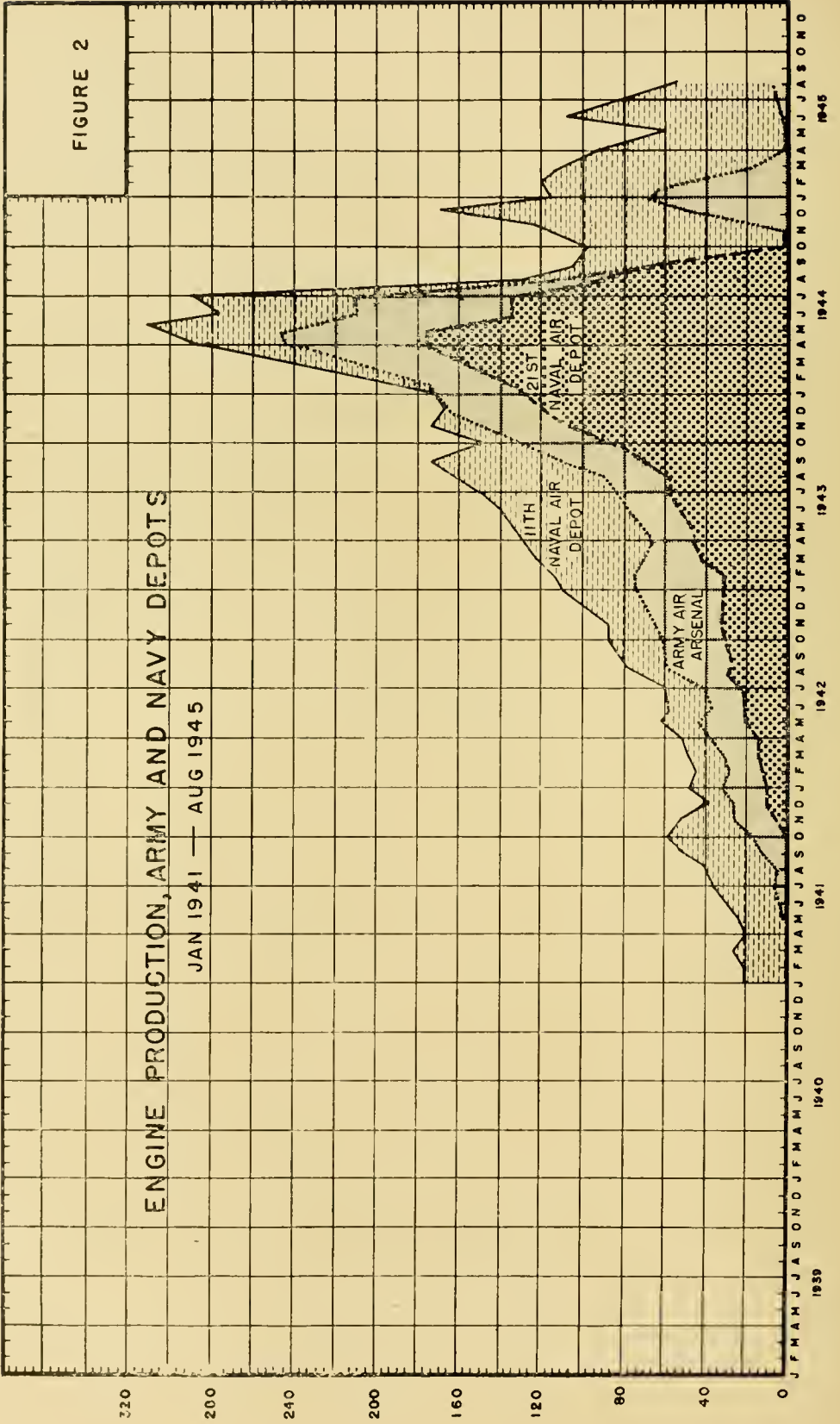
Intelligence sources did not reveal the transfer of engine production of the Army Air Arsenal from Tachikawa to Kanazawa.

FIGURE 1

AIRFRAME PRODUCTION, ARMY AND NAVY DEPOTS

JAN 1941 — AUG 1945











APPENDIX B

Airframe and engine production, Army and Navy Depots, January 1941-August 1945

AIRCRAFT PRODUCTION	1941												1942												1943												1944												1945												Grand total							
	January	February	March	April	May	June	July	August	September	October	November	December	Total	January	February	March	April	May	June	July	August	September	October	November	December	Total	January	February	March	April	May	June	July	August	September	October	November	December	Total	January	February	March	April	May	June	July	August	September	October	November	December	Total	January	February	March	April	May	June	July	August		September	October	November	December	Total		
<i>First Army Air Arsenal</i> <i>N. A. D.</i>																																																																				
Ann (K1 30).....	6	7	8	4	6	4	4	2	1	5	6	42	7	8	10	6	9	11	14	16	19	22	23	170	24	23	29	22	23	23	4	23	23	4	22	27	35	4	50	324	45	40	40	30	34	15	14	12	10	15	20	23	303	40	28	0	0	0	6	19	0						93	42
Sonia (K1 51).....							1	2	3		6	23	7	8	10	6	9	11	14	16	19	22	23	170	24	23	29	22	23	23	4	23	23	4	22	27	35	4	50	324	45	40	40	30	34	15	14	12	10	15	20	23	303	40	28	0	0	0	6	19	0						93	42
Osier (K1 43).....																																																																				
Perzy (K1 67).....																																																																				
Total.....	6	7	8	4	6	4	5	4	4	5	6	65	7	8	10	8	9	11	14	16	19	24	25	177	27	26	33	25	26	26	27	27	26	24	29	60	366	45	40	40	30	34	15	14	12	10	16	20	28	303	40	28	0	1	0	6	19	0						94	1,005			
<i>Eleventh N. A. D.</i>																																																																				
Willow (K5 Y1).....												27												9														76														75																
Jake (R13 A1).....	2	2	2	2	2	2	2	2	2	3	3	27	3	3	3									9															3	5	7	10	15	20	15							76														75		
Kate (B5 H2).....																5	5	5	5	10	10	10	10	70	10	10	10	15	15	15	15	15	15	15	15	15	165	15	15	16	1	4	6	1	20	12		24	27	45	94	24	22	26	25	6	11	7	0						280			
Julie (Subsel).....																																																																				
George (Shilton).....																																																																				
Total.....	2	2	2	2	2	2	2	2	2	3	3	27	3	3	3	5	5	6	6	10	10	16	10	79	10	10	10	15	15	15	15	15	15	15	15	16	165	15	15	16	1	4	5	1	20	12		24	27	139	24	22	26	25	6	11	7	1						532				
<i>Koss Twenty-first N. A. D.</i>																																																																				
Peto (E1 M2).....					2	2	2	3	3	4		16																																																								
Claude Jr. (A5 M4-k).....																																																																				
Zeki, Jr. (A6 M2-K).....																																																																				
Grace (Ryssel).....																																																																				
George (Shilton).....																																																																				
Total.....				2	2	2	3	3	4			16								2	7	9	8	6	32	13	15	19	24	32	29	34	42	60	70	72	73	483	68	62	66	54	55	50	30	17	9	6	0	0	408	2	1	8	4	0	2	8	1						966			
Jack (Rablen).....																																																																				
Grand total.....	8	9	10	8	10	8	10	9	10	8	9	108	10	11	13	18	14	16	19	28	36	43	43	288	50	51	62	64	73	70	76	84	101	110	126	138	1,014	131	122	120	95	109	90	60	50	33	23	48	61	942	17	79	69	62	15	10	22	0						2,700				
<i>ENGINE PRODUCTION</i>																																																																				
<i>Army Air Arsenal</i>																																																																				
HA 25.....						3	5	5	10	15	20	16	74																																																							
HA 31.....																																																																				
HA 4.....																																																																				
Total.....						3	5	5	10	15	20	16	74																																																							
<i>Eleventh N. A. D.</i>																																																																				
HA 2.....					1	8	5	10	10	15	10	54																																																								
HA 6.....																																																																				
Kinsel B.....	20	19	25	20	23	24	26	29	30	30	10	236																																																								
Total.....	20	19	25	20	23	25	29	34	40	40	25	310																																																								
<i>Twenty-first N. A. D.</i>																																																																				
HA 23.....											5	10	15																																																							
Grand total.....	20	19	25	20	23	28	34	39	50	55	36	399	45	42	46	49	59	55	68	75	78	83	83	376	106	109	117	123	125	135	142	155	167	142	144	160	1,628	164	194	228	277	361	267	292	121	100	96	120	165	2,314	112	115	109	00	68	163	77	51						6,821				



FIRST NAVAL AIR DEPOT, KASUMIGAURA  
(NAVY DEPOT REPORT NO. XIX-1)

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## THE DEPOT AND ITS IMPORTANCE IN THE AIRCRAFT INDUSTRY

### INTRODUCTION

The First Naval Air Depot (Dai-ichi Kaigun Kokusho) was primarily engaged in repair of airframes, aircraft engines, ordnance, and automotive equipment, but also produced the Type 93 intermediate trainer Willow (K5Y1) in small quantities from January to July 1944, and the suicide aircraft Baka 11 for 4 months starting December 1944. Production amounted to 1.3 percent of all Willow production and about 80 percent of all Baka 11 production.

The depot, set up as such in October 1941, was 50 percent completed in that month, 60 percent in June 1943, and 100 percent in August 1944. It was located in Ibaraki prefecture, west of Kasumigaura and about 2 miles south of Tsuehinra city, adjacent to Kasumigaura airfield and the buildings of the Kasumigaura Air Group. In addition to the necessary shops, service buildings, and storage sheds, the depot provided six dormitories and a hospital.

The activities of the depot included, in addition to aircraft production, repair to the Type 97 attack plane Kate, the Type 96 attack plane Nell (transport version), Willow (in particular, fuel equipment and landing gear), and the Zeke fighter-bomber (in particular, bomb equipment); repairs to engines of many types; repairs to navigational meters and gages, electrical and optical equipment, machine-guns and bombing equipment, and fixed ordnance parts; repairs to automobiles, and production of auxiliary fuel equipment for automobiles.

### ORGANIZATION AND OPERATION

The depot maintained a separate department for each type of work; aircraft department, engine department, ordnance department, and (from April 1945) an automobile department, as well as the usual service and administrative departments.

The total employment for July 1942 was 3,977, of which 1,607 were direct workers; for July 1943, 5,983 (3,504 direct workers); for July 1944, 10,713

(5,869 direct workers); and for August 1945, 12,671 (7,271 direct workers) (Reference Item 1). Comparatively small numbers of students and military personnel were employed (Appendix A).

There were two shifts of 12 hours each, from 0700 to 1900 and from 1900 to 0700, with 90 percent of employees on the day shift. This shift had 30 minutes for lunch and for supper, and two 15-minute rest periods, at 0915 and 1500. No particular time was specified for rest periods during the night shift.

### THE DISPERSAL PROGRAM

The first dispersal, from May to December 1944, involved removing important equipment from some 17 points in the surrounding county (Appendix B). This program was only 20 percent completed, and almost no effect was noticed upon the operation of the depot.

The second dispersal, January to August 1945, consisted of a removal to an underground site just outside the depot (aircraft department) and another near the village of Fukuhara, lying to the north of the depot (engine department). This move was 55 percent completed, and production dropped about 20 percent. The decline in both capacity and actual repairs shown by the engine department during this period was ascribed directly to the effects of dispersal.

### THE AIR ATTACKS

#### DIRECT ATTACKS

The depot was attacked on 16 February, 10 May, 9 June, 10 July, and 13 August 1945, the duration of attacks being about 10 minutes in each instance. These were Navy raids except for the May and June attacks (Twentieth Air Force). The attacks were directed primarily against the airfield or the seaplane base rather than the depot itself.

The aircraft department was affected most heavily, suffering damage to 107,640 square f

the repair shops for larger planes, as well as the heat treatment shop, power plant, a blower shop, wood propeller shop, the small-type plane air shop, wooden-manufacture machine shop, painting, sewing, and metal plating shops, and a warehouse for finished products. In addition to this, 32,292 square feet of the employee training building, the materials storage building of the accounts department, the waste oil reprocessing plant, and an assembly hall were damaged. Casualties from these raids were 21 deaths and 2 injuries.

The air-raid precaution program of the depot provided slit trench shelters for as many as 4,700 persons, and placed greatest emphasis on defense against fire (Reference Item 2).

## PRODUCTION STATISTICS

The depot produced, in all, 75 Willows, the best production in any 1 month being 20 (June 1944). Production of Baka 11 amounted to 600 engines, of which 197 were made in February 1945, the peak month. The original plan to produce 1,000 Willows a month through March 1945 was not carried out (Appendix C; Reference Item 3). Peak air accomplishments for both engines and air-

frames was in October 1944 (Appendix D; Reference Item 3).

Repair of damage to facilities and equipment by air attack had not been made by the close of the war. This was ascribed to a lack of labor and materials. All but one attack occurred after production had stopped, but the general decline in repair work accomplished must be laid, in part, to this cause, as well as to the dispersals.

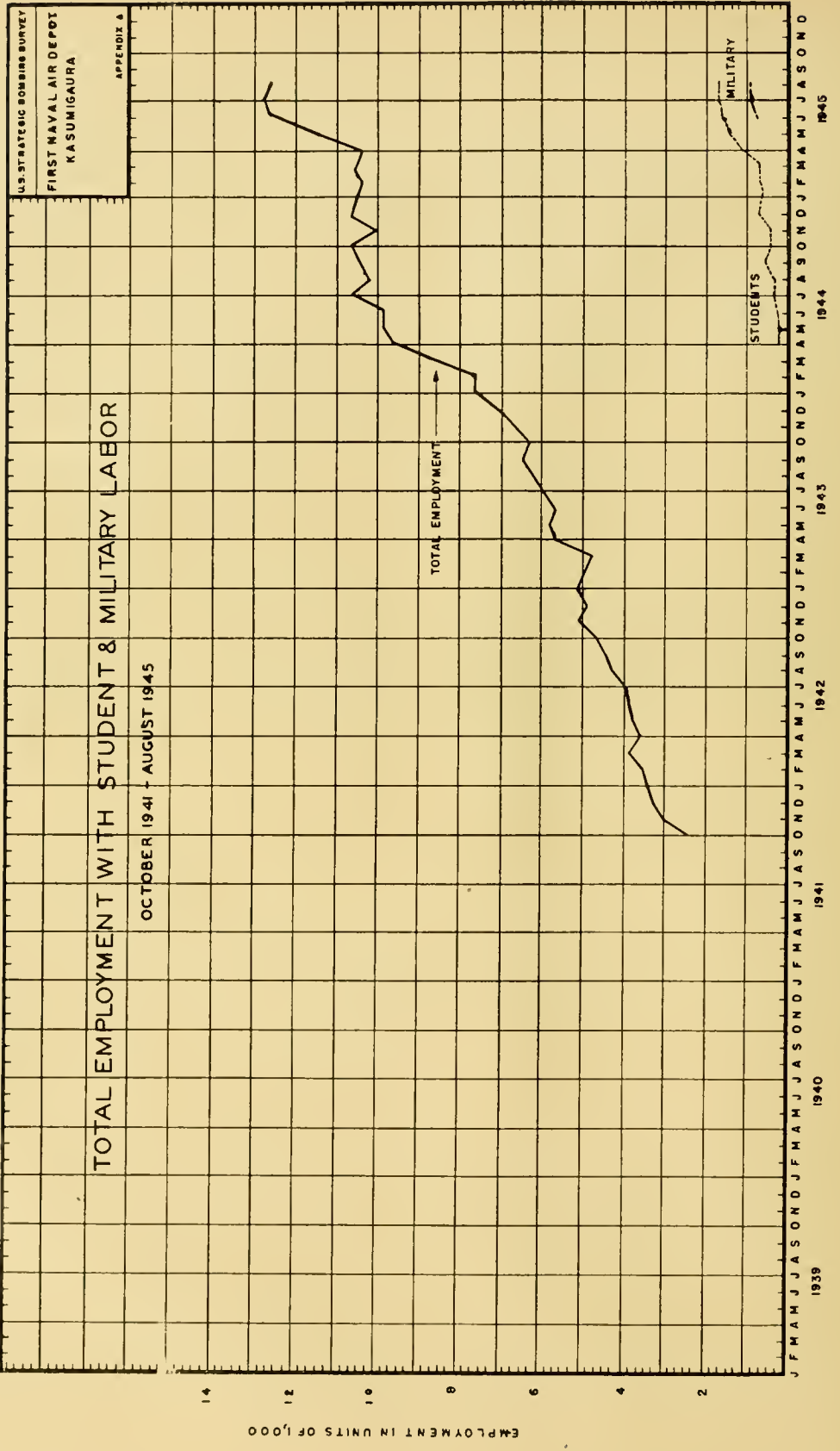
## EVALUATION OF PRE-ATTACK INTELLIGENCE

War Department Military Intelligence Service (G-2), recognized the depot as a repair station in operation, but never published any evidence that it was engaged in aircraft production.

## REFERENCE NOTES

The following material is on file with records of the United States Strategic Bombing Survey, Aircraft Division, at the Office of the Adjutant General, War Department, Washington, D. C.

Reference Item 1..... Employment statistics.  
Reference Item 2..... Air raid precautions.  
Reference Item 3..... Production statistics, including man-hours.



SAKAE MURA

MISHIYAKE STA

MARAKE STA

MARAKE MACH

TRIKHURA SH

TRIKHURA STA



KASUMIURA

DORM B 1 DINING ROOM

DORM B 2 DINING ROOM

TRIKHURA AIR GROUP

ENGINE REPAIR SHOP

WATERALS WAREHOUSE

FOR RECORDS FACTORY

PLANE DEPT

DORM B 3

DORM B 4

ONOHARA MURA

SUPPLY DEPT SMALL DUMPS

SUPPLY DEPT SMALL DUMPS

SUPPLY DEPT SMALL DUMPS

SUPPLY DEPT SMALL DUMPS

ORDNANCE DEPT ELECT SHOP

ORDNANCE DEPT MACH SHOP

ENG DEPT REPAIR SHOP

ENG DEPT REPAIR SHOP

SHIMIZU STA

MUNICIPALITY

AIR FIELD

KASUMIURA AIR GROUP

YANUMURA

SUPPLY DEPT

YAMASHIRO WAREHOUSE

FUHASHIURA MURA

ASAKI MURA

OHADA MURA

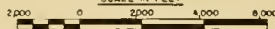
ENG DEPT MACH SHOP

USHIKU STA

USHIKU MURA

NOTE-  
PRIOR TO DISPERSAL ALL FACILITIES WERE WITHIN AREA SHOWN THUS

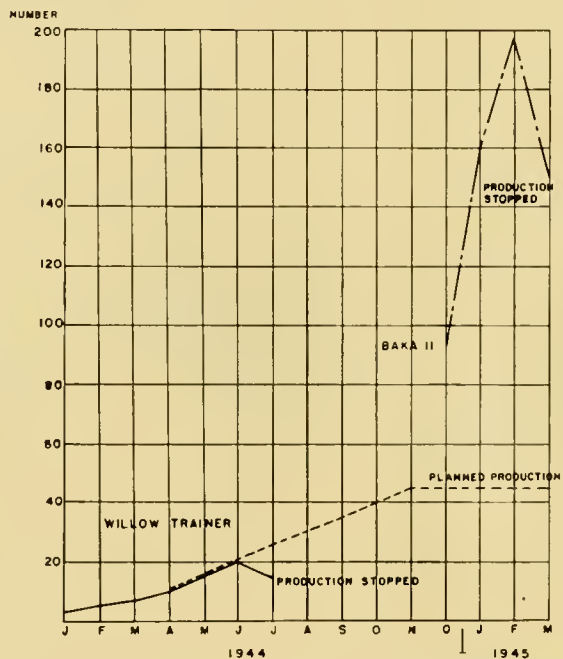
SCALE IN FEET



FIRST NAVAL AIR DEPOT  
DISPERSAL MAP

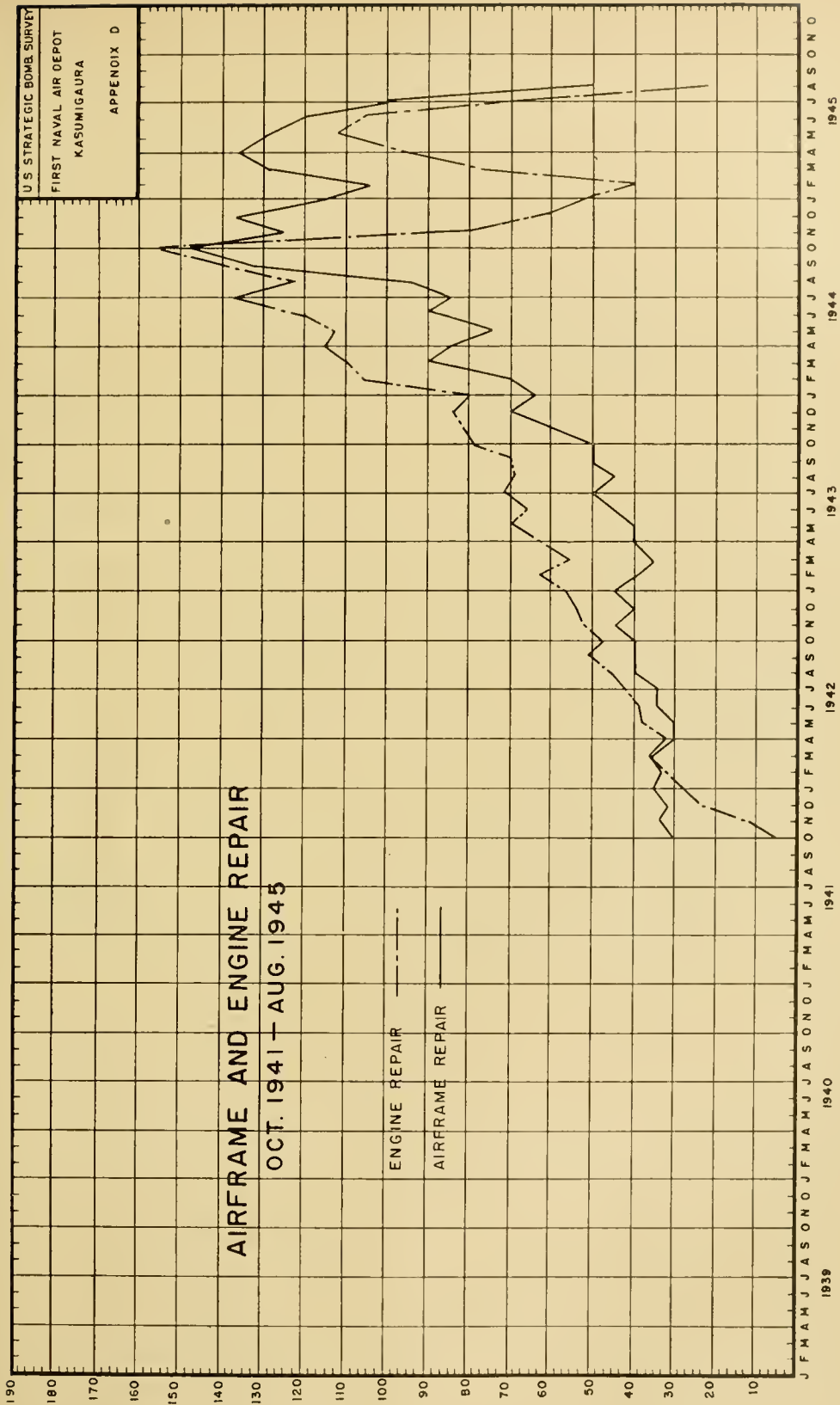
### PRODUCTION OF AIRCRAFT BY TYPES

JAN 1944 — MAR 1945



U S STRATEGIC BOMB SURVEY  
 FIRST NAVAL AIR DEPOT  
 KASUMISaura  
 APPENDIX C





ELEVENTH NAVAL AIR DEPOT  
(DEPOT REPORT NO. XIX-2)

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## THE DEPOT AND ITS IMPORTANCE IN THE AIRCRAFT INDUSTRY

### INTELLIGENCE

The Eleventh Naval Air Depot (Dai Juichi Kaigun Kokusho) was one of four air depots that were producing or were about to produce aircraft. The depot manufactured both air frames and aircraft engines. In 1943 and 1944 (fiscal year, April to March) it completed 150 and 196 aircraft respectively, or about 7.5 and 8.3 percent of the national total production of single-engine bombers for those years. The principal types of planes manufactured were the Type 97 Model 3, Kate 12, a single-engine Navy attack plane; and the Suisai, Judy 11, 12, and 33, single-engine Navy dive bombers. At the close of war it was about to produce the Shiden, George 11, an experimental land-based fighter using a Homare 21, 18-cylinder radial engine.

