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THE UNITED STATES
STRATEGIC BOMBING SURVEY

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No. 1

EFFECTS OF AIR ATTACK
ON
OSAKA—KOBE—KYOTO

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Urban Areas Division
June 1947

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*U. S. Strategic Bombing Survey
"Reported" (original) 58*

THE UNITED STATES
STRATEGIC BOMBING SURVEY

EFFECTS OF AIR ATTACK
ON
OSAKA—KOBE—KYOTO

Urban Areas Division

Dates of Survey:

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This report was written primarily for the use of the U. S. 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.

PREFACE

The accompanying report includes three urban area studies dealing with Osaka, Kobe and Kyoto, the principal cities of the Osaka region. Osaka was, after Tokyo, Japan's most important administrative and industrial center. Like Osaka, Kobe was included among the five key metropolitan areas subjected to mass incendiary attacks between 9 March and 15 June 1945. Kyoto was the only major Japanese city still intact when hostilities were ended on 14 August 1945. The reports attempt to provide an integrated view of the economic life of these three cities before and during the period of B-29 operations, with particular attention to the direct and indirect consequences of area attacks.

Practically all material incorporated in these city reports was obtained on the spot by USSBS field teams during November and December 1945. Detailed questionnaires, covering the period October 1943–August 1945, were distributed for completion by municipal and prefectural authorities, by other appropriate public agencies, and by a broad representation of industrial units in Osaka, Kobe, and Kyoto, and in all other bomb-damaged cities in this region. To supplement the basic statistical data thus acquired, members of the field team carried out a program of interviews and special investigations in each city on the major topics covered in the final reports.

Upon completion of the field investigations, all members of the Osaka team participated in the preliminary organization of material at USSBS headquarters in Tokyo during late December 1945 and January 1946, and half the members

returned to Washington to complete this work with the help of other personnel. Processing and statistical analysis of the factory production questionnaires was handled after arrival in Washington by a special staff of the Urban Areas Division and by the Statistical Analysis Division of the Survey. Results of this effort have been used along with other material to determine production trends and assess the effects of air attack on the urban economies of the Osaka region. A detailed description of these standard factory questionnaires and the analytical procedures applied is presented in the Urban Areas Division's summary report (USSBS Report No. 55). In addition to this latter report, which deals with effects of air attack on the urban economy of Japan as a whole, detailed urban area reports have also been prepared on the Tokyo-Kawasaki-Yokohama complex (USSBS Report No. 56), on Nagoya (Report No. 57), Nagasaki (USSBS Report No. 59) and Hiroshima (USSBS Report No. 60).

Specific reference will be found throughout this volume to other USSBS reports dealing with various phases of the war production program and with such related problems as morale, labor, and over-all policy. In such reports and in the USSBS archives there is a substantial amount of material dealing with the cities and industries of the Osaka region during the war period. A considerable part of this material—both factual and interpretive—was consulted in the assessment and final organization of data, collected by the Urban Areas team for the studies in this volume.

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INTRODUCTION AND SUMMARY

The Osaka region includes Osaka, Kobe and Kyoto—three of Japan's six major cities—and a number of smaller war production centers. As with the rest of Japan proper, air operations against this region had their impact on an economy already under great strain as a result of inadequate skilled labor, materials and industrial equipment of all types. Furthermore, because of basic changes in Japan's strategic position and severe declines in availability of raw materials, this seriously weakened industrial system was undergoing a fundamental transition. Prior to initiation of air attacks, it was changing from a maximum-level war economy, emphasizing production of such slowly-completed offensive war items as aircraft carriers, tanks and heavy ordnances to a "cyclone-cellar" economy concentrating on production of essential items for defense of the home islands.

In the absence of advanced planning these problems of transition exposed serious organizational and economic weaknesses even before B-29 operations began to test Japan's capacity to take punishment. Our initial strategic air attacks from the Marianas forced wholesale dispersal and reorganization of aircraft and related production, putting new claims on the country's overburdened internal transport system and her rapidly-disappearing stocks of general machinery, electrical equipment, building materials, etc. It is against this background that U. S. attacks on Japanese urban areas must be assessed. These attacks not only crippled efforts to complete readjustments which would permit sustained output of the most urgent war items at reduced level, but also caused enormous losses of industrial equipment and production resources. The most compelling result of mass attacks, however, was the effect on the urban populations and on the pattern of government and business controls.

Disruption of housing, public utilities and essential supporting services occurred on so vast a scale that organized effort was paralyzed. Japan's evident inability to maintain essential activity and effectively resist our air power swept away all hope of victory. Under the conditions which existed by July 1945 it was obvious that continued resistance promised nothing but additional punishment. The war had, indeed, been brought home to the enemy.

THE OSAKA REGION

The Osaka region covers a broad cross-section of central Honshu, the main island of Japan. It includes seven of the country's basic political subdivisions corresponding to our states, and three of its six principal metropolitan areas. The eastern tier of four prefectures bordering the Nagoya region was relatively unimportant from an economic or strategic standpoint. Fukui prefecture, on the north coast of the island, is a mountainous area with one sizable inland trading center—the capital city of the same name—and the Japan Sea port of Tsuruga, which rose to considerable importance as a transshipping point during the last months of the war. Shiga prefecture includes the rich Lake Biwa agricultural basin east of Kyoto but, despite the existence of several large textile mills, had no significant role in war industry. Nara prefecture, south of Kyoto and east of Osaka, was likewise of little strategic interest, although important for the region's food requirements. Wakayama prefecture included much of the rugged Kii Peninsula southeast of Osaka, but aside from a few fishing ports and two oil refineries all economic activity there was concentrated in the capital city. Two large branch factories of war plants in Osaka and Kobe had been established in Wakayama City and these, along with port facilities and other industry, enhanced its target importance. Fukui, Tsuruga and Wakayama were the only towns in these four outlying prefectures included in the Twentieth AF incendiary program against secondary urban centers during the last eight weeks of the Pacific war. Precision attacks on the two oil refineries south of Wakayama complete the record of air operations in these sections, aside from fighter sweeps and scattered "last-resort" bombings.

Kyoto prefecture included the ancient capital city with its large population and considerable industrial developments as well as the Maizuru Naval Base—a secondary installation from the standpoint of naval shipbuilding but the country's major convoy control point and operating base on the Japan Sea. Neither Kyoto nor Maizuru received any scheduled attacks, although B-29s repeatedly mined the coastal waters between Maizuru and Tsuruga. Aside from a few military installations and one aircraft assembly plant, out-

lying districts of Kyoto prefecture had developed few war industries. Dispersal activities from Osaka and Nagoya into the many textile mills near Kyoto City and into "bomb-proof" rural sites were intensified during 1945 but had not progressed far prior to the attack period.

Hyogo prefecture, the westernmost in the region, cut completely across the island and was of considerable strategic interest, but practically all its war industry was concentrated in a narrow belt along the Inland Sea west of Osaka. The 15-mile coastal strip between Kobe, the prefectural capital, and Osaka was almost continuously built up. Directly adjoining Osaka City was the heavy industry town of Amagasaki, and war plants dotted the district to the north as well as the chain of suburban developments stretching west to Kobe. Along with Kobe, all these towns facing Osaka Bay suffered considerably from incendiary attacks. Amagasaki was damaged as a part of the last urban raid on Osaka: Mikage, Ashiya and Nishinomiya were hit in the urban area operation against the latter city and in the last Kobe attack.

West of Kobe along the Inland Sea were two other urban area targets—Akashi, with its aircraft and other war plants, and Himeji, important industrial and trading center for the Harima district of the Inland Sea coast. Textile mills in Himeji had been converted to aircraft assembly and other war production and the adjoining port town of Shikama included several chemical and basic metal plants. Directly to the west at Hirohata was Japan's newest integrated steelworks, a major element in the basic industry of the region: and several large fabricating, chemical and electrical equipment enterprises had been established near by. There was one important ordnance plant and a chemical works along the coast between Himeji and Akashi, but otherwise practically all manufacturing activity west of Kobe was crowded into the towns already mentioned. Except for the Hirohata steelworks these enterprises all depended heavily upon materials and components supplied from Kobe and Osaka.