In aircraft engines the depot manufactured principally Kasei Model 15 or Ha 32, a 14-cylinder radial engine, used on the twin-engine bomber Betty Model 11; and the Homare 21 or Ha 45, an 18-cylinder radial engine. Maximum production of Kasei engines was attained during 1943; 519 were completed, or 1.8 percent of the total engine production in Japan. Homare engine production for 1944 was 689 or 1.4 percent of the total Japanese production for this year.

The Eleventh Naval Air Depot was located at Hiro on the Inland Sea at the mouth of the Hirose-Okawa River about 3 miles southeast of Kure. Originally it was concerned principally with repairs but did supply aircraft and engines to the Air Force as early as 1930. It was, however, officially established on 1 October 1941. The depot at the time of its establishment consisted of a marine engine department and an aircraft department, but the two operated separately. On 6 June 1945 the two departments were combined due to the increasing importance and priority given to aircraft production. The marine engine department was to supply aircraft parts, but by the end of war it had not yet fully converted itself.

A branch arsenal also was established on 1 April 1945 in Iwakuni, which was located to the west of it. This was intended to be used for small aircraft repair but later was converted for the purpose of aircraft production.

Figures for the original floor space of the Eleventh Naval Air Depot were lacking but expansion since 1942 amounted to more than 1,300,000 square feet, most of which was above ground. About 480,000 square feet of this (from September 1944) represented dispersal rather than expansion of facilities (Appendix A).

The depot was under the direct jurisdiction of the Naval Air Headquarters, which planned the production schedule, supplied and made allocations for raw materials, and in general had direct supervision. After the formation of the Munitions Ministry, production schedules and allocation of raw materials were coordinated with the over-all schedules set up by the Ministry.

### EMPLOYEES

The employment for the Eleventh Naval Air Depot for 1945 was 53,200, with 31,920 classified as direct or productive workers, constituting 60 percent of the total. The employment in 1939 was 14,000 with 9,400 or 67 percent in productive work. All these figures seem high for the amount of production achieved but it is believed to be due to the fact that it includes the marine engine department which was not concerned with aircraft manufacture until June 1945 when it was combined with the Eleventh Naval Air Depot. Personnel in 1945 included regular employees (77 percent), conscripted students (19 percent) and military (4 percent). Students were employed from June 1944 and military personnel in June 1945. The multiple-shift (3-shift) schedule of work was used at the depot but the third shift had only a small percentage of student labor and no other employees. The employment schedule therefore was for all practical purposes on 2 shifts.

The relative percentage of each type of labor on each shift was as follows:

Shifts	Regular	Military	Student
	Percent	Percent	Percent
Day .....	40	50	10
Evening .....	60	50	80
Night .....			10

The relative efficiency of the three-shift schedule was not indicated, but since its actual usage was limited, it would be safe to say it was not very effective. The employees on a two-shift schedule worked on an average 9.2 hours a day prior to 1944, and 9.3 hours in 1944 and 1945.

Labor turnover at the depot remained fairly stable. Direct employees averaged approximately 25,000 per month from January 1944 through August 1945 (excluding military and student labor). Hence, the increase in labor during this period was accomplished by the use of students and military personnel. Actual rate of turnover in personnel could not be determined due to lack of data.

### DISPERSAL

Original plans for dispersal were made in March 1944 by the Navy in anticipation of air attacks. The plan emphasized dispersal to underground factories. Some dispersal to underground shops was carried out during 1944 but the main dispersal began in March 1945 in the main depot. At the close of war about one-half of all planned excavation for dispersed shops was completed. In the main depot 444,000 square feet were planned of which 236,000 square feet were completed. The total planned excavation for all shops was more than 900,000 square feet divided among six sites. These were as follows: main depot at Hiro, Yoshiura, Kirigushi, Kaitaichi, Uchinomi, and Iwakuni (Appendix B). At the end of the war there were, apart from 1,600 machines installed in the main depot, 500 machines in the other underground shops. Total dispersal covered more than 40 sites located in southern Honshu and Shikoku (Appendix C).

The production objectives for the dispersed plants as of the close of war were 400 aircraft engines per month at the main arsenal and 40 planes per month at the Iwakuni branch arsenal. The whole program was well on its way but, due to various difficulties, production had not actually started.

Relative productive efficiency following dispersal was not possible to determine since the war ended before actual production began. However, where dispersal had been completed the morale of the workers improved, according to the officials.

No particular aid was received from Germany in the dispersal of the depot.

### THE AIR ATTACKS

There were three direct attacks on this Navy Air Depot as follows:

Date	Time	Attacking force	Number of bombs	Type of bombs	Damage
19 Mar. 1945	1700-0800	Carrier attack	51	HE	Minor
5 May 1945	1045-1125	20th Airforce B-29s	400	HE	Heavy
2 July 1945	0000-0200	Area attack on Kure	10	HE-1B	Minor

The attack of 19 March was reported to be minor and the aircraft engine department suffered no damage. Approximately 50 bombs were dropped with hits on 2 boiler houses, 2 machine shops, an assembly shop, a testing shop and other shops aside from near misses which caused some damage (Appendix D). Stray bombs entirely out of the factory area were not indicated on the bomb layout map (Appendix E-1). Casualties were 61 dead and 88 injured.

The 5 May attack was concentrated and severe damage was caused. In the engine department roofs and walls of every shop were damaged as well as its electrical system. Warehouses containing engine parts were burned as were drawings and records. 80 of the machine tools in the department also were damaged severely.

The damage caused in all departments was not definitely known, but more than 500 machines of various types were damaged, many of which were not repairable (Appendix D). The bomb plot was not complete in that some buildings were indicated as damaged without any bombs plotted having struck in the immediate area. Presumably, instantaneously fuzed bombs left craters after striking roofs.

According to the bomb plot some 22 shops were damaged. Casualties were: 112 killed and 100 injured (Appendix E-2).

In the attack of 2 July, which principally was aimed at Kure, few bombs fell in the Hiro district (Appendix D). No casualties occurred and only few buildings were destroyed, among them the engine inspection shop and a warehouse containing

wood-working machines such as lathes, cutting machines, etc., which were destroyed also. In addition, some engine parts were destroyed, causing a drop in the manufacture of engines (Appendix E-3).

For air defense the only information available is that there were three anti-aircraft machine guns at Kihatayama manned by a crew of three men each. At Hachiroyama there were two anti-aircraft machine guns manned by a crew of three each. In addition, there was a portable smoke screen apparatus in charge of guards, and two boats used during the air raids for transportation purposes.

The effect of the area bombing on the production of aircraft engines can be seen by the fact that about 42 percent of the parts came from cooperating works located in Tokyo, Tamashima in Kagayama prefecture, and Hiroshima. Of these suppliers 58 percent were destroyed which is reflected in the fact that parts shortage became severe.

## PRODUCTION STATISTICS

Over-all production from 1939 to 1945 was 594 frames with 926 planned or ordered by the government. From 1930 to 1945, 1,211 aircraft were completed. Aircraft manufactured between 1930 and 1939 were of various types, but Navy attack planes were manufactured during each of these years.

Between 1939 and 1945 the following types of aircraft were produced: Type 97 Model 2 (Kate 11), single-engine bomber; Reisu (Jake), a single-engine reconnaissance plane; Type 97 Model 3 (Kate 12), a single-engine Navy attack plane; Kinsei (Judy 11, 12, and 33), single-engine Navy dive bombers; and Shiden (George 11), an improved single-engine Navy fighter (Appendix F).

The Kate 11 was manufactured in 1939 with a total of 50 for the year. In 1940 and 1941 manufacture was limited to Jake of which 48 were produced. In 1942 and 1943 production was exclusively Kate 12 aircraft of which 250 were produced during the 2 years. In the following year 30 additional Kate 12s were manufactured. Production of the Judy type also began and during 1944 and 1945 a total of 215 (including Judy 11, 12 and 33) were produced.

At the close of war, the production of the improved George 11 was just beginning and one was completed.

Over-all production of aircraft engines from

1930 to 1945 was 3,141 units. No planned figures were available for this period but, during 1944 and 1945, 1,248 Homare 21 engines were manufactured as against 2,110 planned. Total production from 1940 to 1945 was 2,445 engines (Appendix F).

Prior to 1940 the Hikari model 1 and the Koto-buki aircraft engines were manufactured. An average of 60 engines were manufactured annually with considerable increase in 1938 and 1939 when 100 and 130 engines were completed, respectively. In 1940 the Kinsei (1,040-horsepower, 14-cylinder radial engine) went into production. Beginning with June, 115 were produced during the year. Kasei engine (1,440-horsepower, 14-cylinder radial engine) manufacture began in June 1941 and amounted to 64 for the year. In 1942 production was devoted exclusively to the Kasei 15, and 240 were completed. Peak production of Kasei, however, was reached in August of the following year, only to be discontinued after October in favor of the Homare 21 (1,970-horsepower, 18-cylinder radial engine). During 1944 and 1945 only Homare 21 engines were manufactured.

Actual production of aircraft compared to planned indicates a lack of coordination from 1944 to the end of the year. From 1939 to 1943 there was no divergence at all with 348 aircraft planned and completed. In 1944 and 1945 (April 1944-July 1945) 555 Judy were planned as against an actual of 215 (Figure 1). The production of air frames during 1944 and 1945 fluctuated greatly and in July and October 1944 it dropped to one and zero, respectively. The drop in October was noted as being due to bombing but no bombing attacks were recorded in the United States Strategic Bombing Survey Tabulating Section records.

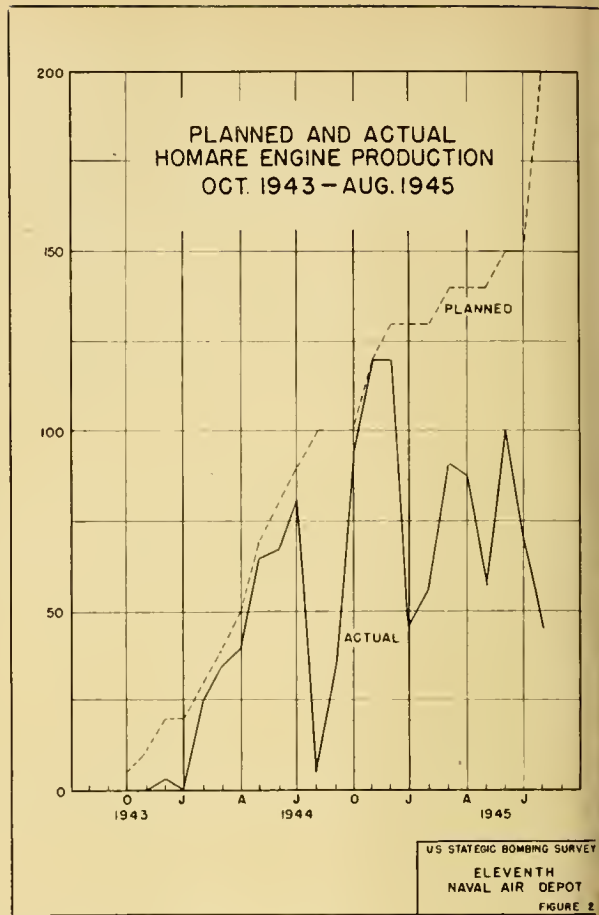
The productive capacity in November 1944 was only 30 aircraft per month while the planned was 60 and actual 24. Hence, the ordered production was out of line with the capacity and there is reason to believe that the orders were "hoped for" figures and not the planned figures made by the depot.

Beginning with the fiscal year April 1945, there was a change in type to the modified George. In order to expedite this change it was planned to reduce Judy production to 20 a month. Despite this, at the end of the war the change to the fighter George had been just completed and production had not started. The production of the fighter George was delayed by a lack of jig equipment.

Production in 1945 was directly affected only by the air attack of 5 May when Judy production declined from 25 in April to 6 in May.

Considering the actual and planned engine production figures, the 2 approximate each other up to December 1944 except for August and September. An increasing divergence occurs after this period in which the actual figures take a downward trend while the planned continues to rise (Figure 2). The planned curve or production figure was to be raised as a matter of policy to 400 by December.

There is sudden decline in production in August 1944, January and May 1945. The severe drop in January and August was due to technical causes—flaws in the engine which required correction. January 1945 also was the beginning of the dispersal program and contributed to the decline. The dip in production in May and again after June was due to B-29 bombing attacks. Production in May, as a result of the air attack of

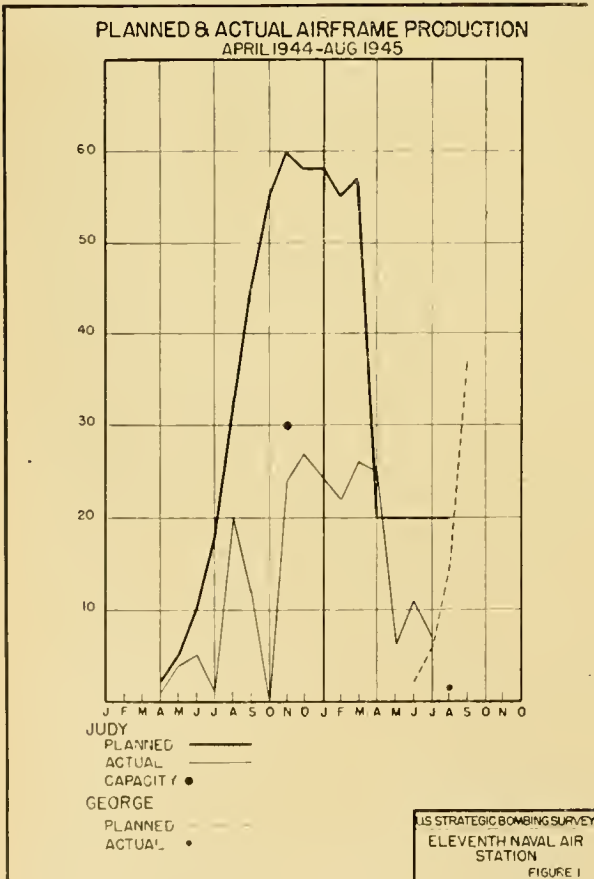


5 May, declined to 58 engines as against 89 for the previous month. Production recovered in June to 101, but in July it again fell to 72 engines.

### EVALUATION OF PRE-ATTACK INTELLIGENCE

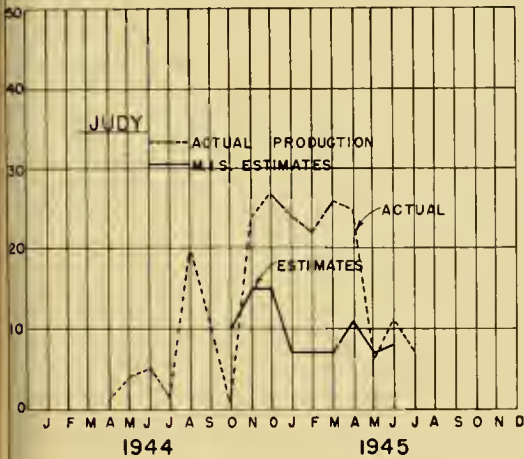
The War Department Military Intelligence Service (G-2) estimate on July production was approximately 56 percent of the actual figure. For example, in November, December, and January of 1944-45 estimates were 15, 15, and 7 while actual production was 24, 27, and 24. The total production estimates for July 1944 to June 1945 were 112 while the actual for the same period was 198.

The intelligence estimates on the aircraft Judy and Kate—12 were given by years and were reasonably close to the actual figures (Figure 3).

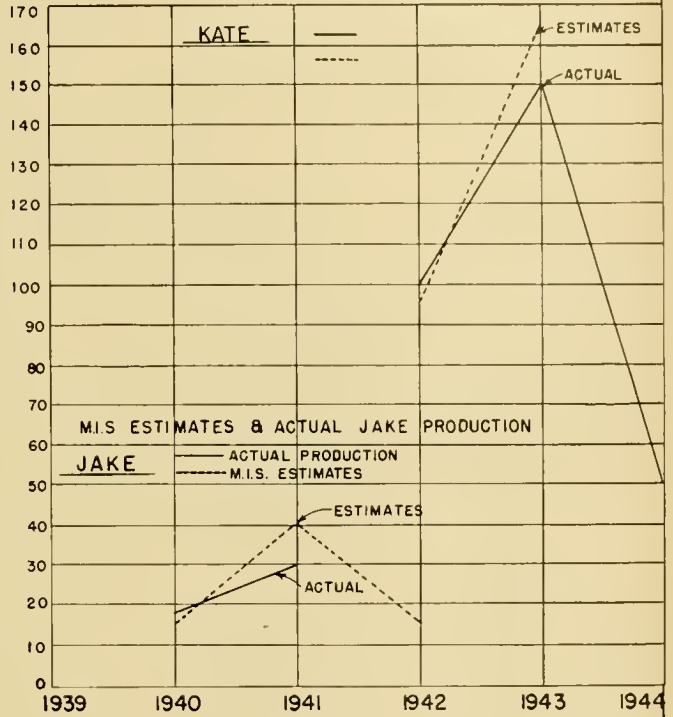


# COMPARISON OF M.I.S. ESTIMATES AND ACTUAL PRODUCTION

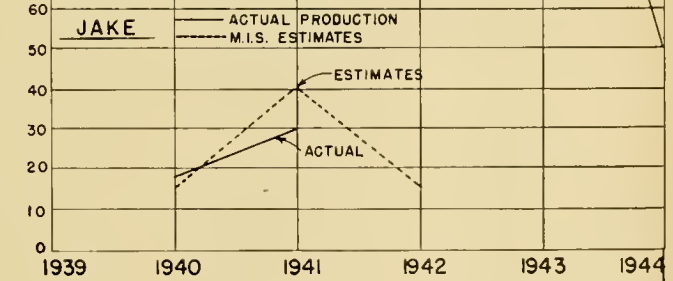
M.I.S. ESTIMATES & ACTUAL JUDY PRODUCTION



M.I.S. ESTIMATES & ACTUAL KATE 12 PRODUCTION



M.I.S. ESTIMATES & ACTUAL JAKE PRODUCTION



U.S. STRATEGIC BOMB SURVEY  
 ELEVENTH NAVAL AIR DEPOT  
 FIGURE 3

## APPENDIX A

*Plant expansion Eleventh Naval Air Depot, January 1942-  
February 1945*

Name	Completed	Area in square feet
Engine warehouse for supplies department.	Jan. 1942	53,798
Steam boiler plant No. 3	16 Mar. 1942	4,198
Warehouse for accounting department	20 Mar. 1942	3,122
Kithatayama oil and grease warehouse	20 Mar. 1942	4,865
Kithatayama explosives warehouse	20 Mar. 1942	4,865
Dispensary for hospital department	31 Mar. 1942	10,742
Engine analysis shop	3 Mar. 1942	3,197
Airframe and engine shop	2 Apr. 1942	41,840
Landing gear assembly shop	3 Apr. 1942	20,312
Oxygen producing shop	23 Sept. 1942	527
General affairs building	Oct. 1942	
Returned goods and materials warehouse	31 July 1943	34,822
Supply shop at Akimura	Aug. 1943	7,416
Purchasing section warehouse	3 Aug. 1943	5,479
General office for engines	3 Sept. 1943	14,229
Machine and finishing shop No. 2	3 Sept. 1943	164,743
Boiler Shop No. 20	3 Sept. 1943	4,198
Supply Shop at Takuma	Mar. 1944	75,703
Wood material shop	3 June 1944	10,635
Exhaust pipe molding shop	18 June 1944	23,552
Airplane shop	18 June 1944	89,309
Airplane assembly shop No. 30	July 1944	64,584
Supply shop at Kure	31 July 1944	99,653
Supply shop at Iwakuni	Aug. 1944	47,609
Supply shop at Kirigushi	Aug. 1944	21,991
Total		841,380
Planned Expansion Used for Dispersal:		
Tokushima shop	Sept. 1944	74,648
Kaitachi shop	10 Nov. 1944	148,952
Shingu shop	28 Feb. 1945	115,455
Iwakuni plant	1 Feb. 1945	140,815
Total		479,870
Grand total		1,321,250

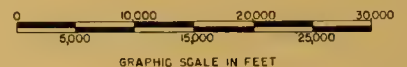


# LOCATION OF DEPOT AND DISPERSAL PLANTS



BLDG NO.	BUILDING
	□ SUPPLIES DEPARTMENT
1	SUPPLY SHOP
2,3	BOMBS AND GUNPOWDER WAREHOUSE
4	ENGINE SHOP (PARTS)
5	ORDNANCE WAREHOUSE (COMMUNICATION ORDNANCE)
6	KURE SUPPLY WAREHOUSE
7, 8, 9	ORDNANCE WAREHOUSE (TORPEDO HEADS, ENGINE PARTS)
10, 11	ORDNANCE WAREHOUSE (ORDNANCE PIECES)
12	BOMBS AND GUNPOWDER WAREHOUSE
13	SUPPLY WAREHOUSE
14, 15	ORDNANCE WAREHOUSE (ORDNANCE PARTS)
16, 17, 18, 19	SUPPLY WAREHOUSE
20	TOKUSHIMA BRANCH SHOP
21, 22, 23	SUPPLY WAREHOUSE
24	NAURO BRANCH OF OSAKA SUPPLY WAREHOUSE
25	SUPPLY WAREHOUSE
	▲ ACCOUNTING DEPARTMENT
26	MATERIALS WAREHOUSE (BULBS, ELECTRIC WIRE, ETC) RAILWAY TUNNEL USED
27	AIRPLANE PARTS WAREHOUSE
28	RAW MATERIAL WAREHOUSE (AIRPLANE PARTS AND LIGHT ALLOY)
29	RAW MATERIAL WAREHOUSE (COAL, OIL, PAPER, COTTON, ETC)
30	RAW MATERIAL WAREHOUSE
	■ MATERIALS DEPARTMENT
31	FOUNDRY (ENGINE CASTING)
32	FOUNDRY
33	FORGING SHOP (ENGINE)
34	FOUNDRY SHOP
35	KELMET SHOP (BEARINGS) IN PROCESS OF BEING PLANNED
	● AIRCRAFT ENGINE DEPARTMENT
36, 37, 38	ENGINE SHOP (PARTS)
39	AIRCRAFT ENGINE
40	TEST CELL SHOP FOR ENGINES IN PROCESS OF BEING PLANNED
	△ AUTOMOBILE DEPARTMENT
41, 42	AUTOMOBILE SHOP
	▣ ORDNANCE DEPARTMENT
43	ORDNANCE SHOP (GUNS AND OPTICAL EQUIPMENT)
44	ORDNANCE AND AUTOMOBILE DEPARTMENT
45	ORDNANCE DEPARTMENT (HEAT TREATMENT)
	○ AIRCRAFT DEPARTMENT
46, 47, 48	AIRPLANE SHOP (PARTS)

NOTE: UNDERLINED CITIES ARE UNDERGROUND SHOPS.