Thus in Hyogo prefecture, there was considerable war industry located outside the capital city. Except for aircraft assembly and basic steel production, this represented a small part of the total. Also, the activities of practically all manufacturing units located in the secondary cities of Hyogo prefecture were intimately related to oper-

ations performed in Kobe and in the regional metropolis, Osaka. Like Kobe, Osaka's immediate neighbor, Amagasaki, had large basic industry and end-product plants and the other suburban towns along the bay between Osaka and Kobe contained a large number of war production units. All of this activity was highly integrated and, aside from aircraft assembly plants in Akashi and Himeji, end-product industrial activity elsewhere in the prefecture was relatively insignificant. Even if the 1945 dispersal program had been successfully completed, there still would have been a high degree of concentration in congested urban centers.

Osaka prefecture, unlike other sections of the region, did not include extensive unpopulated mountain areas. Its boundaries were confined to the rich agricultural plain which surrounded Osaka City to the north, east and south, and it was dotted with satellite towns. An elaborate network of roads and electric interurban lines linked these suburbs with the city itself. A number of large war plants had developed in suburbs around the city and along Osaka Bay to the south, although Sakai, directly south of Osaka, was the only large satellite town within the prefecture. As already indicated, Amagasaki and other suburbs in Hyogo prefecture to the west were also closely linked to Osaka.

In aircraft, shipbuilding, ordnance, machinery, electrical equipment, and other industrial fields essential to Japanese war production, the Osaka region had a vital responsibility. With few exceptions, end-product and supporting industries were located in the region's principal urban centers.

Japan's aircraft industry was well represented in the Osaka region, although both the Nagoya and Tokyo regions were relatively more important in this field. Two major aircraft concerns had their principal operations here. Three Kawasaki airframe and subassembly plants were located between Osaka and Kobe and the company's fourth unit was established in Himeji. Principal Kawasaki engine and airframe operations were concentrated just west of Akashi and this company also operated large component plants in Kobe, Sakai, and the Osaka suburbs.

Late in 1944, Mitsubishi Aircraft began to expand its parts production in Kyoto and to undertake wholesale transfer of engine assembly plants

into that city from Nagoya. Japan International Aircraft also operated parts plants in Kyoto to serve its assembly unit just south of the city and was building light engines for trainers in Amagasaki. For the war period as a whole, the Osaka region was credited with about 25 percent of combat aircraft production and about 20 percent of engine output. Of great importance for Japan's total air effort were the two Sumitomo aircraft propeller plants in Osaka and neighboring Amagasaki which, together, supplied 40 percent of Army combat propellers and virtually all of those required for Navy planes. Most of the components and fabricating plants which supported this activity were located in the region's three principal cities and these also contributed to the final assembly plants in Nagoya and elsewhere in Japan.

Shipbuilding was also a major industry in the Osaka region. Shipyards here accounted for about 28 percent of Japan's new construction and major repairs during the war period, almost 16 percent of the total being performed in Kobe and 11 percent in Osaka. On a tonnage basis, additions to the Japanese Navy represented only one-tenth of wartime merchant shipbuilding but this fraction was relatively much more important in terms of cost and strategic value. The Osaka region turned out 22 percent of all naval construction. Almost 40 percent of all wartime additions to the Japanese Navy were constructed at naval bases located outside this region, but private yards in Kobe and Osaka each accounted for 10 percent of the total with the rest of the region's share being built at the Maizuru Naval Base.

Thus both in naval and merchant shipbuilding, the Osaka region had a major position. Except for the Maizuru Naval Base and one yard in Amagasaki, all these facilities were concentrated in Osaka and Kobe. This region also had an important part in the wartime program for construction of small wooden vessels. Roughly a fifth of all boatways and all tonnage launched in this category were in the Osaka region and an even higher proportion of the engines required for such craft were produced here. These small boatyards were scattered among small harbors throughout the main islands of Japan. Osaka City was the only point where a considerable amount of such building was concentrated in one town and this metropolis also had many small producers

of gas and diesel engines for boats built in this region and elsewhere along the Inland Sea.

The Osaka region was somewhat less important in the field of ordnance. Except for the Maizuru Base, there were no major naval establishments or arsenals located here but Osaka and surrounding suburbs included many private plants supplying ordnance items, mines and similar material to the Navy. The Osaka Army Arsenal was one of the largest ground ordnance establishments in the Empire and, with its near-by branch plants and private subcontractors, accounted for almost one-fifth of all Army requirements. Two large shell-loading plants were located south of Kyoto and the production of ordnance components and air armament items was carried on in that city and in all centers around Osaka Bay.

The considerable development of aircraft and ordnance components production in cities of this region was a logical outgrowth of the prewar industrial pattern. Osaka had been the machinery and general equipment workshop for Japan and this position had been reinforced by the large heavy industries of Kobe and the many light precision machinery enterprises of Kyoto. Roughly a third of Japan's wartime capacity for making machine tools and general industrial equipment was located in this region—by far the greater part of it in Osaka. Similarly, 24 percent of Japanese electrical equipment production originated here, with 14 percent concentrated in Osaka City, seven percent in Kobe, and the balance in Kyoto.

Approximately the same pattern of regional importance and urban concentration existed in such other auxiliary fields as industrial rubber products and in drugs and general chemicals. In the field of basic metals, the region was relatively unimportant for preliminary ore reduction and refining. But Osaka was a major fabricating center for non-ferrous metals refined elsewhere. A similar pattern existed in iron and steel. Except for the new integrated iron and steel mill near Himeji, the region's basic steel production was less extensive than the forging, rolling and fabricating activities carried on at Osaka, Kobe and Amagasaki. About 6 percent of the country's open-hearth steel capacity was located in Kobe and almost as much more in Osaka and Amagasaki, but in order to economize on transport, iron and steel production was increasingly concentrated elsewhere.

Much of the region's importance for basic manufacturing and for military end-products was an outgrowth of its central position for Empire as well as Home Island communications. Kobe was the connecting point for Japan's key east-west rail lines and had been Japan's major prewar overseas port. Osaka, even more than Kobe, took on added importance as a wartime transshipment point for overseas military supplies as well as for imports of vital raw materials.

To an increasing extent, all through the war, military agencies used Osaka as a center for final inspection, packing and storage of outbound military shipments. Even during 1945, when convoy traffic was no longer feasible from Osaka, much of the military supplies destined for the support of forces overseas or in Western Honshu and Kyushu were assembled here and then forwarded by rail.

In this process of handling inbound and outbound transshipments during the war, there was steadily growing participation of Osaka's industry as well as its warehouses and port facilities. After direct waterborne traffic to Tokyo and Nagoya had to be halted in order to avoid submarine losses, many additional minor but essential processing operations came to be performed in Osaka. This development considerably extended the utilization of Osaka's many small factories and workshops, although these already had a vital role in subcontracting for major war plants in and around Osaka City.

The network of rail lines around Osaka included many local interurban routes as well as the east-west trunk lines already mentioned. In addition, there were cross-island routes leading to the Japan Sea coast from Kyoto, Osaka, Kobe, and Himeji. Like the main east-west lines, however, their traffic was dependent, to a major extent, upon a single marshalling yard in Osaka's northeast outskirts—the largest in Japan. Especially after traffic through the Inland Sea had been cut down by B-29 mining, main-line rail traffic was severely strained at this point. A most serious problem toward the end of the war was the adequate maintenance of railway rolling stock. The region's facilities for new construction and repair were concentrated in a few large units that sustained heavy damage in area attacks on Osaka and Kobe. Except for the internal damage and dislocation within these two cities, a considerable amount of freight haulage could have been main-