## APPENDIX C

### *Dispersed factories and warehouses*

Place	Section	Function
Gobara	Accounting	Airplane parts and light alloys stored.
Nakakurose	do	Do.
Yakeyama	Supply	Ordnance parts stored.
Yoshiura	Engine	Parts manufacture.
Koyanra	Supply	Ordnance parts stored.
Kannonasaki	do	Torpedo head section stored.
Hosogoe	do	Engine parts stored.
Kaitajichi	Armament	Machine guns, bombs and optical equipment manufacture.
Kirigushi	Supply	Bombs and explosives stored.
Akizuki	do	Do.
Nomi	Raw materials	Casting work (engine)
Tokushima		Repair of planes.
Takuma	Supply	Supply work and armament parts.
Do	Airplane	Repair of large planes.
Kauouji	Supply	Supply work and armament parts.
Imabaru	Airplane	Airplane parts manufacture.
Mitsugahama	Supply	Armament parts storehouse.
Nakashima	do	Armament parts stored.
Wada	do	Communication equipment stored.
Matsuyama	do	Supply work and armament parts.
Yawatahama	Engine	Manufacture of engine parts.
Iwakuni	Supply	Supply work and armament parts.
Do		Repair of planes.
Tojo	Raw materials	Kelmet bearings.
Ato	Engine	Running test of motors.
Hinoura	Supply	Bombs and explosives stored.
Nenoura	Raw materials	Forging of raw materials.
Kanagari	Accounting	Coal, organic resin, paper.
Yosigase	do	Electric bulbs and line stored.
Kurashiki	Supply	Supply work, armament parts.
Himeji	do	Do.
Naruo	do	Do.
Osaka	do	Do.
Do	Auto plant	Repairing of autos.
Do	Accounting	Received and transferred various materials in Osaka area.
Komatsushima	Supply	Supply works and armament parts.
Tokushima	do	Do.
Uchinoumi		Parts manufacture.
Kure	Supply	Parts stored.
Hiro	Main arsenal	
Takehara	Raw materials	Foundry shop.
Kasaoka	Airplane	Airplane parts.
Mizushima	Supply	Parts stored.

## APPENDIX D

*Bomb damage table, Eleventh Naval Air Depot*

19 MARCH 1945 ATTACK

Map location	Shops or buildings that were damaged	Hits	Near miss	Miss	Damage caused
83	Test foundry shop	---	1	---	Partial damage.
Near 70	Test call shop	---	---	---	No damage.
71	Lumber warehouse	---	---	4	
72	Battery room	---	---	---	
69	Boiler house	2	---	---	Partial damage of 20 percent.
56	No. 112 shop	1	---	5	Practically no damage.
47	No. 3 machine shop	1	2	---	Severely damaged, 60 percent. 50 machines; 33 repairable, 17 irreparable.
52	No. 2 machine shop	4	2	1	Severely damaged.
53	No. 1 assembly shop for engines.	2	---	---	Severely damaged, 60 percent.
51	Boiler house	1	---	---	Severely damaged. 8 machines; 4 repairable, 4 unrepairable.
50	Test running shop for assembly shop.	4	---	---	Severely damaged, 40 percent. 18 machines; 12 repairable, 6 unrepairable.
39	No. 1 shop	1	---	---	Partial damage.
37	No. 11 shop	1	---	3	Do.
26	No. 103 shop	---	1	---	Do.
24	No. 20 shop	2	---	5	Severely damaged.
21	No. 50 shop	1	---	2	Partial damage.
17	No. 42 shop	---	2	---	No damage.
	Total	23	8	20	

5 MAY 1945 ATTACK

90	No. 3 repair shop	---	1	1	3 machines damaged, 1 irreparable.
84	Near transformer shop	---	---	6	No. 1 shop was severely damaged. No. 2 shop was partially damaged. Building burned.
83	Nos. 1 and 2 test foundry shop.	2	---	---	
81	Testing shop	1	---	---	2 buildings which are not labeled in the map were burned.
64	Near No. 2 testing shop.	2	---	---	
67	Test foundry shop	---	1	---	Partially damaged.
66	Testing shop.	---	1	---	Do.
68	Testing shop for marine engines.	2	---	---	Severely damaged, 40 percent. 26 machines damaged, 4 irreparable.
57	Power station	---	---	4	Partially damaged. 6 machines damaged, 5 irreparable.
56	No. 112 shop.	---	---	5	Severely damaged. 113 machines damaged, 82 irreparable.

*Bomb damage table, Eleventh Naval Air Depot—Continued*

5 MAY 1945 ATTACK—Continued

Map location	Shops or buildings that were damaged	Hits	Near miss	Miss	Damage caused
62	No. 116 shop	3	---	---	Partially damaged. 92 machines damaged, 40 irreparable.
52	Machine shops Nos. 1 and 2.	9	1	2	Severely damaged (208 machines in the plant). 125 machines damaged, 55 irreparable.
53	No. 1 assembly shop for engines.	2	---	---	Severely damaged, 90 percent (30 machines in the plant). 20 machines damaged, 15 irreparable.
49	No. 2 assembly shop	7	---	---	Severely damaged, 90 percent. 31 machines damaged, 27 irreparable.
48	No. 1 tool shop	---	5	---	Severely damaged, 50 percent. 43 machines damaged, 10 irreparable.
37	No. 11 shop	2	4	---	Severely damaged. 11 machines damaged, 9 irreparable.
39	No. 1 shop	8	8	---	Severely damaged.
	Near No. 1 shop	4	---	---	3 buildings which are not labeled on the map were burned.
35	No. 2 shop	2	---	---	Severely damaged.
36	Drawing shop	2	---	---	Do.
25	No. 10 shop	9	8	---	Severely damaged. 17 machines, 13 irreparable.
24	No. 20 shop	4	8	---	Severely damaged.
23	No. 40 shop	2	---	3	Severely damaged. 27 machines, 2 irreparable.
21	No. 50 shop	5	---	6	Severely damaged.
	Total	64	48	18	

2 JULY 1945 ATTACK<sup>2</sup>

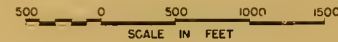
84	Near transformer shop	---	2	---	No damage.
89	Boiler shop	---	1	---	Do.
61	Receiving station for delivered goods.	1	---	---	Severely damaged.
57	(Power station and repair shop.)	---	2	---	No damage.
52	No. 1 machine shop	1	1	---	
50	Testing shop	1	---	---	
49	No. 2 assembly shop	1	---	---	
	Total	4	6	---	

<sup>1</sup> Approximately 400 bombs are said to have been dropped on this raid but only 130 are accounted for.

<sup>2</sup> This attack was directed principally against Kuré.

# BUILDING LAYOUT

(RAIDS OF 19 MARCH 1945)



## LEGEND

SHOPS	NAMES	SHOPS	NAMES
1	NO.22,23 UNDER GROUND(NO 5 SHOP)	52	MACHINE SHOP
2	NO.20 UNDER GROUND(NO 4 SHOP)	53	ENGINE ASSEMBLY SHOP BRANCH
3	NO 7 MATERIAL WAREHOUSE	54	CASTING 8 PRESS SHOP
4	NO 6 "	55	BOILER HOUSE OF ASSEMBLY SHOP
5	OXYGEN SHOP	56	NO.112 SHOP
6	AVIATION LIGHT OIL STORAGE	57	POWER STATION
7	SEA PLANE WAREHOUSE	58	REPAIR SHOP OF POWER STATION
8	AIRCRAFT STORAGE	59	NO.5 MATERIAL WAREHOUSE
9	TEST CELL SHOP	60	NO.3 RECEIVING STATION OF DELIVERED GOODS
10	NO.14 UNDER GROUND(NO 1 SHOP)	61	NO.116 SHOP
11	NO.12,14 (NO 7 SHOP)	62	BOILER HOUSE OF FORGING SHOP
12	NO 4 UNDER GROUND	63	NO 2 TESTING SHOP
13	NO 15 "	64	NO.1 TESTING SHOP FOR MACHINE TOOLS
14	NO 2 "	65	TESTING SHOP
15	NO 1 "	66	TEST FOUNDRY SHOP
16	NO 8 MATERIAL WAREHOUSE	67	TESTING SHOP FOR MARINE ENGINES
17	NO 42 SHOP	68	BOILER HOUSE
18	NO 41 "	69	TEST CELL SHOP
19	NO 3 BOILER HOUSE TEMPORARY STORAGE FOR GOVERNMENTAL SUPPLY MATERIAL	70	TEMPORARY WAREHOUSE
20	NO 51 SHOP	71	ELECTRIC BATTERY ROOM
21	TEMPORARY WELONG SHOP	72	DINING ROOM
22	NO 40 SHOP	73	TEMPORARY OFFICE
23	NO.20 SHOP	74	WAREHOUSE OF TEST MACHINES FORGING AND HEAT TREATMENT SHOP OF MACHINE TOOLS
24	NO 10 "	75	NO.1 TESTING SHOP
25	NO.103 "	76	SUNNOMAE UNDER GROUND WORKING SHOP FOR UTILIZATION OF WASTE
26	NO.105 "	77	OFFICE OF CASTING LAB
27	NO.107 "	78	TESTING SHOPS (NO.1 & 2)
28	LABORATORY	79	MACHINE AND TESTING SHOP
29	NO.1 BOILER HOUSE	80	TEST FOUNDRY SHOP
30	NO.101 SHOP	81	TRANSFORMER SHOP
31	NO.4 SHOP	82	NO.1 TRANSFORMER SHOP OF UNDER GROUND
32	NO.6 UNDER GROUND(NO.1 SHOP)	83	NO.4 MACHINE SHOP
33	NO.2 BOILER HOUSE	84	NO.1 NADA UNDER GROUND
34	NO.2 SHOP	85	NO.2 TRANSFORMER SHOP OF UNDER GROUND
35	DRAWING SHOP	86	BOILER SHOP
36	NO.11 SHOP	87	NO.3 REPAIR SHOP
37	NO.1 MATERIAL WAREHOUSE	88	AUXILIARY MARINE ENGINE ASSEMBLY SHOP
38	NO.1 SHOP	89	NO.115 SHOP
39	NO.5 UNDER GROUND	90	NO.3 TOOL SHOP
40	TRANSFORMER SHOP	91	EMERGENCY STORES WAREHOUSE
41	GENERAL SHOP	92	OIL & GREASE WAREHOUSE
42	NO.2 TOOL SHOP	93	FORGING SHOP
43	COPPER SHOP	94	BOILER HOUSE
44	BOILER HOUSE	95	TURBINE BLADE MACHINE SHOP
45	WELONG SHOP	96	NO.2 SHIRATAKE UNDER GROUND
46	NO.3 MACHINE SHOP	97	NO.1 "
47	NO.1 TOOL SHOP	98	NO.3 SHIRATAKE TESTING SHOP FOR MACHINE TOOLS
48	NO.2 ASSEMBLY SHOP	99	SHIRAIISHI UNDER GROUND
49	TEST CELL SHOP OF ASSEMBLY SHOP	100	
50	BOILER HOUSE OF ASSEMBLY SHOP	101	
51		102	

U.S. STRATEGIC BOMBING SURVEY  
ELEVENTH NAVAL AIR DEPOT



# BUILDING LAYOUT

(RAIDS OF 5 MAY 1945)



## LEGEND

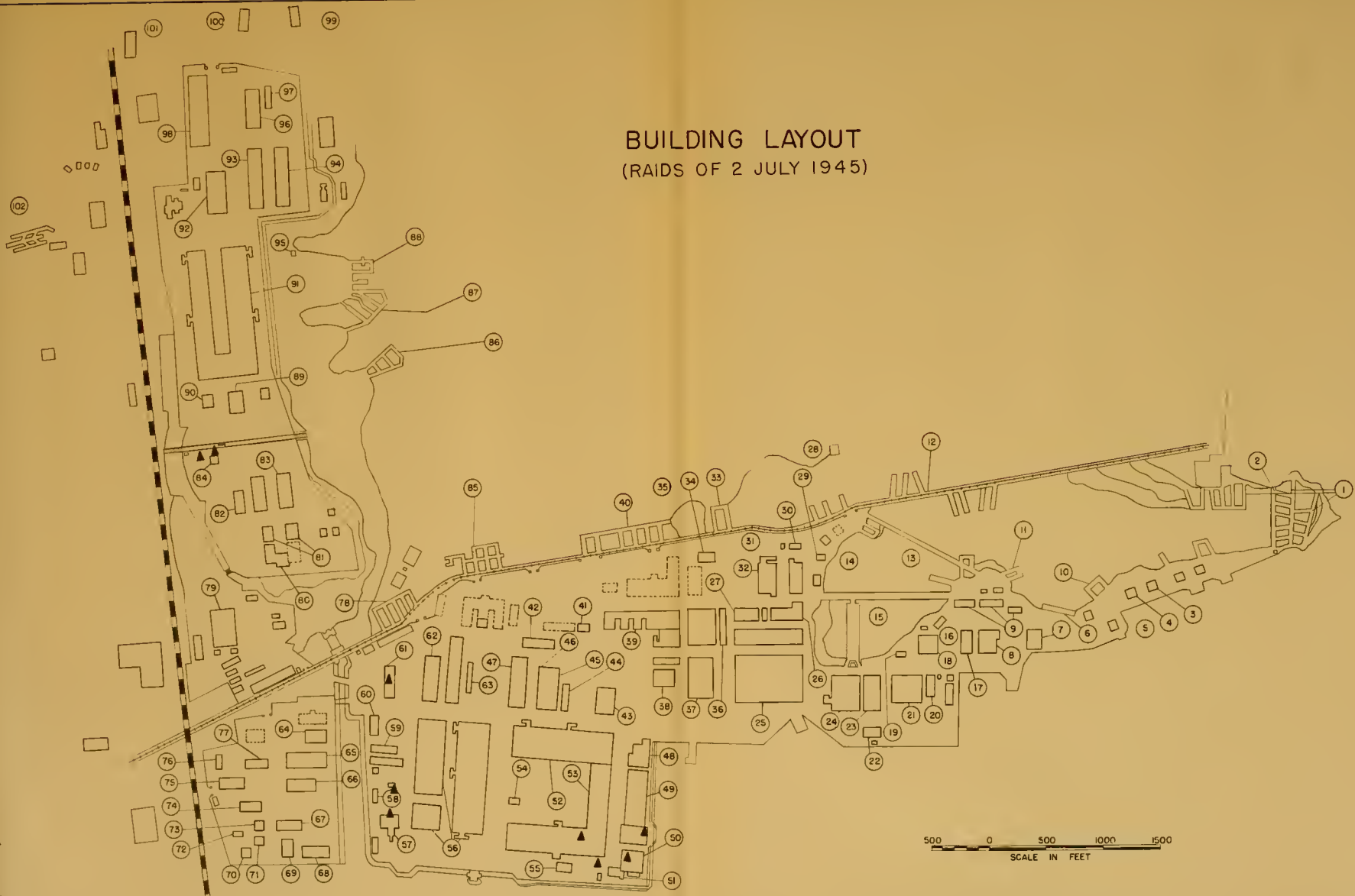
SHOPS	NAMES	SHOPS	NAMES
1	NO 22,23 UNDER GROUND (NO 5 SHOP)	52	MACHINE SHOP
2	NO 20 UNDER GROUND (NO 4 SHOP)	53	ENGINE ASSEMBLY SHOP BRANCH
3	NO 7 MATERIAL WAREHOUSE	54	CASTING & PRESS SHOP
4	NO 6 "	55	BOILER HOUSE OF ASSEMBLY SHOP
5	OXYGEN SHOP	56	NO. 112 SHOP
6	AVIATION LIGHT OIL STORAGE	57	POWER STATION
7	SEA PLANE WAREHOUSE	58	REPAIR SHOP OF POWER STATION
8	AIRCRAFT STORAGE	59	NO. 5 MATERIAL WAREHOUSE
9	TEST CELL SHOP	60	NO 3 "
10	NO 14 UNDER GROUND (NO 1 SHOP)	61	RECEIVING STATION OF DELIVERED GOODS.
11	NO 12,14 " (NO 7 SHOP)	62	NO 116 SHOP
12	NO 4 UNDER GROUND	63	BOILER HOUSE OF FORGING SHOP
13	NO 15 "	64	NO 2 TESTING SHOP
14	NO 2 "	65	NO 1 TESTING SHOP FOR MACHINE TOOLS
15	NO. 1 "	66	TESTING SHOP
16	NO. 8 MATERIAL WAREHOUSE	67	TEST FOUNDRY SHOP
17	NO 42 SHOP	68	TESTING SHOP FOR MACHINE ENGINES
18	NO 41 "	69	BOILER HOUSE
19	NO 3 BOILER HOUSE TEMPORARY STORAGE FOR GOVERNMENTAL SUPPLY MATERIAL	70	TEST CELL SHOP
20	NO 51 SHOP	71	TEMPORARY WAREHOUSE
22	TEMPORARY WELDING SHOP	72	ELECTRIC BATTERY ROOM
23	NO 40 SHOP	73	DINING ROOM
24	NO 20 SHOP	74	TEMPORARY OFFICE
25	NO 10 "	75	WAREHOUSE OF TEST MACHINES, FORGING AND HEAT TREATMENT SHOP OF MACHINE TOOLS
26	NO 103 "	77	NO 1 TESTING SHOP
27	NO 105 "	78	SURFONMAE UNDER GROUND WORKING SHOP FOR UTILIZATION OF WASTE
28	NO 107 "	79	NO 107 "
29	LABORATORY	80	OFFICE OF CASTING LAB
30	NO 1 BOILER HOUSE	81	TESTING SHOPS (NO. 1 & 2)
31	NO 101 SHOP	82	MACHINE AND TESTING SHOP
32	NO 4 SHOP	83	TEST FOUNDRY SHOP
33	NO 6 UNDER GROUND (NO 1 SHOP)	84	TRANSFORMER SHOP NO 1 TRANSFORMER SHOP OF UNDER GROUND.
34	NO 2 BOILER HOUSE	85	NO 4 MACHINE SHOP
35	NO 2 SHOP	86	NO 1 NAQA UNDER GROUND NO 2 TRANSFORMER SHOP OF UNDER GROUND.
36	DRAWING SHOP	87	NO 1 NAQA UNDER GROUND NO 2 TRANSFORMER SHOP OF UNDER GROUND.
37	NO 11 SHOP	88	BOILER HOUSE
38	NO 1 MATERIAL WAREHOUSE	89	BOILER SHOP
39	NO 1 SHOP	90	NO 3 REPAIR SHOP AUXILIARY MARINE ENGINE ASSEMBLY SHOP
40	NO. 5 UNDER GROUND	91	NO 115 SHOP
41	TRANSFORMER SHOP	92	NO 3 TOOL SHOP
42	GENERAL SHOP	93	EMERGENCY STORES WAREHOUSE
43	NO 2 TOOL SHOP	94	COPPER SHOP
44	COPPER SHOP	95	OIL & GREASE WAREHOUSE
45	BOILER HOUSE	96	FORGING SHOP
46	WELDING SHOP	97	BOILER HOUSE
47	NO 3 MACHINE SHOP	98	TURBINE BLADE MACHINE SHOP
48	NO 1 TOOL SHOP	99	NO 2 SHRATAKE UNDER GROUND
49	NO 2 ASSEMBLY SHOP	100	NO. 1 " NO 3 SHRATAKE TESTING SHOP FOR MACHINE TOOLS
50	TEST CELL SHOP OF ASSEMBLY SHOP	101	SHIRAIISHI UNDER GROUND
51	BOILER HOUSE OF ASSEMBLY SHOP	102	