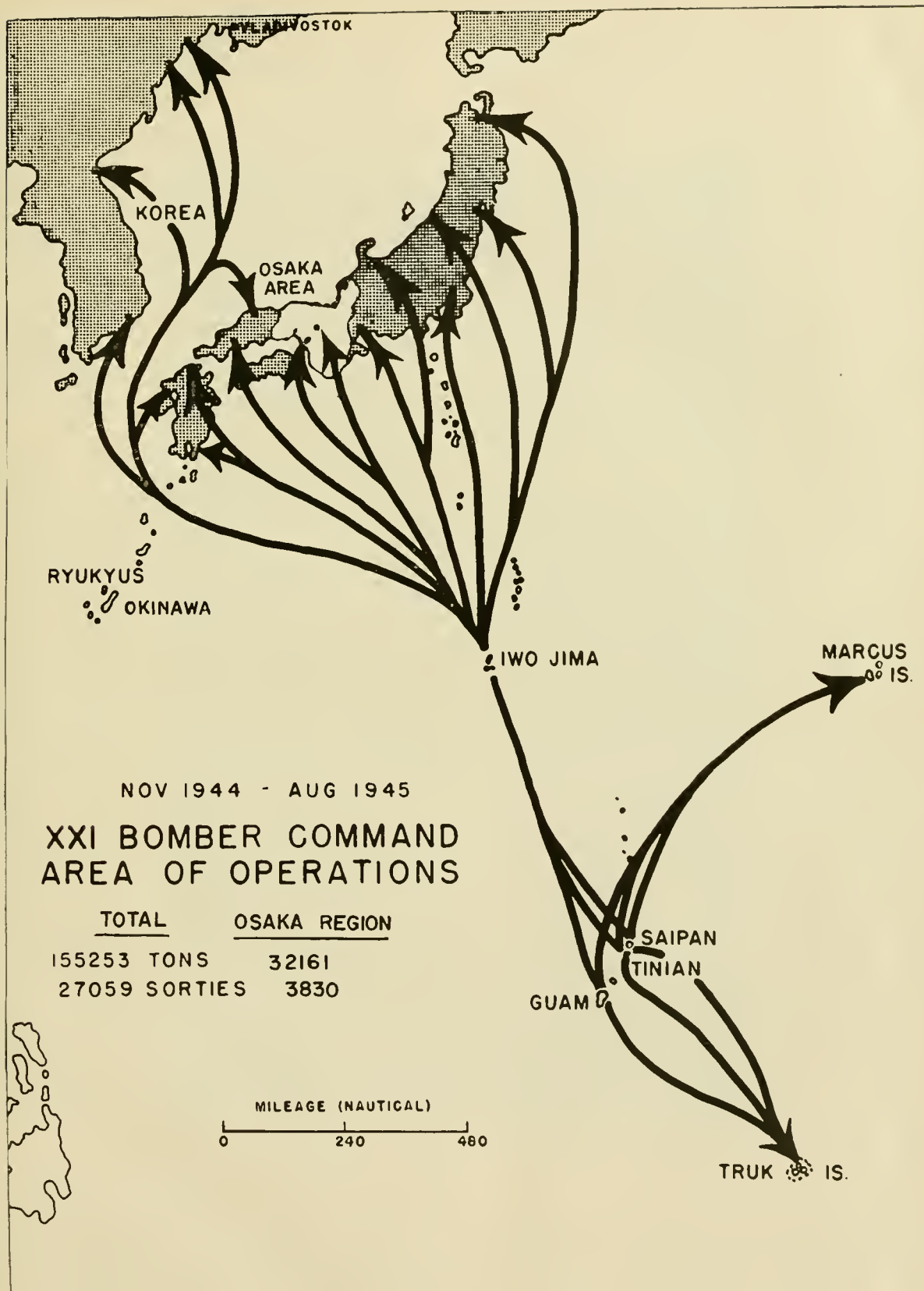
tained despite trunkline rail interruptions and mining through use of interurban rail routes and lighters and other small wooden craft along the Inland Sea coast. These normally important elements in local and inter-city traffic proved highly vulnerable in the general breakdown of urban functions.

This section has outlined the pattern of economic concentration in the Osaka region and its general contribution to the Japanese war economy. Both in terms of military end-products and supporting industrial activity, the role of the large urban centers has been stressed. Their administrative importance was equally great. Aside from a few aircraft assembly plants, generally situated outside the urban areas, these industrial concentrations presented the region's most attractive targets for Air Force planners, especially for incendiary bombing. The following section outlines the development of B-29 operations against the Japanese homeland and the role of urban area and other attacks in the Osaka region.

U. S. Air Effort against the Osaka Region

Aside from a few tactical sweeps during the last weeks of the war by fighters from Iwo and from Navy carriers, all U. S. air operations in the Osaka region were conducted by the Twentieth AF with B-29s based in the Marianas. Map 2 gives a general picture of the operation area and indicates the relative weight of effort aimed against the Osaka region. Targets in this region included urban areas, aircraft plants, petroleum refineries, and one arsenal. Mining campaigns were also carried out in the Inland Sea and Japan Sea approaches to the region's ports.

B-29 operations were initiated from the Marianas toward the end of November 1944 but the main effort did not get started until March 1945. During this preliminary period of training and organization, 20 missions were carried out against the Japanese homeland. Sixteen were precision attacks on priority aircraft plants and four involved trial use of incendiaries against industrial concentrations and congested urban areas. One high-explosive mission hit the Kawasaki aircraft plant located at Akashi, just west of Kobe, early in January 1945 and one test incendiary raid hit a waterfront industrial area in Kobe on 4 February. Otherwise, the Osaka region escaped Twentieth AF attentions, except for occasional reconnaissance missions, until the second phase of our



operations was initiated on 9 March. By that time, B-29 strength in the Marianas had been built up from 119 to 385, despite relatively high losses, and enough munitions had arrived to permit a trial of the mass incendiary technique against Japan's major urban concentrations.

Between 10 and 20 March four key industrial and administrative centers were hit in large-scale low-level incendiary attacks—Tokyo, Nagoya, and the main war production cities of the Osaka region, Osaka and Kobe. The success of these missions produced an immediate reorientation of the Twentieth AF strategic plan. The following quotation from an official operations summary emphasizes the revolutionary change in cost factors as well as in the results achieved. Previous high-altitude daylight missions had been plagued by air opposition and weather problems affecting bombing accuracy, and loss ratios had averaged more than five percent.

In just ten days, the entire picture changed. Flying individually, bombing at night from altitudes averaging 7,000 feet, the B-29s burned a path of destruction through the four principal cities of Japan. Thirty-two square miles of the most potent war industry concentrations were destroyed. In that ten days, the XXI Bomber Command, with an average of 380 assigned aircraft, flew 1,535 sorties (75 percent as many as had been flown in the preceding 3½ months), delivering 9,365 tons of incendiary bombs (three times the tonnage dropped in the preceding 3½ months), at a cost of .9 percent of the participating crews, the lowest loss rate yet attained.

The conclusion to be drawn from this "blitz" and the implications for future planning were inescapable. By lowering the bombing altitude, the effectiveness of each B-29 was increased tremendously. Bomb loads more than doubled; using radar methods, the weather ceased to be a serious factor; the number of aircraft dropping on the primary target soared from 58 percent to 92 percent; enemy fighter opposition was negligible; decreased bombing altitude meant less operating strain which added up to more sorties per aircraft; crew morale rose with each attack and Iwo Jima provided a refuge for the battle-damaged and those low on fuel.

Japan's urban industrial concentrations had been proved highly vulnerable to destruction by incendiary attack. After a careful analysis of the bombing results, preparations were made immediately for an extensive incendiary effort against the remaining important industrial areas of Japan with a view toward forcing her surrender prior to invasion day.