U.S. STRATEGIC BOMBING SURVEY  
ELEVENTH NAVAL AIR DEPOT





# BUILDING LAYOUT (RAIDS OF 2 JULY 1945)



## LEGEND

SHOPS	NAMES	SHOPS	NAMES
1	NO 22,23 UNDER GROUND (NO 5 SHOP)	52	MACHINE SHOP
2	NO 20 UNDER GROUND (NO 4 SHOP)	53	ENGINE ASSEMBLY SHOP BRANCH
3	NO 7 MATERIAL WAREHOUSE	54	CASTING & PRESS SHOP
4	NO. 6 "	55	BOILER HOUSE OF ASSEMBLY SHOP
5	OXYGEN SHOP	56	NO. 112 SHOP
6	AVIATION LIGHT OIL STORAGE	57	POWER STATION
7	SEA PLANE WAREHOUSE	58	REPAIR SHOP OF POWER STATION
8	AIRCRAFT STORAGE	59	NO. 5 MATERIAL WAREHOUSE
9	TEST CELL SHOP	60	NO. 3 RECEIVING STATION OF DELIVERED GOODS.
10	NO 14 UNDER GROUND (NO 1 SHOP)	61	NO. 116 SHOP
11	NO 12,14 (NO 7 SHOP)	62	BOILER HOUSE OF FORGING SHOP
12	NO. 4 UNDER GROUND	63	NO. 2 TESTING SHOP
13	NO 15 "	64	NO. 1 TESTING SHOP FOR MACHINE TOOLS
14	NO 2 "	65	TESTING SHOP
15	NO. 1 "	66	TEST FOUNDRY SHOP
16	NO 8 MATERIAL WAREHOUSE	67	TESTING SHOP FOR MARINE ENGINES
17	NO 42 SHOP	68	BOILER HOUSE
18	NO 41 "	69	TEST CELL SHOP
19	NO 3 BOILER HOUSE	70	TEMPORARY WAREHOUSE
20	TEMPORARY STORAGE FOR GOVERNMENTAL SUPPLY MATERIAL	71	ELECTRIC BATTERY ROOM
21	NO 51 SHOP	72	DINING ROOM
22	TEMPORARY WELDING SHOP	73	TEMPORARY OFFICE
23	NO 40 SHOP	74	WAREHOUSE OF TEST MACHINES FORGING AND HEAT TREATMENT SHOP OF MACHINE TOOLS.
24	NO. 20 SHOP	75	NO 1 TESTING SHOP
25	NO. 10 "	76	SUNMONGMAE UNDER GROUND WORKING SHOP FOR UTILIZATION OF WASTE
26	NO 103 "	77	OFFICE OF CASTING LAB
27	NO. 105 "	78	TESTING SHOPS (NO 1 & 2)
28	NO. 107 "	79	MACHINE AND TESTING SHOP
29	LABORATORY	80	TEST FOUNDRY SHOP
30	NO 1 BOILER HOUSE	81	TRANSFORMER SHOP
31	NO. 101 SHOP	82	NO 1 TRANSFORMER SHOP OF UNDER GROUND.
32	NO 4 SHOP	83	NO 4 MACHINE SHOP
33	NO 6 UNDER GROUND (NO 1 SHOP)	84	NO 1 NADA UNDER GROUND
34	NO 2 BOILER HOUSE	85	NO 2 TRANSFORMER SHOP OF UNDER GROUND
35	NO 2 SHOP	86	BOILER SHOP
36	DRAWING SHOP	87	NO 3 REPAIR SHOP AUXILIARY MARINE ENGINE ASSEMBLY SHOP
37	NO. 11 SHOP	88	NO. 115 SHOP
38	NO 1 MATERIAL WAREHOUSE	89	NO 3 TOOL SHOP
39	NO 1 SHOP	90	EMERGENCY STORES WAREHOUSE
40	NO 5 UNDER GROUND	91	OIL & GREASE WAREHOUSE
41	TRANSFORMER SHOP	92	FORGING SHOP
42	GENERAL SHOP	93	BOILER HOUSE
43	NO 2 TOOL SHOP	94	TURBINE BLADE MACHINE SHOP
44	COPPER SHOP	95	NO 2 SHRATAKE UNDER GROUND
45	BOILER HOUSE	96	NO 1 "
46	WELDING SHOP	97	NO 3 SHRATAKE TESTING SHOP FOR MACHINE TOOLS
47	NO 3 MACHINE SHOP	98	SHRAISHI UNDER GROUND
48	NO L TOOL SHOP	99	
49	NO 2 ASSEMBLY SHOP	100	
50	TEST CELL SHOP OF ASSEMBLY SHOP	101	
51	BOILER HOUSE OF ASSEMBLY SHOP	102	



U.S. STRATEGIC BOMBING SURVEY  
ELEVENTH NAVAL AIR DEPOT







**TWENTY-FIRST NAVAL AIR DEPOT, OMURA**  
**(Depot Report No. XIX-3)**

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# THE DEPOT AND ITS IMPORTANCE IN THE AIRCRAFT INDUSTRY

## INTRODUCTION

The Twenty-first Naval Air Depot, located about 10 miles northeast of Nagasaki in the town of Omura, Kyushu Island, produced both airframes and airplane engines. The plant had approximately 45 principal buildings and a similar number of smaller shops, offices, storehouses, and engine test cells. In addition, there were about 25 hangars of various sizes in the area (Appendix A). A branch of the depot was at Hiu at the mouth of the Omura Bay near Sasebo in northwestern Kyushu. Forging and casting was done at Hiu.

The order establishing the depot was issued in March 1939. Construction began in May 1939. Prior to completion of the original plan, an expansion was ordered in July 1941 and construction in line with the expansion plan was begun immediately. The depot officially was opened 1 October 1941, although operations had been commenced some months earlier. Construction was completed in April 1942.

The principal aircraft type produced was the Type O observation seaplane, Model 11, Pete. The depot also produced two types of training fighters, Zeke and Claude, Type O and Type 96 advanced trainers. During the later stages of the war, the depot abandoned production of its older types in favor of small-scale production of the Aichi-designed torpedo and dive bomber, Ryusei, Model 11, Grace, and the Kawanishi fighter, Shiden, Model 21, George (Photo 1). Peak production of 73 airplanes per month at the depot was reached in December 1943, representing about 3 percent of the total production of the industry for that month.

From 1941 to 1944, the depot produced the Amakaze 11 (Tempu 11), 9-cylinder, 360-horsepower radial air-cooled engine. Peak production of 170 of these engines in April 1944 constituted 4 percent of the production of the entire engine industry for the month. Production of this engine type was abandoned in late 1944, but planned production of the 18-cylinder Homare

(Ha 45), 1,795-horsepower engine never materialized.

Apart from its production functions, the depot was extensively engaged in repair of all Navy types of aircraft and engines.

## EMPLOYMENT

Employment at the depot rose more or less gradually throughout the war and reached a total of 23,878 employees in September 1944 prior to the first air attack. Student labor was used after June 1944. Fluctuations in the numbers of employees beginning in October 1944 were due to the varying numbers of students used. Increased employment to 26,391 in October and 28,772 in November 1944 was due to the use of large numbers of students in cleaning up after the heavy October air attack and in assisting in the consequent dispersal operations (Figure 1 and Table 1).

TABLE 1.—Total employment January 1941–August 1945

Date	Student	Direct	Total
1941			
January	.....	2,544	4,750
February	.....	3,056	5,100
March	.....	3,173	5,300
April	.....	3,210	5,360
May	.....	3,245	5,420
June	.....	3,273	5,470
July	.....	3,300	5,510
August	.....	3,360	5,610
September	.....	3,472	5,800
October	.....	3,658	6,100
November	.....	3,825	6,400
December	.....	4,140	6,900
1942			
January	.....	4,375	7,300
February	.....	4,640	7,750
March	.....	4,970	8,300
April	.....	6,300	10,500
May	.....	6,410	10,700
June	.....	6,540	10,900
July	.....	6,810	11,350
August	.....	7,200	12,000
September	.....	7,500	12,500
October	.....	7,620	12,700
November	.....	7,790	12,980
December	.....	8,160	13,600
1943			
January	.....	8,490	14,000
February	.....	8,700	14,500
March	.....	8,990	15,000
April	.....	9,900	16,500
May	.....	10,010	16,700
June	.....	10,220	17,050
July	.....	10,430	17,400
August	.....	10,610	17,700
September	.....	10,860	18,100
October	.....	11,070	18,450
November	.....	11,290	18,800
December	.....	11,500	19,150

TABLE I.—Total employment January 1941 August 1945 — Continued

Date	Student	Direct	Total
1941			
January		11,620	19,100
February		11,830	19,760
March		12,080	20,120
April		12,300	20,500
May		12,490	20,810
June	572	13,342	21,872
July	1,145	14,009	22,755
August	1,214	14,330	23,164
September	1,628	14,895	23,878
October	3,891	17,000	26,391
November	6,072	19,070	28,772
December	3,390	15,580	24,290
1945			
January	3,315	15,632	24,415
February	3,912	16,510	25,232
March	4,878	16,800	26,378
April	3,966	16,195	25,704
May	4,876	16,286	26,222
June	4,457	16,019	25,558
July	5,152	13,322	25,597
August <sup>1</sup>			

<sup>1</sup> Data unavailable for August.

Navy officials estimated indirect labor accounted for approximately 40 percent of the total labor supply. Two shifts were used in the ma-

chine shops of the air frame section from September 1943 through October 1944. Approximately 57 percent of the employees of the machine shops worked in the day shift from 0700 to 1900 and 43 percent worked the night shift.

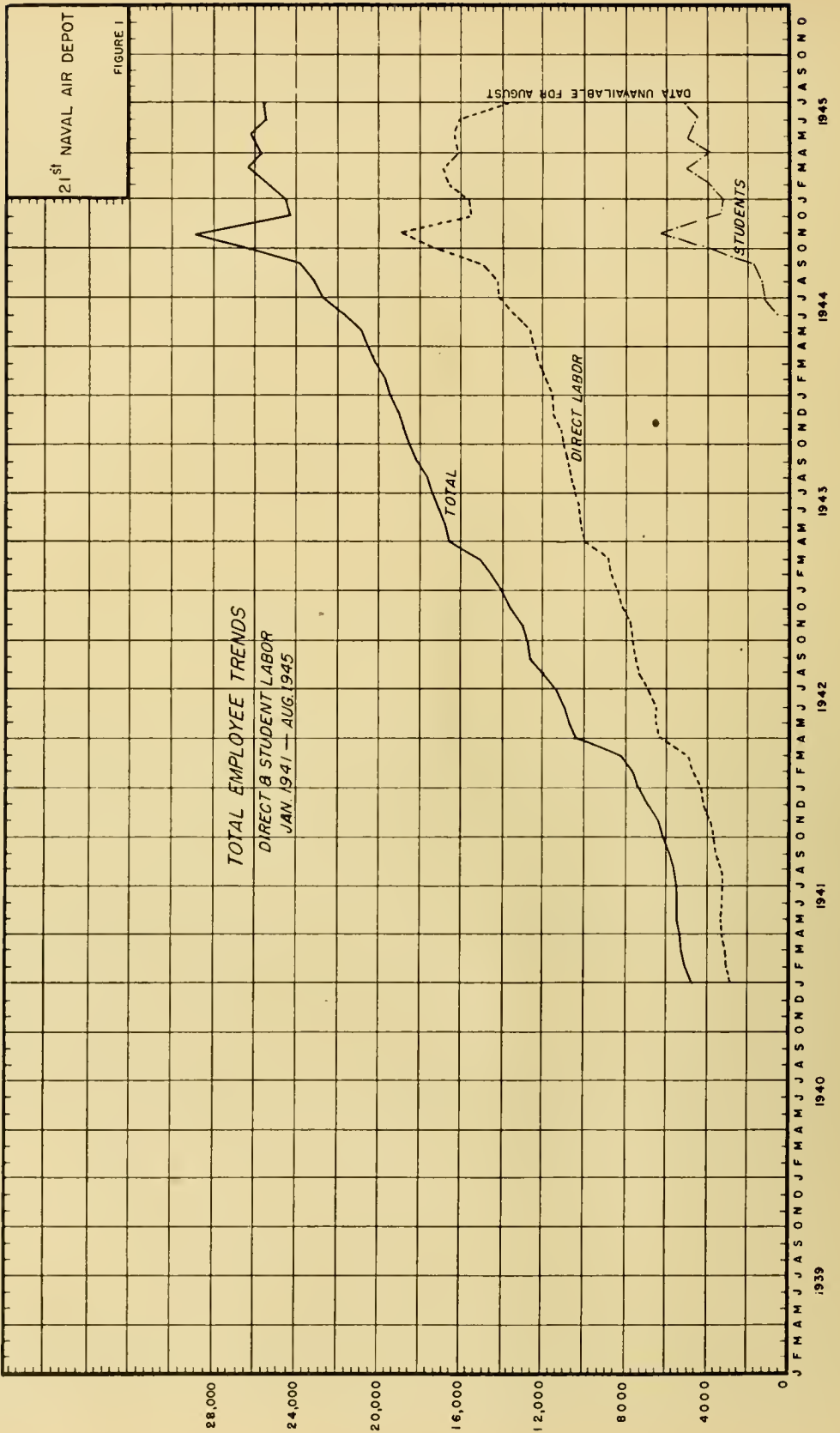
After the October 1944 air attack, the use of multiple shifts was abandoned until May 1945, when the employees of the airframe machine shops went on a three-shift system. About 40 percent of these employees worked from 0700 to 1600, 30 percent from 1600 to 2400, and a like percentage from midnight to 0700.

### THE DISPERSAL PROGRAM

First damaged by air attack on 25 October 1944, the depot was dispersed starting in November of that year. Both the maintenance and repair and the aircraft production functions of the depot were dispersed from the original location and apart from each other, though still remaining in the



Photo 1: Grace, foreground, and George in front of damaged final aircraft assembly building, Naval Air Depot, Omura





same general Omura area. The air-frame assembly functions of the depot were scattered throughout the Omura area, primarily in the Korigawa and Mizubakari districts (Appendix C).

The managerial and design functions were dispersed in the Ikeda district in 28 buildings comprising a total area of 58,300 square feet. Sheet metal working was performed in seven small buildings in the Suzuta district, and 2 tunnels in the same area with a total space of 15,984 square feet were used as machine shops. Production at the dispersed locations began in January 1945.

Most of the airframe construction took place in the Korigawa district of the Omura area. Forty-one small buildings in upper Korigawa contained 90,720 square feet of floor space and were used in fuselage and wing assembly of Grace. A like number of buildings and floor area in middle Korigawa was used for metal working and machining. Final assembly of Grace was maintained at

the original depot site in Omura, utilizing sheds constructed underneath the framework of bombed-out buildings (Photo 2).

In the Mizubakari district of the Omura area was a similar development of dispersed shops (Photo 3). This development contained 45 buildings with a total floor space of 107,500 square feet, devoted to fuselage (Photo 4), wing (Photo 5), and final assembly of George (Photo 6).

The center of engine construction was shifted from Omura to the Isahaya area (Appendix B). In the Oguri district of Isahaya a total of 67,500 square feet of small dispersed surface shops were devoted to engine construction, and 21,600 square feet of underground machine shops also were put into operation. In the Kaneyama district of the Hasami area north of Omura, 80 percent of a planned 66,400 square feet of underground machine shops had been completed by the end of the war.

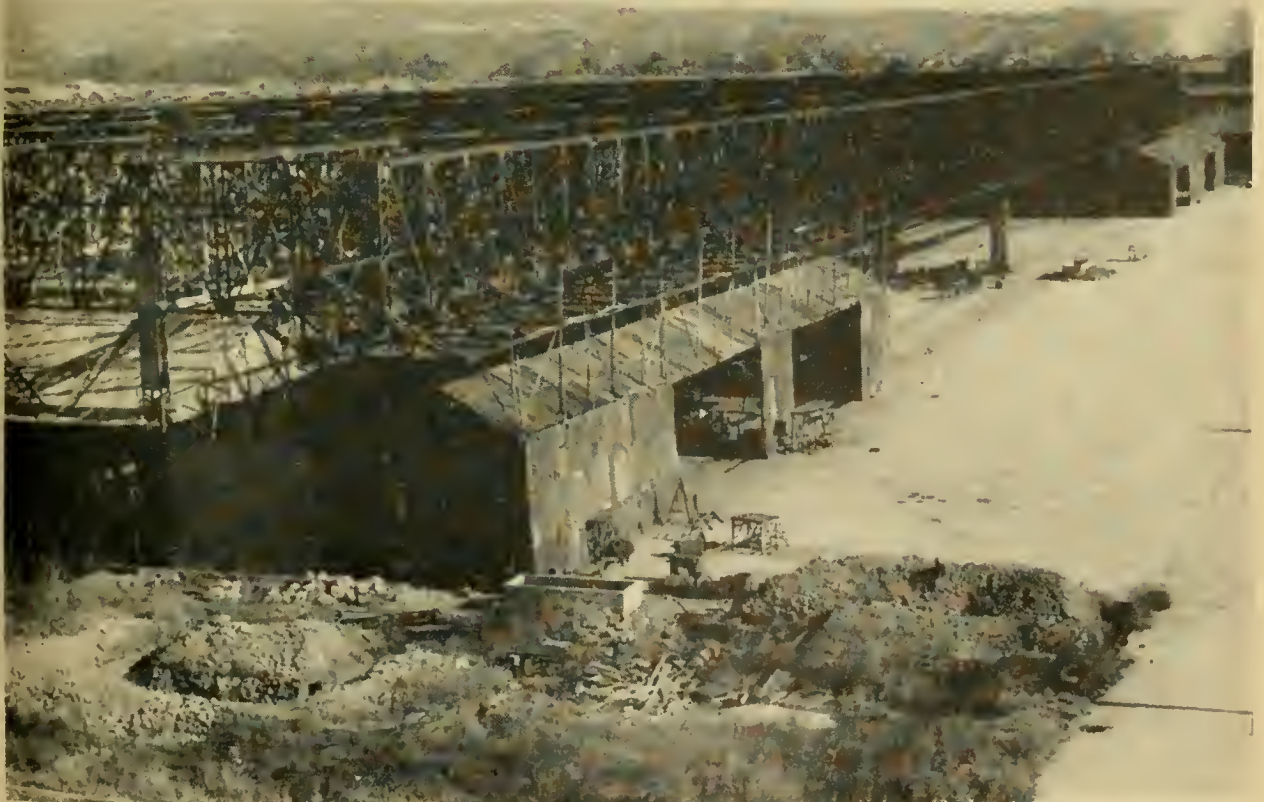


Photo 2: Assembly sheds under skeleton of No. 2 final assembly building, Omura



Photo 3: Three of 45 dispersed shops at Mizubakari

There was no airplane production during November and December 1944 while the dispersal was being accomplished. Limited production in the dispersed locations began in January 1945, but was insignificant thereafter, due as much to the difficulty of operation in the dispersed sites as to the change-over to production of the newer combat types, George and Grace.

Production of Homare engines was planned for the dispersed engine plants but, due to the difficulties of obtaining parts and of operating in the dispersed locations, all production of new engines ceased after the dispersal and the entire capacity of the engine works was devoted to repair.

The predominant feature of the dispersal program of this depot was the geographical proximity of the new dispersal areas to the old location. The dispersal was accomplished over a two-month period because of the short distances

the machine shops had to be moved, and because the problem of transplanting the labor supply was avoided.

### AIR ATTACKS

The first air attack on the Twenty-first Navy Air Depot came on 7 July 1944, during the second B-29 attack on the Japanese homeland. This attack was of small scale compared to the size of attacks that were to follow. Although 17 B-29s had the depot, the Sasebo dock area, and the Tabata Iron and Steel Works for targets, there were no hits in the depot area (Appendix D).

The next attack on the depot occurred on 2 October 1944. A total of 71 aircraft dropped 156 tons of bombs on the plant. Extensive damage to installations and production resulted.

Both the final air frame assembly buildings and the large machine shop, several tool shops,

ging shop, and storage buildings were destroyed (Photo 7). Many other buildings were damaged including the engine parts finishing shop, engine assembly shop and some of the engine test cells (Photos 8 and 9).

There were 253 employees killed and approximately 250 injured as a result of the attack. Production of engines had ceased at the plant prior to the attack, but conversion from the Nakaze 11 to production of the Homare engine was halted. The depot produced no engines after the attack and the subsequent dispersal.

Also, as a result of the dispersal activities effected off by this 25 October attack, there was a halt in airframe production by the depot for the 2 months following. Production of aircraft at the dispersed locations commenced in January 1945, but never exceeded eight airplanes in any 1 month. The extremely low production during 1945 was due partly to the effort to produce newer combat types, but also resulted from difficulties of operat-

ing in the dispersed locations to which Navy officials felt forced to move as a result of the October attack.

The original Omura plant was a target on several occasions thereafter but without the signal success of the October attack. On 21 November the depot was the target for 94 aircraft carrying 202.5 tons of bombs. No bombs fell in the plant area and there was no damage to plant installations. Two employees were killed outside the plant.

On 19 December 1944, 32 aircraft carrying 51 tons of bombs, had the Omura depot as a target. A conference building and some dormitories outside of the immediate plant area were damaged and 2 employees were killed.

Forty-five B-29s dropped 89 tons of bombs on the depot on 6 January 1945, resulting in some hits among the engine test cells and on a seaplane maintenance shop. One death resulted from the attack.

Carrier planes of the Fifth Fleet attacked the



Photo 4: Interior of dispersed George fuselage assembly shop at Mizubakari



Photo 5: Interior of dispersed George wing assembly shop at Mizubakari

depot on 18 March 1945 with some damage resulting in the hangar area of the depot. There were no casualties.

Following the strike of 18 March there were eight more attacks on the depot in March, May, June, and July 1945. The aircraft plant was not the primary target in any of these attacks, but the attacks were against airfield installations or other targets and the depot was hit only incidentally. No additional damage to productive facilities was caused. Casualties from these later attacks totaled 18 killed and a similar number wounded.

The history of the bombing program on this particular target might well be limited to the attack of 25 October 1944. This attack came at a time when operations were being conducted in a normal fashion. Later attacks were directed against the physical skeleton of the plant after the bulk of its functions had been transferred elsewhere. The physical damage then caused was

enormously greater than that inflicted in a subsequent attack.

The dispersal instituted as a direct result was an important factor in reducing the production of this depot to insignificance when compared to earlier production.

### PRODUCTION STATISTICS

From April 1941 through August 1945 the depot produced a total of 966 aircraft. It had a total capacity of 1,030 and government orders for 1,000 aircraft. Over the same period, its engine production totaled 2,132 compared with capacity of 2,224 and orders for 2,615 engines.

During the early months of the operations of the depot, both capacity and actual production of aircraft were small. Airframe production was abandoned in October 1941 in favor of production of engines and extensive aircraft and engine repairs.

Production of airframes was resumed in July 1942, and both capacity and actual production expanded regularly reaching 73 airplanes per month in December 1943 (Figure 2). During the first 6 months of 1944, production fell off, as did capacity, due to cut-backs in production of the observation seaplane, Pete, and the conversion of some facilities to the production of the new torpedo and dive bomber, Grace.

During the last half of 1944, production declined greatly due first to abandonment of one trainer type, the subsequent complete cessation of Pete production, the first heavy air attack in October and the consequent dispersal.

As a result of the dispersal activities, there was no airframe production during the last 2 months of 1944. Production at dispersed sites had commenced during 1945, but was still small—only eight airplanes in July and one in August at the end of the war. The low production during

1945 was attributable not only to operations in dispersed locations but also to production of the newer types of planes, the bomber, Grace, and the fighter, George.

Government-planned production followed actual production fairly closely during the early years, but exceeded both capacity and actual production during most of 1944 and 1945. The plans called for a larger production of the newer type combat planes than could be realized.

Numerically, the most important type produced was the observation seaplane Pete, followed by the Zeke and Claude trainers (Figure 3). It was not until late in the war that the depot went into regular production of any of the newer combat type planes. During 1945, the depot concentrated only on the first-line types Grace and George.

The only engine produced was the Amakaze 11, 9-cylinder radial air-cooled 360-horsepower engine. Capacity and actual production increased in close



Photo 6: Typical shed used for final assembly of George at Mizubakari



Photo 7: Interior view of damage to No. 1 final assembly shop at Omura

correlation from the start of production in November 1941 to a peak of 170 engines per month in April 1944 (Figure 4). From mid-1944 production fell off in line with a decision on the part of the navy to abandon production of the Amakaze engine in favor of planned production of the 18-cylinder Homare engine. Engine production had ceased altogether by October when the first effective air attack on Omura resulted in the dispersal of activities.

After dispersal the planned Homare engine production failed to materialize, as preparations for production were halted by the 25 October attack and production in the dispersed locations was too difficult to maintain. Emphasis was placed on engine repair after dispersal.

#### EVALUATION OF TARGET INTELLIGENCE

Estimates of production of the reconnaissance plane Pete were fairly sound from the angle of

total production; actual production totaled 59 as compared with an estimated 576. The high estimated rate of 40 per month was actual exceeded during 4 months, and reached 50 per month during 3 of those months (Figure 5). Pete actually went out of production 2 months before it was estimated to have ceased.

The production rate of the bomber Grace was greatly overestimated at 10 per month in 1944 when the highest production actually achieved any month was 4 airplanes. Intelligence had no inkling as to planned fighter production at the depot.

Production of Zeke trainers was correctly attributed to the depot, although actual production of Claude trainers was missed.

Production of the Amakaze 11 engine was correctly attributed to the Twenty-first Naval Air Depot by intelligence, but the quantity of production never was estimated.

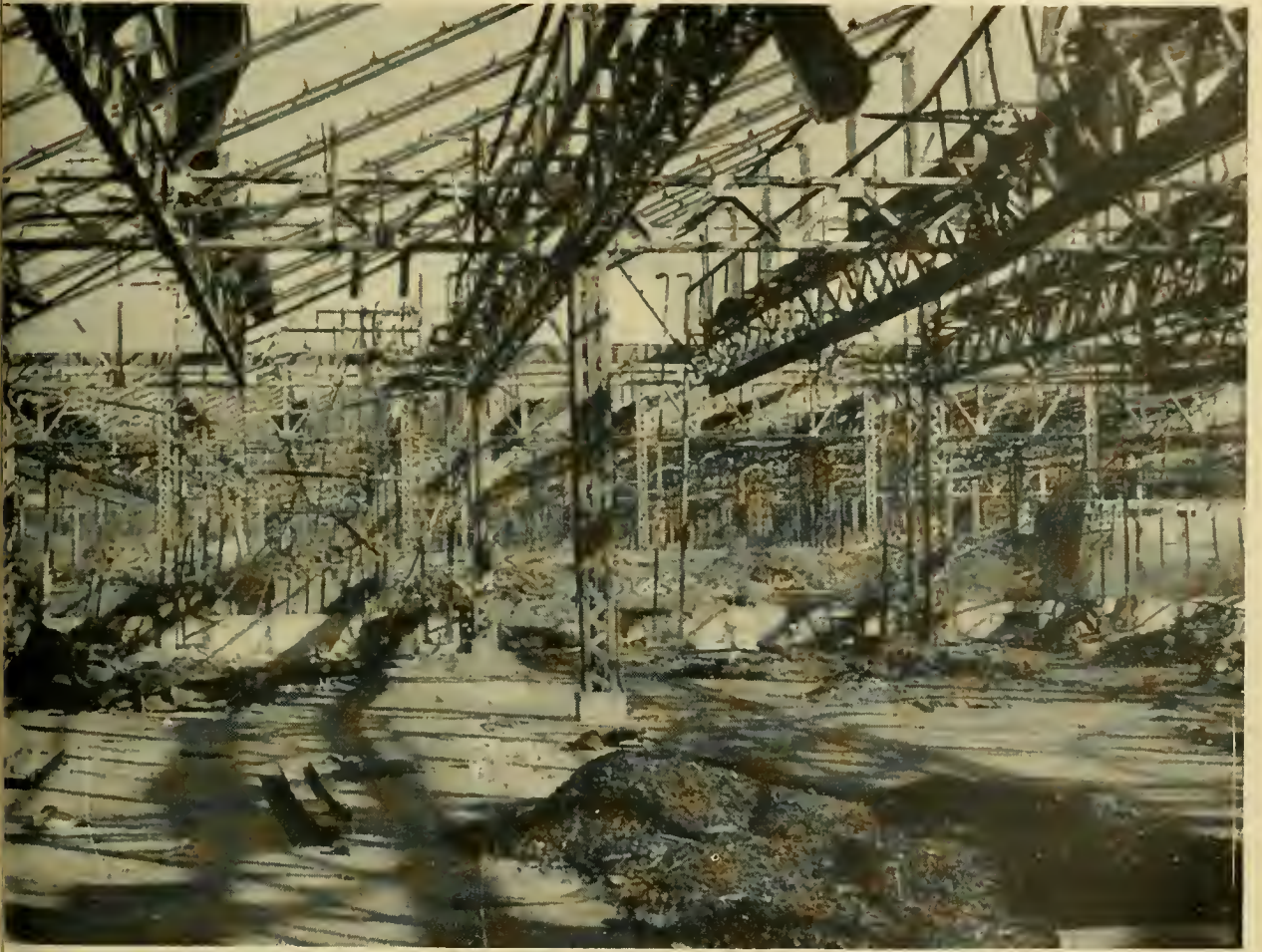


Photo 8: Interior view of engine adjusting shop; engine assembly building, in background



Photo 9: Bomb damage to engine test cells

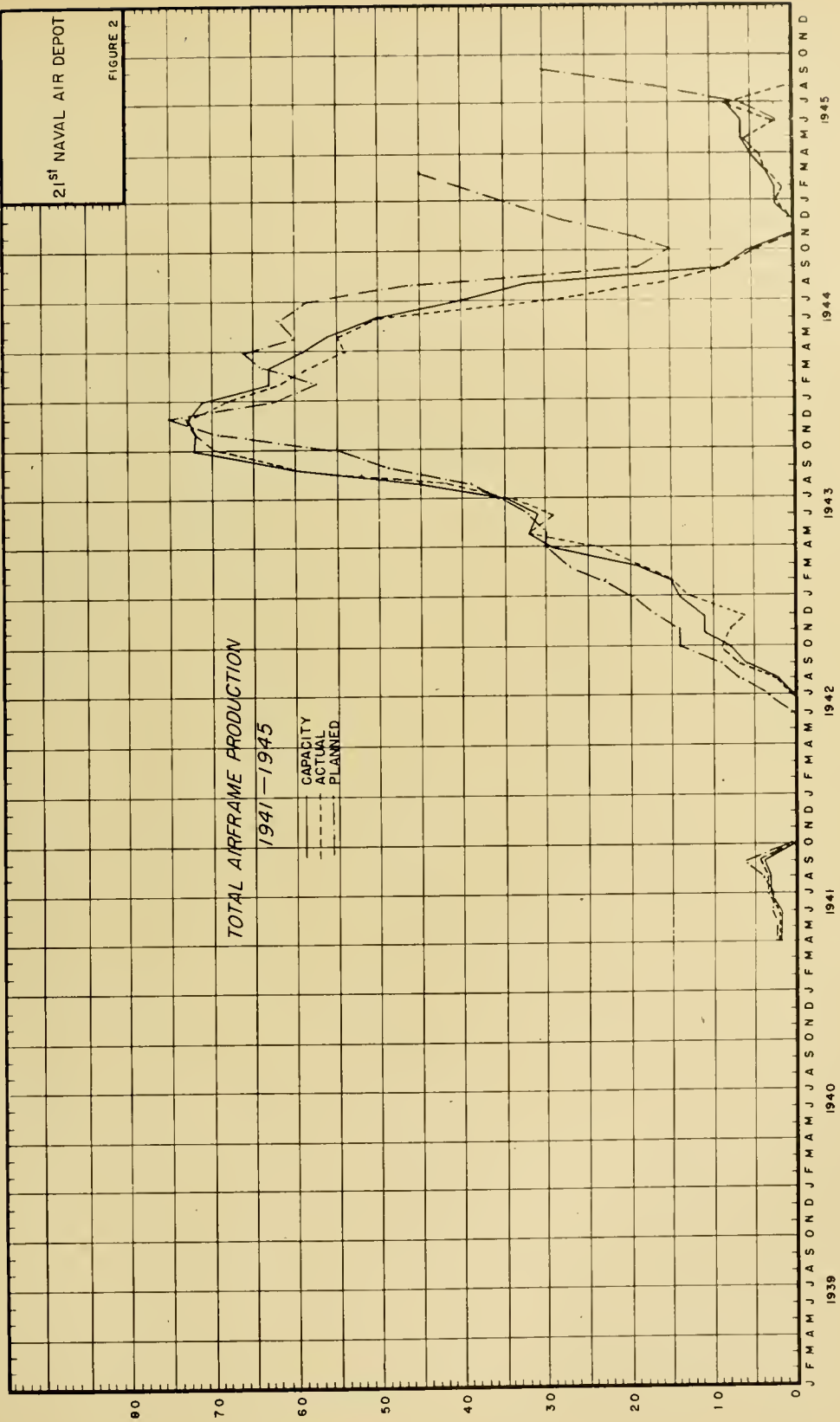


FIGURE 2

TOTAL AIRFRAME PRODUCTION

1941-1945

CAPACITY  
ACTUAL  
PLANNED



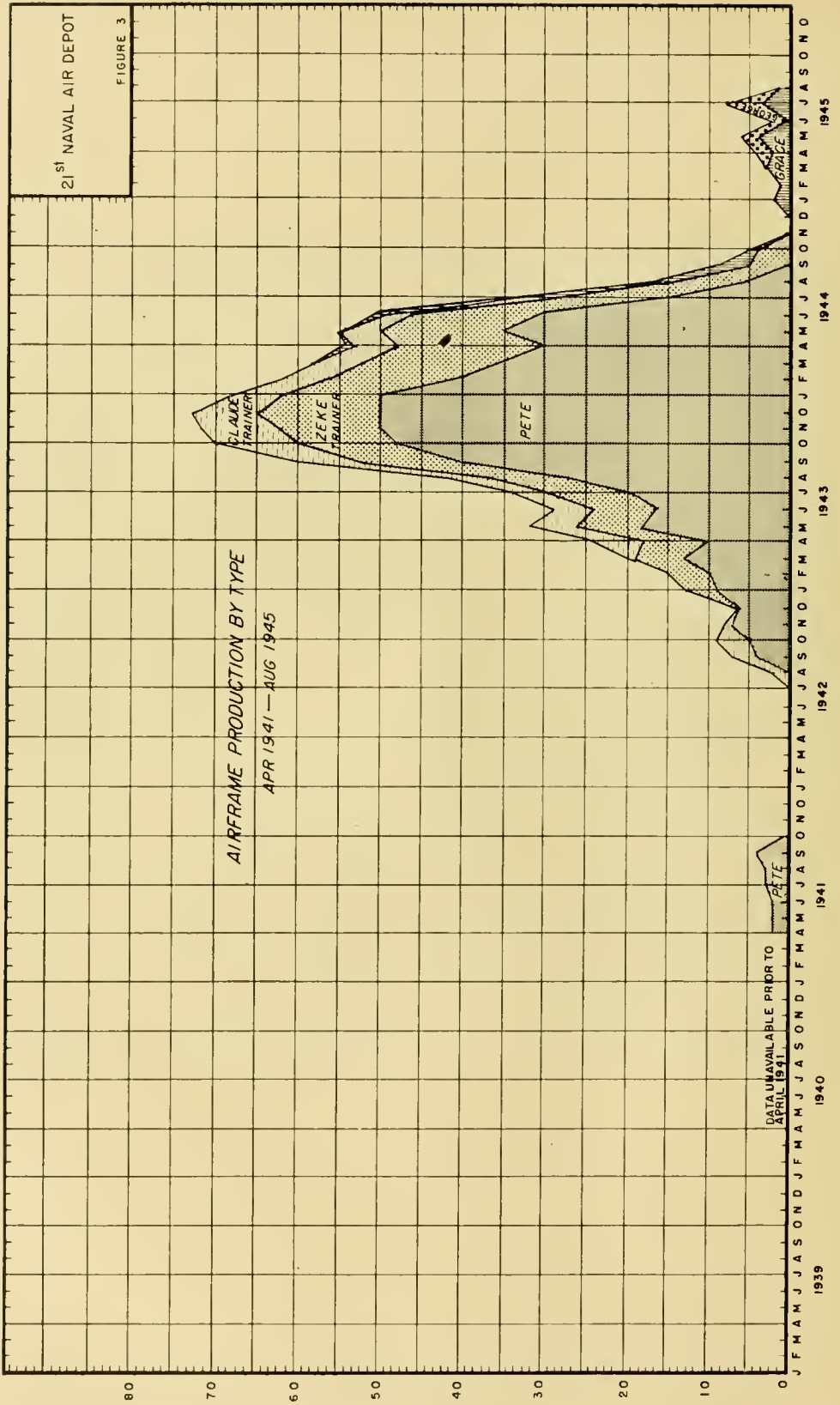
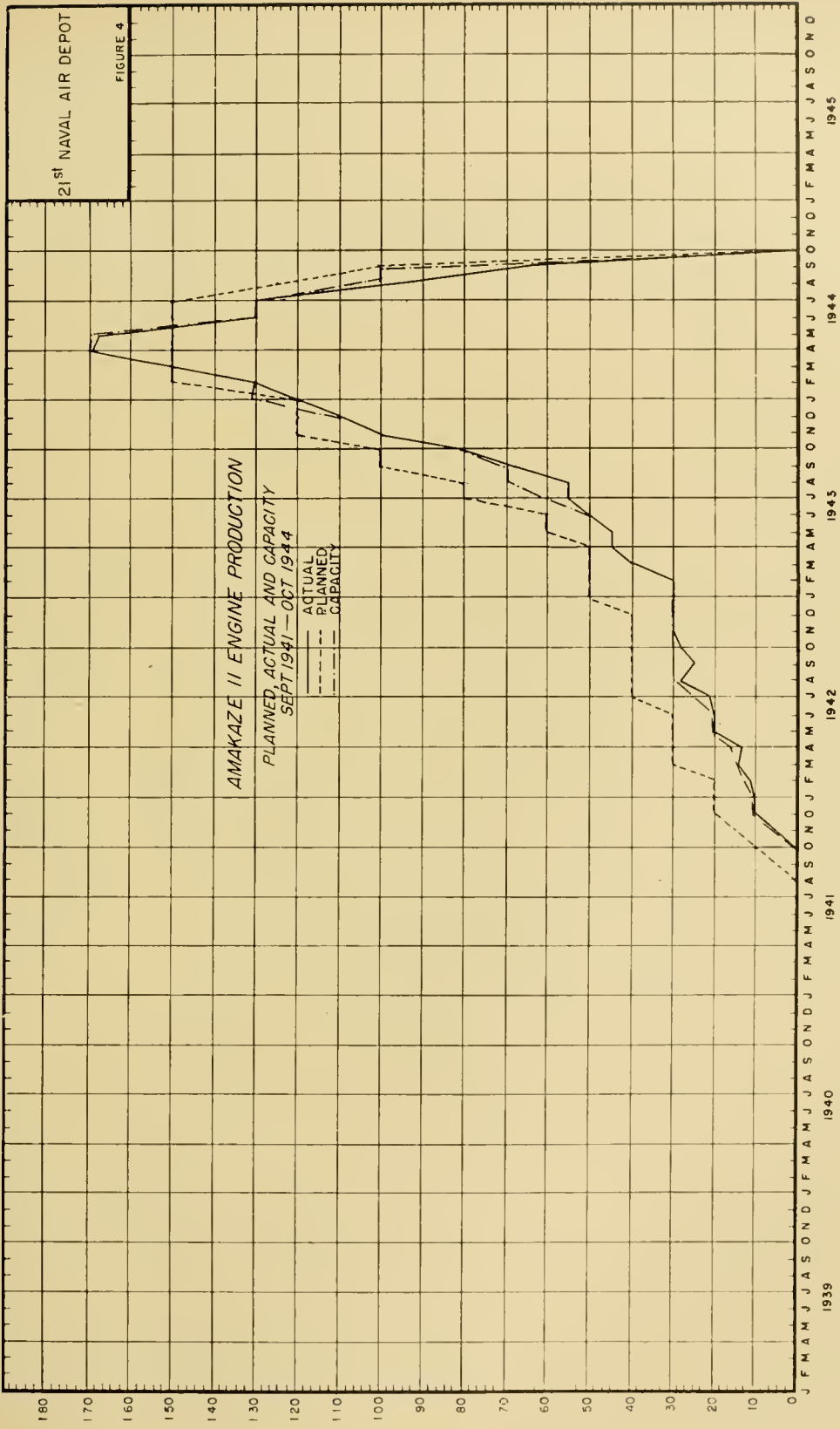


FIGURE 4

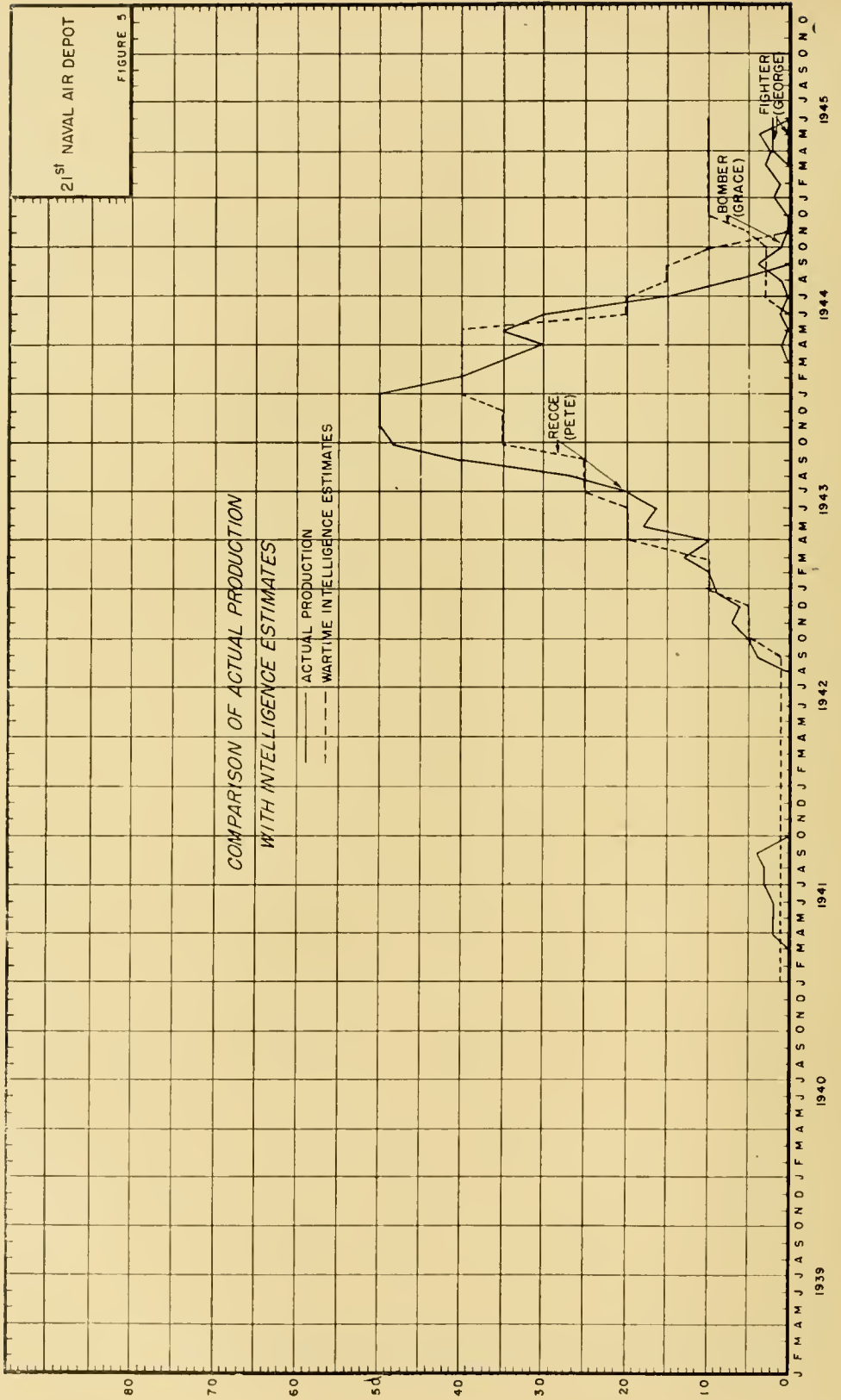
AMAKAZE II ENGINE PRODUCTION  
PLANNED, ACTUAL AND CAPACITY  
SEPT 1941 - OCT 1944

— ACTUAL  
- - - PLANNED  
- - - CAPACITY



COMPARISON OF ACTUAL PRODUCTION  
WITH INTELLIGENCE ESTIMATES

— ACTUAL PRODUCTION  
- - - WARTIME INTELLIGENCE ESTIMATES



**LEGEND**

- 1 MAINTENANCE SHOP FOR LAND BASED PLANES
- 2 CHECKING STATION
- 3 SHOP
- 4 STORAGE
- 5 AIRCRAFT STORAGE
- 6 AIRCRAFT STORAGE
- 7 HANGAR
- 8 FLYING BOAT HANGAR
- 9 SEAPLANE HANGAR
- 10 POWER STATION
- 11 PROPELLER STATION
- 12 AIRCRAFT REPAIR SHOP
- 13 AIRCRAFT WASHING SHOP
- 14 AIRCRAFT WASHING PLANT
- 15 GARAGE
- 16 BOILER ROOM
- 17 AIRFRAME PARTS REPAIR SHOP
- 18 HEAT TREATMENT
- 19 PUMP
- 20 WAREHOUSE
- 21 MAINTENANCE SHOP FOR SEAPLANES
- 22 TEST CELLS
- 23 TOOL SHOP
- 24 ADJUSTING SHOP
- 25 OFFICE
- 26 PLATING SHOP
- 27 ENGINE ASSEMBLY
- 28 ENGINE STORAGE
- 29 FORGE
- 30 COPPER SHOP
- 31 DOPE SHOP
- 32 PACKING AND SHIPPING
- 33 TOOL STORAGE
- 34 ENGINE WASHING SHOP
- 35 POWER SUB-STATION
- 36 ENGINE MACHINE SHOP
- 37 CASTING
- 38 PUMP ROOM
- 39 RESEARCH SHOP
- 40 NO. 1 FORGE SHOP
- 41 NO. 2 FORGE SHOP
- 42 ENGINE TURNING SHOP
- 43 MOULD SHOP
- 44 MACHINE SHOP
- 45 DORMITORIES
- 46 DELIVERY
- 47 SHOP AND BOILER ROOM
- 48 TOOL PLANT
- 49 SHEET METAL SHOP
- 50 FUSELAGE PARTS SHOP
- 51 WING ASSEMBLY
- 52 NO. 1 FINAL ASSEMBLY SHOP
- 53 NO. 2 FINAL ASSEMBLY SHOP
- 54 WOODWORKING SHOP



U. S. STRATEGIC BOMBING SURVEY  
 PLANT LAYOUT OF  
 TWENTY-FIRST NAVAL AIR DEPOT  
 OKURA, KYUSHU  
 APPENDIX A

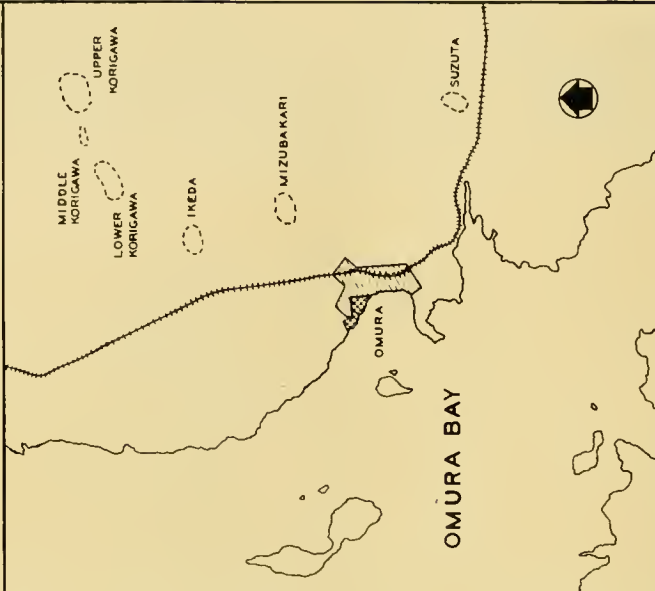
LOCATIONS OF PLANTS OF TWENTY FIRST NAVAL AIR DEPOT.