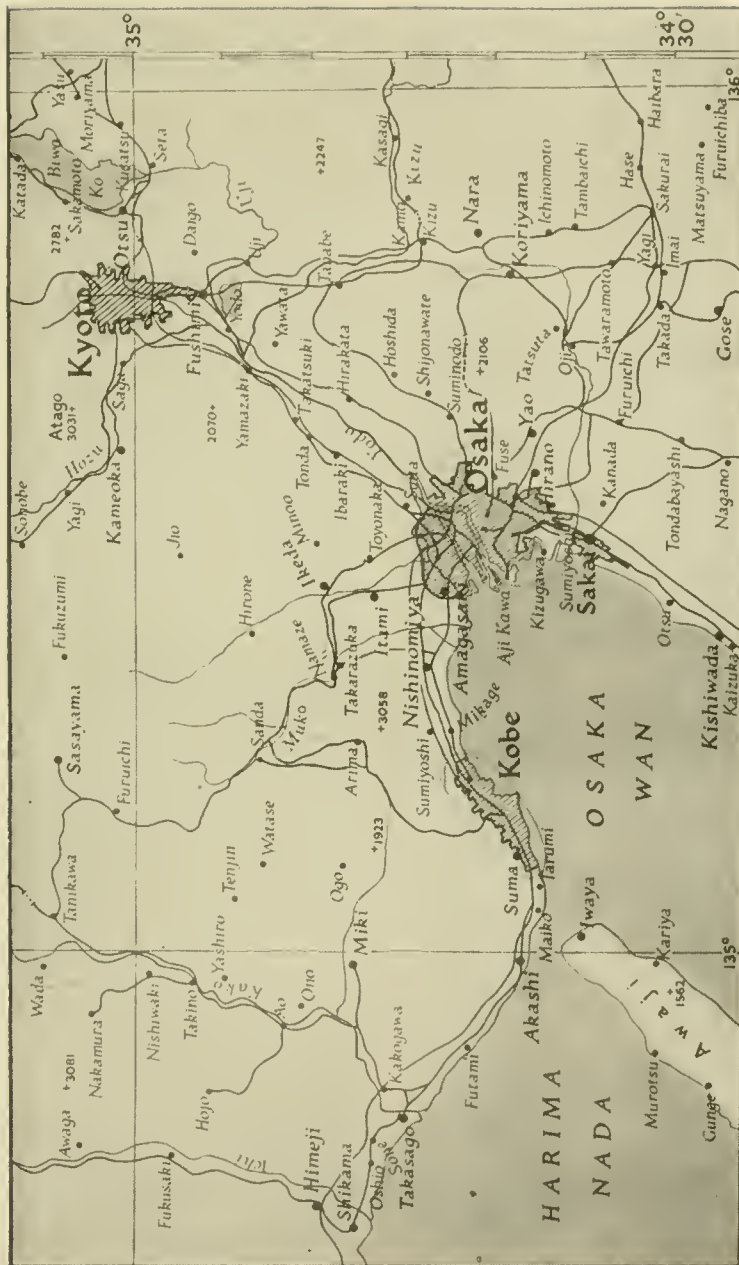
The basic plan of subordinating strategic bombing to the projected surface invasion could not be altered, but the place of urban attacks was now firmly established in operational planning. To

quote again:

During periods when the weather forecast of Japan indicated a reasonable chance of visual bombing conditions, attacks were scheduled against key industrial objectives with high-explosive bombs and, when visual bombing conditions were not indicated by forecast weather, the urban industrial areas were attacked with incendiary bombs, employing radar bombing methods. Thus two parallel systems of targets were developed: the key industrial objectives such as aircraft plants, arsenals, oil installations and marshalling yards as one system, and the urban industrial concentrations as the other. The war began to assume "short term" aspects. General LeMay believed that all-out air attack could force Japan to surrender prior to the planned invasion and, at the calculated risk of exhausting all available crews, he committed the command accordingly. In accordance with this plan, every effort was made to expedite the shipment of large quantities of incendiary munitions from the U. S. to the Marianas bases.

Subsequent strategic operations by the Twentieth AF can be grouped in six partially overlapping phases: completion of the urban attack program against the main industrial centers; extension of the incendiary program to smaller cities; mining of coastal waters and key harbors; continued policing of the aircraft industry; precision attacks on other industries regarded as essential to preparations for invasion; and, finally, the atomic bomb attacks. Until the last 8 weeks of the war, the timing of these operations was drastically affected by the chronic shortage of incendiary bombs and the necessity of diverting effort to support the Okinawa invasion. Thus, the urban area program against key cities could not be completed until 15 June—more than three months after initiation. This delay was most serious in the case of the Osaka and Kobe schedule, where more than seventy-five days intervened between attacks. Some mines were dropped at the end of March but the main program to interdict Inland Sea and Japan Sea shipping was not initiated until May. Exceptionally favorable weather in June made it possible to mount twenty daylight formation high explosive attacks that month, but only one was possible during July and only three days could be so used before the surrender in August.

During the intensive period of operations—9 March to 14 August 1945—approximately twenty-two percent of Twentieth AF effort was devoted to precision high explosive attacks, almost seventy percent to urban attacks, and the balance to min-



ing and to Kyushu airfield attacks in support of Okinawa. Urban attacks represented seventy-five percent of all efforts against the Osaka region, but munitions shortages forced delay of this program until the last ten weeks of the war. After the single attacks on Osaka and Kobe in March, these cities were not again disturbed until June. About half the total damage was thus not achieved until a two and one-half months' period of grace had been provided these cities for reorganization and dispersal. Especially in Osaka, most of the larger industrial facilities were still intact after the single March raid.