— AIR FRAME WORKS  
 - - - ENGINE WORKS



U.S. STRATEGIC BOMB SURVEY  
 21ST NAVAL AIR DEPOT  
 APPENDIX B.

DISPERSAL OF AIRFRAME PRODUCTION FROM OMURA



SCALE IN FEET.  
 5000 3000 1000 0  
 1000 2000 0

U.S. STRATEGIC BOMB SURVEY  
 21ST NAVAL AIR DEPOT  
 APPENDIX C.

**BOMB PLOT  
21ST NAVAL AIR DEPOT**

**LEGEND**

- 1 MAINTENANCE SHOP FOR LAND BASED PLANES
- 2 CHECKING STATION
- 3 SHOP
- 4 STORAGE
- 5 AIRCRAFT STORAGE
- 6 AIRCRAFT STORAGE
- 7 HANGAR
- 8 FLYING BOAT HANGAR
- 9 SEAPLANE HANGAR
- 10 POWER STATION
- 11 PROPELLER STATION
- 12 AIRCRAFT REPAIR SHOP
- 13 AIRCRAFT MAINTENANCE SHOP
- 14 AIRCRAFT WASHING PLANT
- 15 GARAGE
- 16 BOILER ROOM
- 17 AIRFRAME PARTS REPAIR SHOP
- 18 PAINT TREATMENT
- 19 PAINT
- 20 DISPENSARY
- 21 MAINTENANCE SHOP FOR SEAPLANES
- 22 TEST CELLS
- 23 TOOL SHOP
- 24 ADJUSTING SHOP
- 25 TOOL ROOM
- 26 PLATING SHOP
- 27 ENGINE ASSEMBLY
- 28 ENGINE STORAGE
- 29 FORGE
- 30 COPPER SHOP
- 31 PACKING AND SHIPPING
- 32 PACKING AND SHIPPING
- 33 TOOL STORAGE
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- 49 SHEET METAL SHOP
- 50 FUSelage PARTS SHOP
- 51 WING ASSEMBLY
- 52 NO 1 FINAL ASSEMBLY SHOP
- 53 NO 2 FINAL ASSEMBLY SHOP
- 54 WOODWORKING SHOP



DATE OF ATTACK	CODE
7 JUL 1944	● NO HITS
25 OCT 1944	■
21 NOV 1944	▲
19 DEC 1944	◆
6 JAN 1945	■
18 MAR 1945	■

U.S. STRATEGIC BOMBING SURVEY  
 PHOTOLOGICAL SECTION  
 TWENTY-FIRST NAVAL AIR DEPOT  
 ONJIMA, KYUSHU  
 APPENDIX D

KOZA NAVAL DEPOT  
(Depot Report No. XIX-4)

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# THE DEPOT AND ITS IMPORTANCE IN THE AIRCRAFT INDUSTRY

## INTRODUCTION

The Koza Naval Depot (Koza Kaigun Kosho) was engaged in the production of the intercepter fighter Raiden (Jack), of which 128 were made from May 1944 to August 1945, 21 percent of all Jack production. The depot opened on 1 April 1944 and continued in operation to the end of the war. It was located in Koza county (Koza-gun), Kanagawa prefecture, about 4 miles northeast of Atsugi station. The total building area was 2,260,440 square feet (including auxiliary installations).

## ORGANIZATION AND OPERATION

Details of production flow at the original site are not available. The functions of the various shops are recapitulated in the discussion of the dispersal locations.

The number of employees increased steadily throughout the period of the depot's operation, reaching a peak of 10,548 workers in June 1945 (Appendix A, Table 1). A single 10-hour shift was used.

TABLE 1.—*Employment statistics*<sup>1</sup>

Year and month	Dis-patched workers <sup>2</sup>	Regular workers	Man-hours per month	Total number of workers present	Increase over month preceding
1944					
April.....	2,000	2,924	81,872	4,926	
May.....	2,000	3,708	84,000	5,708	
June.....	2,000	4,496	86,800	6,496	788
July.....	2,000	5,124	89,488	7,124	628
August.....	2,000	5,912	94,752	7,912	788
September.....	5,000	3,000	99,904	8,000	88
October.....	5,000	3,100	102,928	8,100	100
November.....	5,000	3,196	105,952	8,196	96
December.....	5,000	3,384	103,824	8,384	188
1945					
January.....	5,000	3,568	125,888	8,568	184
February.....	5,000	3,676	143,472	8,676	108
March.....	5,000	3,784	165,536	8,784	108
April.....	3,000	6,000	168,000	9,000	216
May.....	3,000	7,440	180,320	10,440	1,144
June.....	3,000	7,548	183,344	10,548	108
July.....	3,000	6,656	186,368	9,656	-892
August.....	3,000	6,688	187,264	9,688	32

<sup>1</sup> All employment was of a single, 10-hour, day shift.

<sup>2</sup> "Haken Koin"—workers sent or borrowed from other factories.

## THE DISPERSAL PROGRAM

The dispersal plan was to move the main facilities and equipment (shops, offices, and warehouses) to four sites near the depot, making the best possible use of topography and wooded areas. Some of the warehouses were to be dispersed elsewhere (Appendix B).

The working area after dispersal was to be 1,291,680 square feet, separable as follows: In shops underground, approximately 645,840 square feet; in tunnels, approximately 322,920 square feet; in surface locations, approximately 322,920 square feet.

The goals were to maintain the same amount of equipment and facility space, and a monthly production of 120 planes. However, building space was reduced to 60 percent of the predispersal area. Plans were made also to economize on materials and labor, to expedite the dismantling of the original plant, and to minimize damage to buildings from air attack prior to dispersal. Easily destroyed material was transferred to the dispersed plants.

Further plans were made to expand the dispersal area in such a way as not to interfere with the production of Jack. The contemplated increase in area was to have been approximately 538,200 square feet.

Work on dispersal commenced in November 1944, but because of orders to change plans, lack of materials, labor, and transportation, and the urgent demand for Jack, construction of and operation in dispersed sites did not come up to expectations. Construction was to have been completed by 15 June 1945, and the operation entirely transferred to the new site by 10 July, but at the end of the war, actual progress represented about 80 percent of plans (70 percent of the planned increase).

A summary of progress in each of the four sites will also show the physical organization of production in the depot.

Number One plant area was the southernmost of the 3 areas to the west of the original plant, and its facilities were all in tunnels or underground shops. It assembled airframes and airframe equipment. Monthly production capacity was to be 60 planes (50 percent of the total). Since the final assembly plants in other areas were delayed, this area was important from the standpoint of production. Temporary roads connected it with the original plant.

Number Two plant area was a dispersal into a ravine just north of Number One. It consisted of wing and fuselage assembly shops (capacity planned for 40 a month), a machine shop (300 machine tools in tunnels), a parts shop (welding, static, metal plates, etc. above ground), and a sheet metal shop (in tunnels). It had by the end of the war assembled 10 wings and fuselages.

Number Three plant area, north of Number Two, was a dispersal into woods and a ravine, and included a final assembly shop (underground, capacity planned for 30 planes a month), fuselage and wing assembly (underground, capacity planned for 40 a month), a parts shop (in tunnels), and a parts warehouse (in tunnels). By the end of the war only the major part of the tunnels had been completed; the remainder was in process of construction.

Number Four plant area lay in woods to the east of the original plant. It was practically completed, and at the end of the war was on the point of starting operation. It comprised a final assembly shop (underground, capacity planned for 30 planes a month), fuselage and wing assembly (above ground, capacity planned for 40 a month), a jig shop, and a wooden parts shop, both above ground.

The dispersal plants produced only 10 planes in all. How much production was lost due to dispersal itself is difficult to determine, since the move was not completed, and there was, in addition, a shortage of materials and parts. The most serious aspect of the dispersal was that it was not completed according to schedule, since no planning was valid until the facilities were ready.

### THE AIR ATTACKS

From April 1945, the depot was under attack at various times by carrier-based fighters raiding the Atsugi airfield south of the arsenal, notably

on 10 July, 18 July, and 13 August. One sheet metal shop was destroyed by machine gun fire. There was a total of 5 deaths and 10 injuries.

### PRODUCTION STATISTICS

Government orders started in April 1944 and were well in excess of plans for production, reaching a figure of 70 in March 1945. In the following month this figure was dropped to 30, the level reached by planned production, and from then on the two figures were identical. It was contemplated that these figures would rise to 80 in February 1946 (Appendix C, Table 2).

TABLE 2.—Planned and actual production, April 1944-August 1945

Year and month	Requested	Planned	Actual	Note	
1944					
April	1			Production delay was due to 1. Delay in completion of equipment (buildings, etc.). 2. Delay in machine tool construction tools, etc.	
May	4	1	1		
June	10	3	0		
July	15	5	0		
August	20	7	1		
September	25	10	2		
October	30	15	3		
November	35	20	4		
December	40	25	6		
1945					
January	50	30	13		Production delay was due to 1. Difficulty in procuring parts due to air attacks. 2. Dispersal.
February	60	30	8		
March	70	30	23		
April	30	30	15		
May	30	30	10		
June	30	30	20		
July	35	35	22		
August	40	40			
Total	525	341	128		

Actual production progressed in a slow and irregular ascent, reaching a peak of 23 in March 1945 and returning to the figure of 22 in August. Production delay during the period May 1944-January 1945 was ascribed to delay in construction of equipment (buildings as well as machine tools, etc.). The delay in the period February-August 1945 was ascribed to difficulty in procuring parts, due to the air raids, and to the effects of dispersal. The receipts of metal precision parts was in some months less than one-half of the amounts ordered (Reference Item 1).

Production suffered little from direct attack in this case, but proved just as vulnerable to attack on suppliers and to shortages of materials and construction. The effect of dispersal was felt not because of the inferior efficiency of a dispersed factory but because of inability to make a rapid transition or to arrange for keeping up production in the interim.

PLANT AREA #3

DISPERSAL LOCATIONS  
KOZA NAVAL DEPOT

MAIN AREA

Warehouses

Tsurumi Sta.

Hospital

Residential

PLANT AREA #4

Fuselage  
& Wings

Laboratory  
Workshop

Job Shop

Airfield Dormitories

Express Railroad to Tokyo - Enoshima Line

PLANT AREA #2

Burned

Burned

PLANT AREA #1

SAGAMI

Nishi-Yamatu Sta.

Residences  
for  
Officials

U.S. STRATEGIC BOMBING SURVEY

KOZA NAVAL ARSENAL

APPENDIX - B



# EVALUATION OF PRE-ATTACK INTELLIGENCE

War Department Military Intelligence Service (2), had identified the depot as a production site for Jack, and supposed that plane production had started in October 1944. This was actually the sixth month of production, but the three planes produced during that time brought the

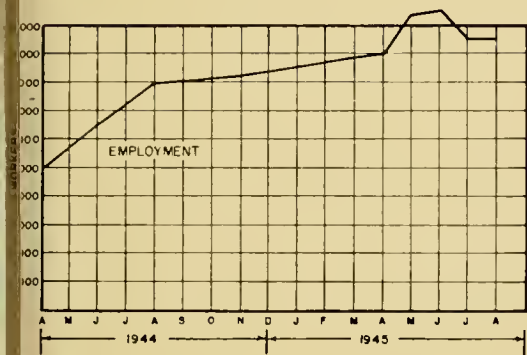
total number made since production started to only seven altogether. No estimate of rate of production was made.

## REFERENCE NOTES

The following material is on file at the office of the Adjutant General, War Department, Washington, D. C.:

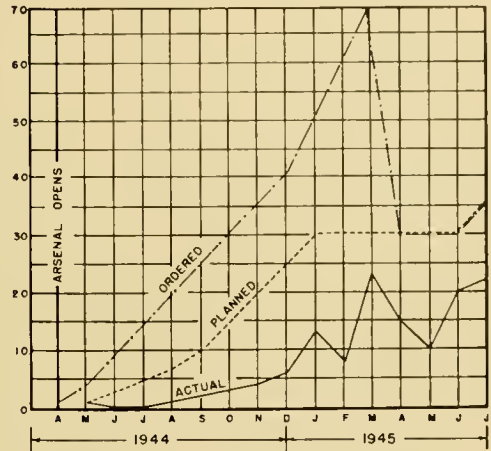
Reference Note 1, Bottleneck Parts, 1945.

TOTAL EMPLOYMENT  
APRIL 1944—AUG 1945



U.S. STRATEGIC BOMBING SURVEY  
KOZA NAVAL ARSENAL  
APPENDIX—A

"RAIDEN" FIGHTER (JACK)  
PLANNED, ORDERED, AND ACTUAL PRODUCTION  
APRIL 1944—JULY 1945



U.S. STRATEGIC BOMBING SURVEY  
KOZA NAVAL ARSENAL  
APPENDIX—C

# TACHIKAWA ARMY AIR ARSENAL

## (Report No. XIX-5)

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## THE ARSENAL AND ITS IMPORTANCE IN THE AIRCRAFT INDUSTRY

### INTRODUCTION

The Tachikawa Army Air Arsenal, located 20 miles east of Tokyo on the outskirts of the town of Tachikawa, was the only Army arsenal engaged in the production of airframes and aircraft engines. During the period 1941-45 air-frame production accounted for 1.4 percent and engine production 1.2 percent of the Japanese total.

The principal model produced in the airframe works was the Ki-51, Type 99 single-engine reconnaissance aircraft, Sonia. Approximately 22 per month were produced for the years 1942 through 1944 by the Tachikawa Arsenal, which was the sole manufacturer of this model.

Other aircraft produced by the arsenal included the Ki-30, Type 97 single-engine light bomber, Ann, and the Ki-43, Type 1 single-engine fighter, Oscar. Only 49 of the latter model were produced although it was one of the Army's outstanding single-engine fighters. The production of Ki-67, Peggy, was planned to begin in the latter part of 1945, but only one was produced before the war ended.

In the engine works the principal product was the Ha-23, a nine-cylinder, air-cooled radial engine of 360 horsepower for trainer aircraft. During the years 1941 through 1944 production averaged 26 per month. Other models included the 1,050 horsepower, 14-cylinder Ha-31, an air-cooled radial with a two-speed supercharger for powering the twin-engine Kawasaki fighter Nick, and the 1,970 horsepower Ha-45, an 18-cylinder radial also equipped with a two-speed supercharger, used in the single-engine Nakajima fighter Frank.

In addition to the manufacture of air frames and engines, the arsenal engaged in all modifications and major repairs for the Tokyo area.

In August 1944 the engine works was moved to the city of Kanazawa, which is on the Japan Sea about 100 miles due north of Nagoya (Appendix A). Owned by the Japanese Army, the Arsenal

was directly under the Commanding General of the Air General Army from whose office all orders were issued. Funds were received from the Army.

### ORGANIZATION AND OPERATION

The commanding officer of this arsenal and its dispersals was Col. Shujiro Tanabe.

The airframe and engine works employed a total of 11,940 workers at the war's end. Prior to September 1943 the arsenal was operated on a one-shift basis; thereafter, until the end of the war, two 11-hour shifts were in effect. One began at 0700 and ended at 1800; the other started at 1900 and ended at 0600. The percentage of workers on the night shift varied from 0 to 40 percent.

The engine works had a peak employment of 5,640 at the end of the war, while the number of air-frame workers reached a peak of 6,300 at the end of the war (Appendices B, C, D, and E).

The airframe works loaned the Mitsubishi firm an average of 866 persons per month from April through December of 1944, and the engine works loaned 1,000 workers to Nakajima from June through October 1944.

Labor turnover in the airframe works amounted to approximately 2 percent in 1942, 1 percent in 1943, and 2 percent in 1944 and 1945. There is no information as to turnover in the engine works. About 40 percent of the workers in both of the plants were soldiers.

### DISPERSAL

The facilities of the Tachikawa Arsenal were dispersed to two widely separated areas: The engine works centered around Kanazawa in Ishikawa prefecture on the west coast, more than 200 miles from Tokyo, while the air-frame works were scattered in the general proximity of Tachikawa within 50 miles of the Imperial Palace (Appendix A).

With the capture of the Marianas Islands by

the United States forces in June 1944, Army authorities considered plans for the dispersal of the arsenal's engine works to Kanazawa. By August, plans were completed and the dispersal carried out.

Early in 1945, following the initial urban area attacks, it was decided to disperse further. A program was put into effect by which the facilities of the engine works were scattered to 35 sites in Ishikawa prefecture and raw materials to 50 additional storage sites.

In the meantime, construction of an underground engine works was undertaken in June at Hayashi, 6 miles south of Kanazawa, and was about 30 percent completed by August when the war ended. This underground plant was to include 11,616 feet of tunnels. Approximately 800 machine tools eventually were to be installed in the underground plant, which was to have, in addition to a machine shop, a raw materials warehouse, components storage, transformer station, and oil storage (Appendix F).

After the dispersal of the engine works in August 1944, the airframe works for a time occupied the section in the Tachikawa Arsenal vacated by the engine works. With the intensification of air attacks toward the end of 1944, plans were formulated for the dispersal of the airframe works also. However, because of difficulties in obtaining building materials and transportation facilities, dispersal of the works' machine shop to Tokorozawa, 12 miles northeast of Tachikawa, was not undertaken until 10 March 1945.

During the same period the sheet metal shop facilities were moved to the Hikawa tunnel, 27 miles west of Tachikawa.

In the meantime, in early February 1945, approximately 60 warehouses had been acquired in the Tachikawa area, and by the first part of March transfer of easily transported materials took place. The decision to disperse raw materials storage resulted when the Musashi plant of the Nakajima Co. was bombed.

To carry the dispersion into effect 1,000 vehicles and 10,000 men were employed. During the transfer, since it was necessary temporarily to expose certain steel and light alloys to the elements in outdoor dumps, a portion of these materials suffered considerable damage.

With the transfer of the sheet metal shop facilities to Hikawa, a portion of the components assembly shop was moved to Sawai, 25 miles southwest of Tachikawa. Due to the poor condi-

tion of roads and the distance, this transfer was on a small scale. At the end of April 1945 components were in limited production at the new site.

In April 1945 the Army authorities decided to construct an underground plant for the airframe works at nearby Shichisei containing 13,200 feet of tunnels. Average height and width of the tunnels was 10 by 13 feet (Appendix G). In August the Shichisei plant was 80 percent completed.

In early May it was decided to move one-half the assembly shop facilities to Takahagi for the assembly of *Sonia* reconnaissance aircraft and the twin-engine medium bomber *Peggy*, but at the end of the month construction of a semiunderground works at Hanno was undertaken to which it was intended to retransfer the final assembly facilities from the Takahagi site.

The dispersal of the airframe works was all within a 27-mile radius of the Tachikawa arsenal (Appendix H).

## ATTACKS ON PLANTS

The Tachikawa arsenal suffered from the effect of three attacks, only one of which was directed against the works as the primary target.

During the attack of 4 April 1945 on the Tachikawa Airplane Co.'s main plant, the "spillover" resulted in hits on the Arsenal. Thinking it was the bombers' target, although damage was light, officials burned all wooden structures not in use. Most of the shop facilities had been dispersed, but it was felt that an uncontrolled fire among empty buildings would spread to the airfield and destroy the aircraft in the hangars.

On 9 June 1945, during a Twentieth Air Force attack directed against the arsenal, 2 airfield hangars were destroyed. Twenty-nine B-29s attacked the target and dropped 169 tons of G bombs. Eighteen aircraft bombed visually and 11 by radar devices. Damage was light.

On 1 August the arsenal was hit during an urban area attack on Hachioji. Incendiaries gutted 4 of the remaining buildings, and there were 29 casualties; 5 dead and 24 injured.

These raids caused damage to only 11 of the approximately 75 buildings (Appendix I).

The urban area attacks on other districts had large effect. It was estimated numerous shortages such as oil, coal, and raw material in general resulted from these attacks.

The Kanazawa Engine Works was not bombed



## PRODUCTION STATISTICS

From 1941 until the end of the war the Tachikawa arsenal had the capacity to produce 1,760 aircraft. Actual production was 1,004. During the period April 1941 to the end of the war engine production capacity was 2,730 while actual production was 1,363.

The capacity of the airframe works was 20 aircraft per month in 1941, at which level it remained until March 1942 when it rose to 30. In September of 1943 it rose to 40 and remained at this level until the end of the war (Figure 1).

Orders lagged below capacity until August 1942 when the 2 coincided at 30 aircraft per month. From September 1942 through March 1945 orders exceeded capacity, rising to 48 aircraft per month in March but dropping sharply to 22 in April 1943. In April 1944 orders again reached capacity which was 40 per month and stayed at that approximate level until February 1945 and dropped off to zero in March (Appendix J).

The important production was that of Sonia. In 1942 the divergence between planned and actual was due to the attempt to establish a program for production of Oscar to parallel the production of Sonia. This was abandoned because of the inability of production engineers to cope with attendant problems.

The large drop in production in June through December 1944 arose from the loan of about 700 workers to Mitsubishi. In early 1945 planned and actual production fell sharply due to the preparation made for the production of Ki 67, a two-engine bomber, Peggy (fig. 1).

Only one Peggy was made because of the confusion arising from dispersal which in turn was caused by bombing and the threat of further attacks. Production of Sonia rose briefly after dispersal and then stopped in July prior to the end of the war.

In the engine works the difficulties encountered in production were similar to those in the airframe works. Low production in the first half of 1943 accompanied the change over from Ha-23 to Ha-31. In September 1944 capacity as well as production fell off due to the dispersal of the

works to Kanazawa. From April 1945 to the end, further dispersal and the attempt to go underground held back production of the Ha-45 (Figure 2). After March 1945 Ha-45 was the only engine in production because of the government's attempt to standardize types. The Kanazawa main works never was bombed but suffered extremely from the threat of bombing.

Actual production stayed fairly close to capacity until August 1944 when general confusion and lack of supplies together with attempted dispersal caused the program to fail (Appendix K).

## EVALUATION OF PRE-ATTACK INTELLIGENCE

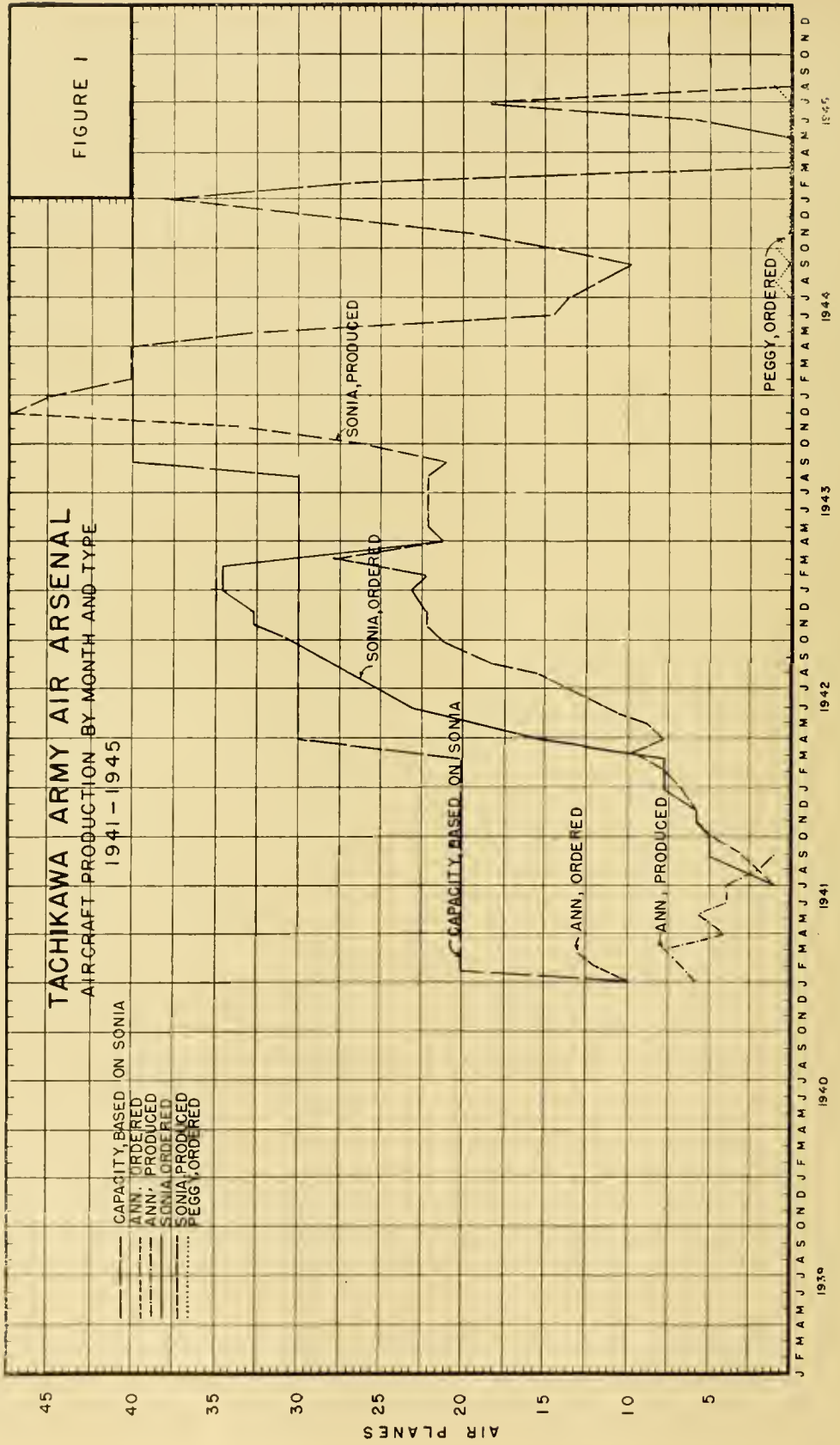
The War Department Military Intelligence Service (G-2), estimate of total production for Sonia was 17 percent over actual (Figure 3). The estimate, although it failed to show all of the fluctuations, did give a very good general trend. Over-all production amounted to 913 Sonias while MIS estimated 1,068. Intelligence did not have any estimate of production on other aircraft as the production was so small it was negligible.

There were no estimates of engine production as the only engine produced in appreciable quantity was the Ha-23. The Ha-23 was only 360 horsepower and Military Intelligence Service made no estimates on low horsepower engines, although aware of the fact that the arsenal was producing other models.

## REFERENCE NOTES

1. Explanatory table of plans for dispersion and evacuation.
2. Damage to tools and powered machinery during the third raid.
3. Aircraft works organization.
4. Receipt of principal metal materials.
5. Component Shops of the engine works.
6. Explanation table for engine works dispersion program.

Reference items are filed with the records of the Aircraft Division, United States Strategic Bombing Survey, in the office of the Adjutant General, War Department, Washington, D. C.



# TACHIKAWA ARMY AIR ARSENAL

## ENGINE PRODUCTION BY MONTH AND TYPE

FIGURE 2

1941—1945

CAPACITY, BASED ON HA-23

HA-23 ORDERED

HA-23 PRODUCED

HA-31 ORDERED

HA-31 PRODUCED

HA-45 ORDERED

HA-45 PRODUCED

CAPACITY, BASED ON HA-23

HA-23 ORDERED

HA-31 PRODUCED

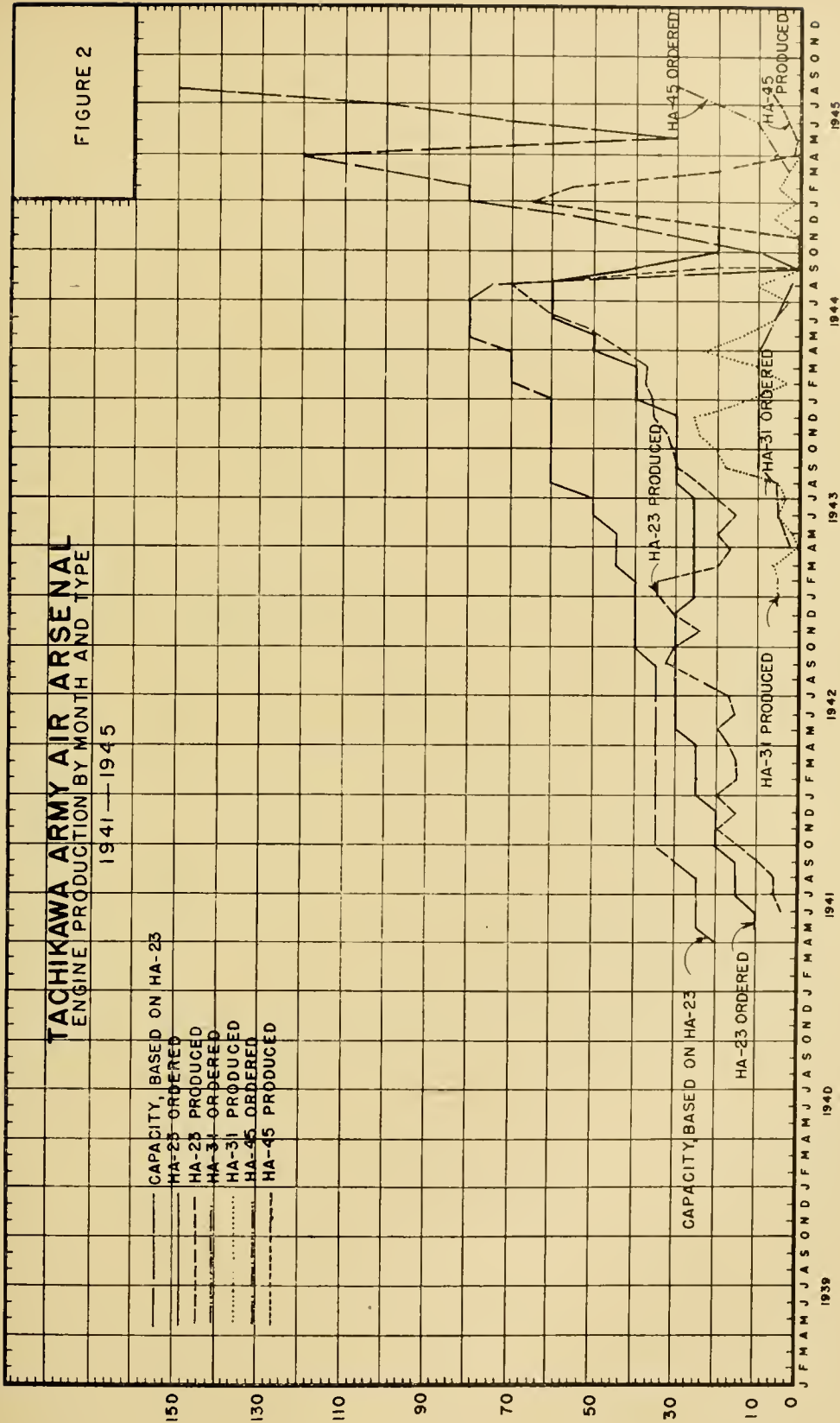
HA-31 ORDERED

HA-23 PRODUCED

HA-45 ORDERED

HA-45 PRODUCED

ENGINES



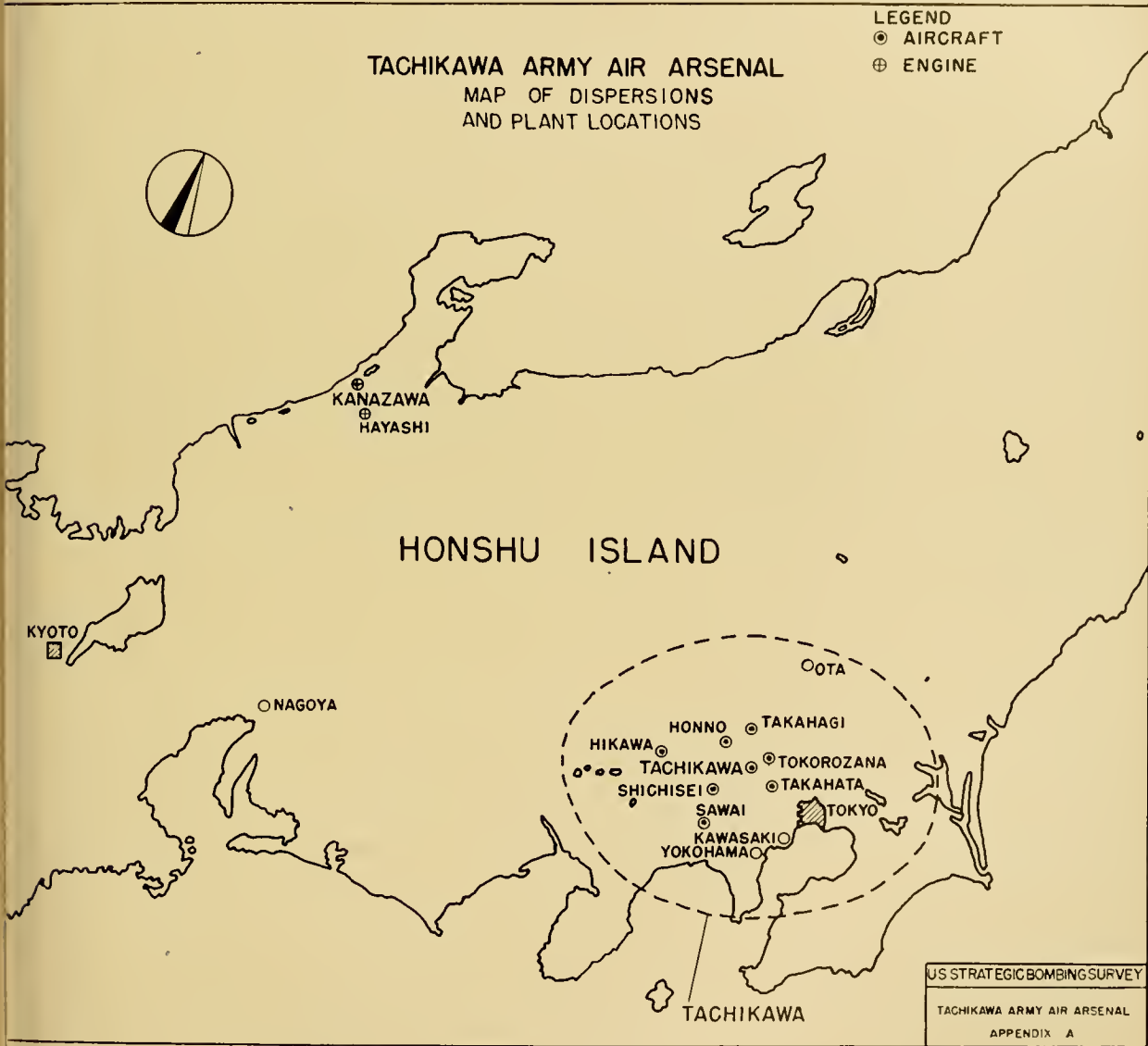
TACHIKAWA ARMY AIR ARSENAL  
 AIRFRAME WORKS  
 INTELLIGENCE ESTIMATE VS ACTUAL PRODUCTION  
 (SONIA)



FIGURE 3

TACHIKAWA ARMY AIR ARSENAL  
 MAP OF DISPERSIONS  
 AND PLANT LOCATIONS

LEGEND  
 ⊙ AIRCRAFT  
 ⊕ ENGINE



U.S. STRATEGIC BOMBING SURVEY  
 TACHIKAWA ARMY AIR ARSENAL  
 APPENDIX A

## APPENDIX B

*Tachikawa Army Air Arsenal monthly employment chart, direct and indirect workers, airframe works*

	1	2	3	4	5	6	7	8	9	10	11	12
1940												
Direct .....				1,000	1,095	1,015	1,035	1,075	1,125	1,185	1,240	1,3
Indirect .....				200	(5)	(10)	(20)	(40)	(50)	(60)	(55)	(6)
					200	200	200	210	230	250	235	2
								(10)	(20)	(20)	(15)	(1)
1941												
Direct .....	1,300	1,300	1,310	1,440	1,465	1,505	1,565	1,590	1,910	2,210	2,220	2,5
Indirect .....	285	295	300	320	325	335	355	360	440	540	540	61
	(10)	(10)	(5)	(20)	(5)	(10)	(20)	(5)	(80)	(100)		(7)
1942												
Direct .....	2,520	2,530	2,540	2,690	2,710	2,740	2,750	2,870	2,940	3,070	3,160	3,23
Indirect .....	(20)	(10)	(10)	(150)	(20)	(30)	(10)	(120)	(70)	(130)	(90)	(7)
	610	610	610	660	670	670	680	710	740	770	800	83
				(50)	(10)		(10)	(30)	(30)	(30)	(30)	(3)
1943												
Direct .....	3,240	3,300	3,400	3,600	3,610	3,620	3,640	3,660	3,760	3,770	3,910	4,0
Indirect .....	(10)	(150)	(10)	(200)	(10)	(10)	(20)	(20)	(100)	(10)	(140)	(15)
	830	880	880	980	980	980	980	980	1,030	1,030	1,090	1,1
		(50)		(100)					(50)		(60)	(7)
1944												
Direct .....	4,145	4,145	4,525	4,525	4,525	4,525	4,525	4,525	4,525	4,525	4,525	4,52
Indirect .....	(85)	(380)	(-250)	(-250)	(-650)	(-1,000)	(-1,300)	(-1,800)	(-1,200)	(-800)	(-500)	(-3)
	1,175	1,175	1,295	1,295	1,295	1,295	1,295	1,295	1,295	1,295	1,295	1,2
	(15)		(120)									
1945												
Direct .....	4,755	4,785	4,885	4,885	4,885	4,885	4,885					
Indirect .....	(230)	(30)	(100)									
	1,365	1,365	1,415	1,415	1,415	1,415	1,415					
	(70)		(50)									

Numbers in parentheses are monthly increase of employees. Negative numbers represent employees detached for work at Mitsubishi. They are included in the monthly figures.

## APPENDIX C

*Nachikawa Army Air Arsenal monthly employment chart, direct and indirect workers, Kanazawa Engine Works, April 1940-July 1945*

	1	2	3	4	5	6	7	8	9	10	11	12
1940												
indirect				480	495	520	545	565	590	620	675	715
direct				100	100	105	105	110	115	120	140	175
1941												
indirect	740	755	800	875	910	950	1,000	1,040	1,050	1,075	1,120	1,140
direct	185	190	200	205	215	220	230	235	240	250	255	270
1942												
indirect	1,180	1,225	1,240	1,260	1,305	1,340	1,400	1,440	1,485	1,500	1,540	1,540
direct	280	285	300	305	305	310	315	320	350	360	380	400
1943												
indirect	1,580	1,615	1,680	1,725	1,780	1,815	1,880	1,850	1,970	1,995	2,040	2,050
direct	405	410	420	450	455	465	495	505	515	520	545	555
1944												
indirect	2,150	2,230	2,300	2,330	2,440	2,505	2,540	2,595	2,700	2,810	2,940	3,030
direct	585	590	605	615	620	650	670	700	720	780	810	880
1945												
indirect	3,210	3,430	3,580	3,750	4,040	4,300	4,375					
direct	915	990	1,030	1,120	1,215	1,250	1,265					

From 6 June 1944 to 10 Oct. 1944, 1,000 workers sent to Nakajima to assist in production and to acquire technical skill.

## APPENDIX D

*Tachikawa Army Air Arsenal direct employees (man-hours), airframe works, April 1940-July 1945*

	1	2	3	4	5	6	7	8	9	10	11	12
1940.....				300,000	301,500	304,500	310,500	322,500	337,500	355,500	372,000	390,000
1941.....	390,000	390,000	393,000	432,000	439,500	451,500	469,500	477,000	573,000	663,000	666,000	750,000
1942.....	756,000	759,000	762,000	807,000	813,000	822,000	825,000	861,000	882,000	921,000	948,000	969,000
1943.....	972,000	1,017,000	1,020,000	1,080,000	1,083,000	1,086,000	1,092,000	1,098,000	1,128,000	1,029,210	1,067,430	1,108,300
1944.....	1,131,585	1,131,585	1,235,325	1,167,075	1,057,875	962,325	880,425	743,925	904,725	1,016,925	1,098,825	1,153,400
1945 <sup>1</sup> .....	1,152,115	1,306,305	1,333,605	1,333,605	1,333,605	1,333,605	1,333,605	1,333,605	1,333,605	1,333,605	1,333,605	1,333,605
Percentage night-shift employees under 2-shift system												
1943.....										15	20	
1944.....	28	40	40	35	30	10	10	10	10	10	10	10
1945.....	10	10	10	10	10	10	10	10	10	10	10	10

<sup>1</sup> For the period April to December 1944, the above chart includes laborers sent to Mitsubishi.



## APPENDIX E

### *Tashikawa Army Air Arsenal, direct employee man-hours, Kanazawa Engine Works*

	1	2	3	4	5	6	7	8	9	10	11	12
0				120,000	123,750	130,000	136,250	141,250	147,500	155,000	168,750	178,750
1	185,000	188,750	200,000	218,750	227,500	237,500	250,000	260,000	262,500	268,750	280,000	285,000
2	295,000	306,250	310,000	315,000	326,000	335,000	350,000	360,000	371,000	375,000	380,000	385,000
3	385,000	404,000	420,000	432,000	445,000	455,000	471,000	480,000	493,000	499,000	510,000	513,000
4	537,500	557,500	575,000	582,500	610,000	626,250	635,000	649,750	675,000	702,500	735,000	757,500
5	802,500	857,500	895,000	937,500	1,010,000	1,075,000	1,093,750					

### *Tashikawa Army Air Arsenal, percent night-shift employees to total employees, Kanazawa Engine Works*

	1	2	3	4	5	6	7	8	9	10	11	12
3										16	18	24
4	29	41	40	40	36	30	30	(1)	(1)	(1)	(1)	10
5	10	10	20	20	26	30	30					

<sup>1</sup> Cessation of 2-shift system due to dispersal to Kanazawa district.

## APPENDIX F

The general plan for underground installation of the engine works at Hayashi.

1. Requirements:

(a) To withstand a direct hit by an 8,800-pound bomb.

(b) To accommodate about 800 machine tools.

2. Machine shop:

Diameter, 16 feet.

Height, 10 feet.

Length, 9,075 feet.

Interval between passage, 66 feet.

3. Transformer station:

Diameter, 16 feet.

Height, 16 feet.

Length, 66 feet.

4. Other underground installations including raw materials warehouse, component warehouse oil storage, etc.

Diameter, 10 feet.

Height, 7 feet.

Length, 1,320 feet.

5. Communication passages, etc.:

Diameter, 13 feet

Height, 10 feet.

Length, 1,155 feet.

6. Summary:

Diameter (feet) -----	16	16	10	
Height (feet) -----	10	16	7	
Length (feet) -----	9,075	66	1,320	1,155
Total, 11,616.				

## APPENDIX G

The general plan for underground installation of the aircraft works at Shichisei.

1. Requirements:
  - (a) Intended to withstand direct hits by 1,100-pound bombs.
  - (b) Intended to accommodate 800 machine tools.
2. Machine shop:
  - Span, 13 feet.
  - Height, 10 feet.
  - Length, 9,240 feet.
3. Jig shop.
  - Span, 13 feet.
  - Height, 10 feet.
  - Length, 908 feet.
4. Repair shop:
  - Span, 13 feet.
  - Height, 10 feet.
  - Length, 363 feet.
5. Transformer room:
  - Span, 20 feet.
  - Height, 13 feet.
  - Length, 66 feet.

6. Medical treatment rooms:

- Span, 13 feet.
- Height, 10 feet.
- Length, 66 feet.

7. Heat treatment shop:

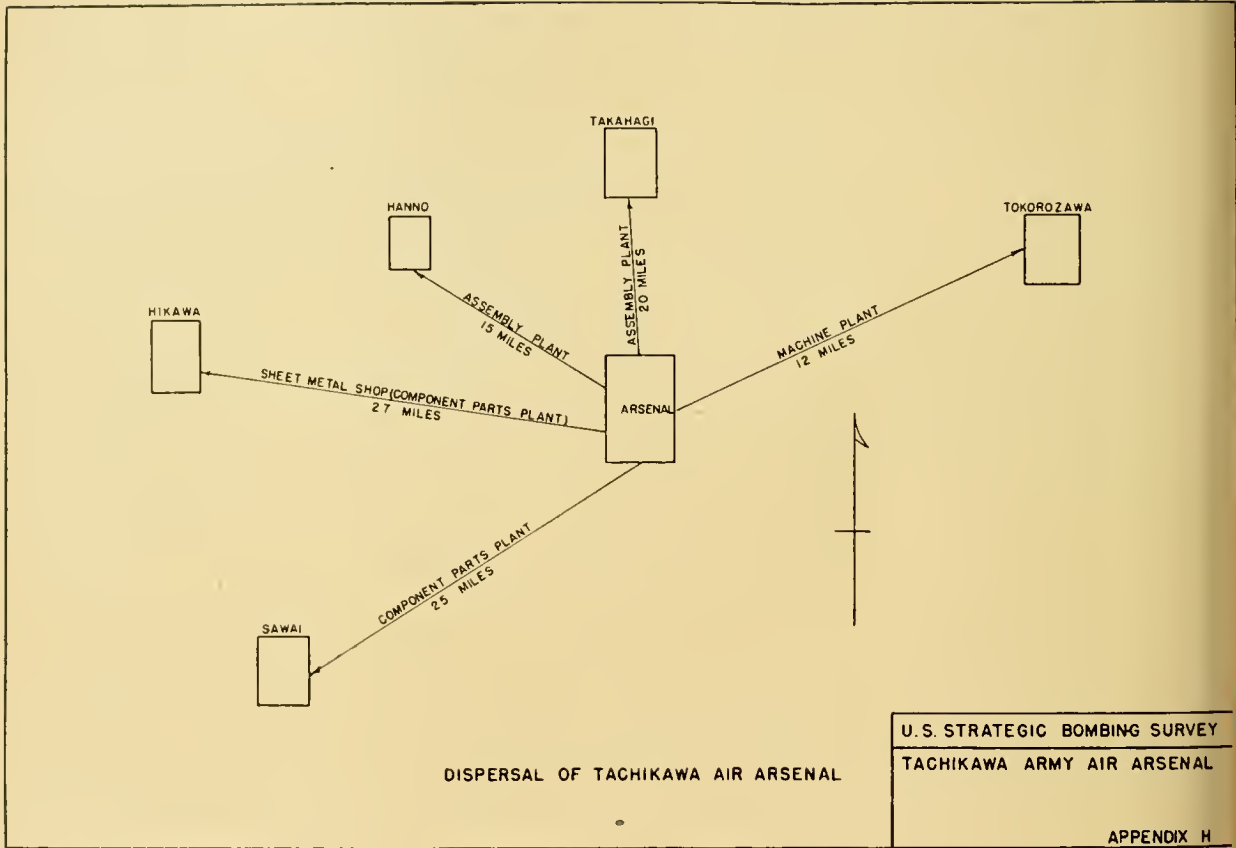
- Span, 20 feet.
- Height, 10 feet.
- Length, 99 feet.

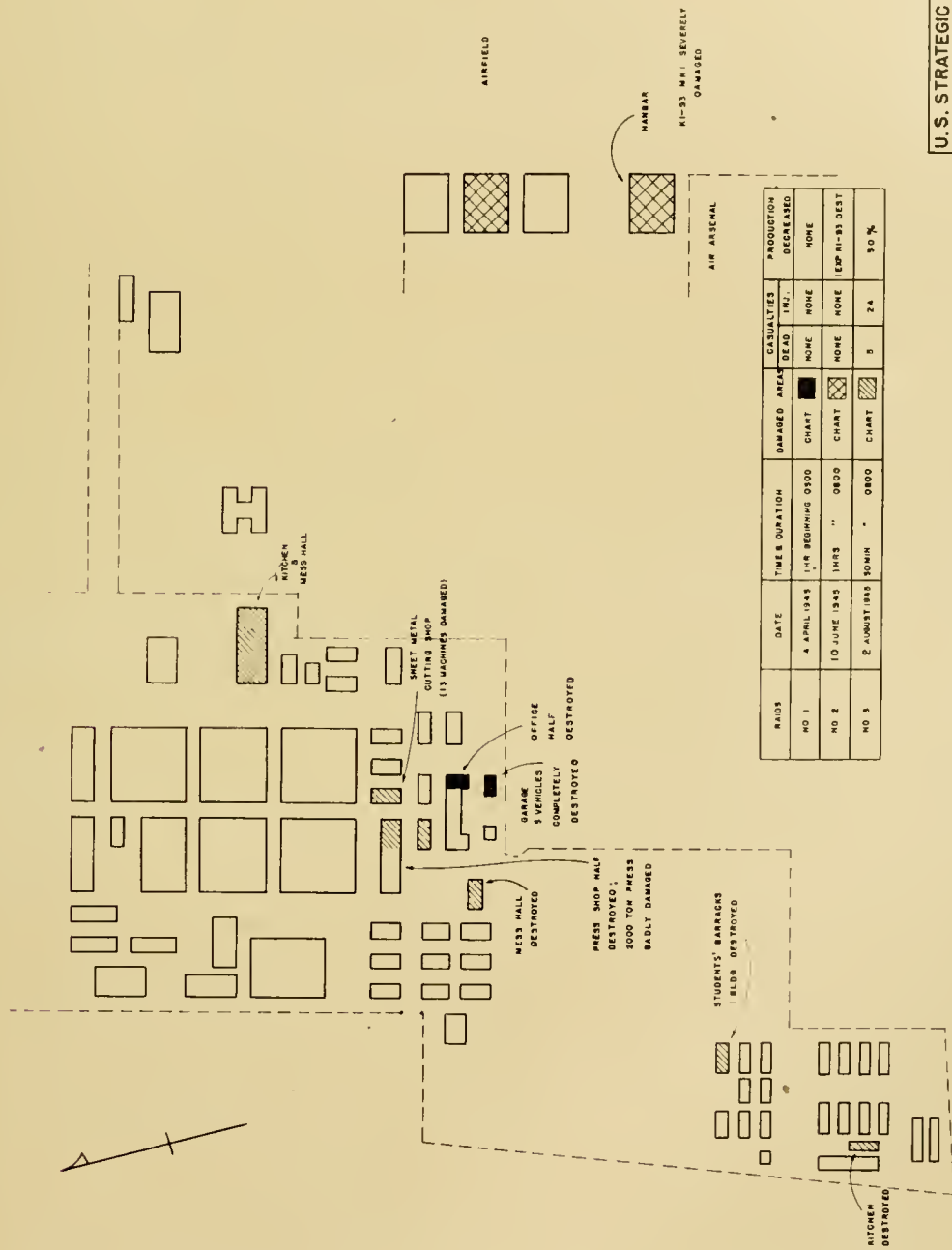
8. Miscellaneous underground installation inspection shops, oil filtration shops, oil storage, etc.

- Span, 13 feet.
- Height, 10 feet.
- Length, 2,788 feet.

9. Summary:

Span (feet)	Height (feet)	Total length (feet)
13	10	13, 035
20	13	66
20	10	99
		13, 200





AIR ATTACK DAMAGE

U. S. STRATEGIC BOMB SURVEY  
TACHIKAWA ARMY AIR ARSENAL

APPENDIX I

# APPENDIX J

## Monthly aircraft production

	Total capacity <sup>1</sup>	Anne		Sonia		Oscar		Peggy		Total	
		Ordered	Produced	Ordered	Produced	Ordered	Produced	Ordered	Produced	Ordered	Produced
<b>1940</b>											
August <sup>2</sup>	3	2	2								2
September	3	3	3								3
October	3	5	3								5
November	10	7	5								7
December	10	8	5								8
<b>Total</b>	<b>29</b>	<b>25</b>	<b>18</b>								<b>25</b>
<b>1941</b>											
January	10	10	6								10
February	20	12	7								12
March	20	13	8								13
April	20		4								
May	20		6								
June	20		4								
July	20		4								
August	20		2	1	1						1
September	20		1	3	2						3
October	20			5	3						5
November	20			5	5						5
December	20			6	6						6
December	20			6	6						6
<b>Total</b>	<b>230</b>	<b>35</b>	<b>42</b>	<b>26</b>	<b>23</b>						<b>61</b>
<b>1942</b>											
January	20			8	7						8
February	20			8	8						8
March	20			8	10						8
April	30			16	8						16
May	30			20	9						20
June	30			24	11						24
July	30			26	14						26
August	20			28	16	2					30
September	30			30	19	3					33
October	30			32	22	4	2				36
November	30			34	23	5	2				39
December	30			34	23	6	3				40
<b>Total</b>	<b>330</b>			<b>268</b>	<b>170</b>	<b>20</b>	<b>7</b>				<b>288</b>
<b>1943</b>											
January	30			36	24	8	3				44
February	30			36	23	10	3				46
March	30			36	23	12	4				48
April	30			22	22		3				22
May	30			23	23		3				23
June	30			23	23		3				23
July	30			23	23		4				23
August	30			23	23		4				23
September	40			24	22		4				24
October	40			25	27		7				25
November	40			26	35		4				26
December	40			27	50						27
<b>Total</b>	<b>400</b>			<b>324</b>	<b>324</b>	<b>30</b>	<b>42</b>				<b>354</b>
<b>1944</b>											
January	40			27	45						27
February	40			27	40						27
March	40			27	40						27
April	40			40	30						40
May	40			40	34						40
June	40			40	15						40
July	40			40	14						40
August	40			40	12			1			41
September	40			40	10				1		40
October	40			40	15						41
November	40			40	20						40
December	40			40	28						40
<b>Total</b>	<b>480</b>			<b>441</b>	<b>303</b>			<b>2</b>			<b>443</b>
<b>1945</b>											
January	40			40	40						40
February	40			28	28						28
March	40										
April	40										
May	40										
June	40				6						
July	40				19						
August	40							1			1
<b>Total</b>	<b>320</b>			<b>68</b>	<b>93</b>			<b>1</b>			<b>69</b>
<b>Grand total</b>	<b>1,789</b>	<b>60</b>	<b>60</b>	<b>1,127</b>	<b>913</b>	<b>50</b>	<b>49</b>	<b>3</b>	<b>0</b>	<b>1,240</b>	<b>1</b>

<sup>1</sup> "Capacity" indicates models converted to medium type, single-engine.

<sup>2</sup> Data prior to August 1940 not obtained.

## APPENDIX K

### *Monthly engine production*

	Total capacity <sup>1</sup>	HA-23		HA-31		HA-45		Total	
		Ordered	Produced	Ordered	Produced	Ordered	Produced	Ordered	Produced
<b>1941</b>									
April	20	5						5	
May	25	10						10	
June	25	10	3					10	3
July	25	15	5					15	5
August	25	15	5					15	5
September	30	15	10					15	10
October	35	20	15					20	15
November	35	20	20					20	20
December	35	20	16					20	16
<b>Total</b>	<b>255</b>	<b>130</b>	<b>74</b>					<b>130</b>	<b>74</b>
<b>1942</b>									
January	35	25	20					25	20
February	35	25	15					25	15
March	35	25	15					25	15
April	35	25	18					25	18
May	35	30	20					30	20
June	35	30	15					30	15
July	35	30	17					30	17
August	35	30	26					30	26
September	35	30	32					30	32
October	40	30	30					30	30
November	40	30	25					30	25
December	40	30	30					30	30
<b>Total</b>	<b>435</b>	<b>340</b>	<b>263</b>					<b>340</b>	<b>263</b>
<b>1943</b>									
January	40	25	35		6			25	41
February	40	25	35		6			25	41
March	45	25	20		7			25	27
April	45	25	18	2				25	18
May	45	25	20	3		2		28	22
June	50	25	17	5		6		30	23
July	50	25	20	7		4		32	24
August	60	30	25	8		5		38	30
September	60	30	30	10		9		40	39
October	60	30	31	10		10		40	41
November	60	30	32	10		12		40	44
December	60	30	33	10		14		40	47
<b>Total</b>	<b>615</b>	<b>325</b>	<b>316</b>	<b>65</b>	<b>81</b>			<b>390</b>	<b>397</b>
<b>1944</b>									
January	60	40	35	10	8			50	43
February	70	40	37	10	2			50	39
March	70	40	37	10	6			50	43
April	70	50	50	10	15			60	65
May	85	50	60	8	8			58	68
June	85	60	65	6	5			66	70
July	85	60	70	4	2			64	72
August	2 80	60	22	2	6			62	28
September	0	40						40	
October	10	20						20	
November	30	20						20	
December	50		40		5				45
<b>Total</b>	<b>695</b>	<b>480</b>	<b>416</b>	<b>60</b>	<b>57</b>			<b>540</b>	<b>473</b>
<b>1945</b>									
January	80		65		1				65
February	80		55		4				59
March	100		14		2			2	17
April	120					2	1	5	1
May	3 30					5	1	7	
June	70					7		7	
July	100					10	2	10	2
August	150					20	5	20	5
September						30	6	30	6
<b>Total</b>	<b>730</b>		<b>134</b>		<b>7</b>	<b>74</b>	<b>15</b>	<b>74</b>	<b>156</b>
<b>Grand total</b>	<b>2,730</b>	<b>1,275</b>	<b>1,203</b>	<b>125</b>	<b>145</b>	<b>74</b>	<b>15</b>	<b>1,474</b>	<b>1,363</b>

<sup>1</sup> Capacity is expressed in terms of HA-35, type 95, 350-horsepower engines. Conversion ratio:  $\frac{HA-23}{1}$  equals  $\frac{HA-31}{2}$  equals  $\frac{HA-45}{3}$ .

<sup>2</sup> Capacity drop from August to December 1944 caused by dispersal from Tachikawa to Kanazawa.

<sup>3</sup> Capacity drop from May to July 1945 caused by additional dispersals.

# UNITED STATES STRATEGIC BOMBING SURVEY

## LIST OF REPORTS

The following is a bibliography of reports resulting from the Survey's studies of the European and Pacific wars. Those reports marked with an asterisk (\*) may be purchased from the Superintendent of Documents at the Government Printing Office, Washington, D. C.

### European War

#### OFFICE OF THE CHAIRMAN

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

#### AIRCRAFT DIVISION

(By Division and Branch)

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

#### Airframes Branch

- 6 Junkers Aircraft and Aero Engine Works, Dessau, Germany
- 7 Erla Maschinenwerke G m b H, Heiterblick, Germany
- 8 A T G Maschinenbau, G m b H, Leipzig (Mockau), Germany
- 9 Gothaer Waggonfabrik, A G, Gotha, Germany
- 10 Focke Wulf Aircraft Plant, Bremen, Germany
- 11 Messerschmitt A G, Augsburg, Germany 

}	Over-all Report
	Part A
	Part B
	Appendices I, II, III
- 12 Dornier Works, Friedrichshafen & Munich, Germany
- 13 Gerhard Fieseler Werke G m b H, Kassel, Germany
- 14 Wiener Neustaedter Flugzeugwerke, Wiener Neustadt, Austria

#### Aero Engines Branch

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

#### Light Metal Branch

- 20 Light Metals Industry of Germany 

}	Part I, Aluminum
	Part II, Magnesium

- 21 Vereinigte Deutsche Metallwerke, Hildesheim, Germany
- 22 Metallgussgesellschaft G m b H, Leipzig, Germany
- 23 Aluminiumwerk G m b H, Plant No. 2, Bitterfeld, Germany
- 24 Gebrueder Giulini G m b H, Ludwigshafen, Germany
- 25 Luftschiffbau Zeppelin G m b H, Friedrichshafen on Bodensee, Germany
- 26 Wieland Werke A G, Ulm, Germany
- 27 Rudolph Rautenbach Leichmetallgiessereien, Solingen, Germany
- 28 Lippewerke Vereinigte Aluminiumwerke A G, Lüneburg, Germany
- 29 Vereinigte Deutsche Metallwerke, Hedderheim, Germany
- 30 Duerener Metallwerke A G, Duren Wittenau-Ber & Waren, Germany

#### AREA STUDIES DIVISION

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

#### CIVILIAN DEFENSE DIVISION

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

#### EQUIPMENT DIVISION

##### Electrical Branch

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

##### Optical and Precision Instrument Branch

- 50 Optical and Precision Instrument Industry Report



### Abrasives Branch

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

### Anti-Friction Branch

- 53 The German Anti-Friction Bearings Industry

### Machine Tools Branch

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

### MILITARY ANALYSIS DIVISION

- 9 The Defeat of the German Air Force
- 0 V-Weapons (Crossbow) Campaign
- 1 Air Force Rate of Operation
- 2 Weather Factors in Combat Bombardment Operations in the European Theatre
- 3 Bombing Accuracy, USAAF Heavy and Medium Bombers in the ETO
- 4 Description of RAF Bombing.
- 4a The Impact of the Allied Air Effort on German Logistics

### MORALE DIVISION

- 4b The Effects of Strategic Bombing on German Morale (Vol. I & Vol. II)

### Medical Branch

- 5 The Effect of Bombing on Health and Medical Care in Germany

### MUNITIONS DIVISION

#### Heavy Industry Branch

- 6 The Coking Industry Report on Germany
- 7 Coking Plant Report No. 1, Sections A, B, C, & D
- 8 Gutehoffnungshuette, Oberhausen, Germany
- 9 Friedrich-Alfred Huette, Rheinhausen, Germany
- 0 Neunkirchen Eisenwerke A G, Neunkirchen, Germany
- 1 Reichswerke Hermann Goering A G, Hallendorf, Germany
- 2 August Thyssen Huette A G, Hamborn, Germany
- 3 Friedrich Krupp A G, Borbeck Plant, Essen, Germany
- 4 Dortmund Hoerder Huettenverein, A G, Dortmund, Germany
- 5 Hoesch A G, Dortmund, Germany
- 6 Bochumer Verein fuer Gusstahlfabrikation A G, Bochum, Germany

#### Motor Vehicles and Tanks Branch

- 7 German Motor Vehicles Industry Report
- 8 Tank Industry Report
- 9 Daimler Benz A G, Unterturkheim, Germany
- 0 Renault Motor Vehicles Plant, Billancourt, Paris
- 1 Adam Opel, Russelsheim, Germany
- 2 Daimler Benz-Gaggenau Works, Gaggenau, Germany
- 3 Maschinenfabrik Augsburg-Nurnberg, Nurnberg, Germany
- 4 Auto Union A G, Chemnitz and Zwickau, Germany
- 5 Henschel & Sohn, Kassel, Germany
- 6 Maybach Motor Works, Friedrichshafen, Germany
- 7 Voigtlander, Maschinenfabrik A G, Plauen, Germany
- 8 Volkswagenwerke, Fallersleben, Germany
- 9 Bussing NAG, Brunswick, Germany
- 0 Muehlenbau Industrie A G (Miag) Brunswick, Germany
- 1 Friedrich Krupp Grusonwerke, Magdeburg, Germany

### Submarine Branch

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

### Ordnance Branch

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

### OIL DIVISION

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

### Oil Branch

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

### Rubber Branch

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

### Propellants Branch

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

### OVER-ALL ECONOMIC EFFECTS DIVISION

- 134 Over-all Economic Effects Division Report  
Gross National Product----- } Special papers  
Kriegsceilberichte----- } which together  
Hermann Goering Works----- } comprise the  
Food and Agriculture----- } above report
- 134a Industrial Sales Output and Productivity

### PHYSICAL DAMAGE DIVISION

- 134b Physical Damage Division Report (ETO)
- 135 Villacoublay Airdrome, Paris, France
- 136 Railroad Repair Yards, Malines, Belgium
- 137 Railroad Repair Yards, Louvain, Belgium
- 138 Railroad Repair Yards, Hasselt, Belgium
- 139 Railroad Repair Yards, Namur, Belgium
- 140 Submarine Pens, Brest, France
- 141 Powder Plant, Angouleme, France
- 142 Powder Plant, Bergerac, France
- 143 Coking Plants, Montigny & Liege, Belgium
- 144 Fort St. Blaise Verdun Group, Metz, France
- 145 Gnome et Rhone, Limoges, France
- 146 Michelin Tire Factory, Clermont-Ferrand, France
- 147 Gnome et Rhone Aero Engine Factory, Le Mans, France
- 148 Kugelfischer Bearing Ball Plant, Ebelsbach, Germany
- 149 Louis Breguet Aircraft Plant, Toulouse, France
- 150 S. N. C. A. S. E. Aircraft Plant, Toulouse, France
- 151 A. I. A. Aircraft Plant, Toulouse, France
- 152 V Weapons in London
- 153 City Area of Krefeld
- 154 Public Air Raid Shelters in Germany
- 155 Goldenberg Thermal Electric Power Station, Knapsack, Germany
- 156 Brauweiler Transformer & Switching Station, Brauweiler, Germany
- 157 Storage Depot, Nahbollenbach, Germany
- 158 Railway and Road Bridge, Bad Munster, Germany
- 159 Railway Bridge, Eller, Germany
- 160 Gustloff-Werke Weimar, Weimar, Germany
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