During the last eight weeks of the war, B-29 strength reached more than twice the level prevailing in March and ample incendiary bombs were finally available. In this period over 8,000 sorties, lifting 54,000 tons, were dispatched against secondary urban centers. This effort compared with 6,960 sorties, lifting 41,600 tons, against the five major urban centers during the 9 March-15 June period. Seventy-six square miles of built-up urban areas were burned in the secondary series representing the substantial destruction of fifty-two cities and partial damage to six others.

Seven missions were dispatched to secondary cities in the Osaka region and, in each case, the level of damage was sufficient to eliminate the planned target area from further consideration. Nine hundred forty-seven aircraft participated, dropping 7,480 tons of incendiaries, and only two planes were lost. These attacks were all carried out from three to six weeks before the surrender.

Before final appraisal of the B-29 program against major Japanese centers, brief comment is required on precision attacks in the Osaka region. Of high explosive attacks, six were directed against five aircraft assembly plants—one early in January and the others during June 1945; three petroleum refineries were hit—one in Amagasaki and the others near Wakayama—toward the end of the campaign; and the Osaka Army Arsenal and Sumitomo aircraft propeller and metal fabricating complex were targets on three occasions between 24 June and the surrender. Together with almost 100 mining sorties, the 1,200 sorties against these targets complete the list of operations in the Osaka region. As already mentioned, 947 sorties were involved in the secondary urban attacks, and 1,585 participated in the Osaka and Kobe urban attacks. Altogether, attacks on this region involved one-fifth of all tonnage dropped

on Japan but only one-seventh of all B-29 sorties.

The initial precision attacks against aircraft assembly plants in this region were highly effective. The one follow-up attack—at Akashi—was unnecessary since operations there had been abandoned in favor of other dispersed sites. Except for this one plant, which was attacked early in January 1945, precision operations were mounted only after the indirect effects of area attacks and dispersal efforts had already considerably reduced output. This program was effective in virtually eliminating final assembly activities at the region's main units.

The refinery attacks caused a great deal of physical damage but did not affect the Japanese fuel position. Two refineries depended entirely on imported crude and had already been reduced to nominal status, and efforts to produce synthetic fuel at the Amagasaki unit had not proved significant. Spillover damage was extensive in this attack but mainly affected power plants and a steel mill already idle as a result of the decline in activity after the March area attacks and the concentration of remaining steel production elsewhere. Three precision attacks were directed against the Osaka Army Arsenal and the Sumitomo aircraft propeller and metal fabricating complex in Osaka. The 26 June attack was largely ineffective due to cloud conditions which forced use of radar under highly unfavorable circumstances. The 24 July attack caused very extensive damage to the Sumitomo complex and moderate damage to the arsenal. A final effort against the arsenal on the last day of the war was highly successful from the standpoint of physical damage, but the March and June urban attacks had reduced activity to a small percentage of the previous level long before these precision operations. Similarly, operations had ceased at the Sumitomo propeller works prior to the effective 26 July attack and reduced output at dispersal sites was already under way. Steel and light metals fabricating here was brought to a standstill by this attack and would have crippled aircraft and ordnance output if the war had continued.

In contrast to the petroleum attacks, the mining problem in the approaches to Osaka and Kobe and elsewhere in the Inland Sea, had an immediate and serious effect on bulk commodity movements essential to local industry. Efforts to divert mainland imports through harbors on the north coast were also frustrated to a considerable extent.

The consequences on war production would have been much more decisive had not urban attacks already reduced industrial production and requirements.

The attacks on secondary urban centers, like those on most of the precision targets, came so close to the cessation of hostilities and after other elements had already begun to reduce activity that it is difficult to determine their actual and potential impact. Precision attacks on aircraft plants at Akashi and Himeji had already reduced aggregate war production considerably before the urban attacks. Sakai and Himeji, in particular, had already felt the effects of urban attacks on Osaka and Kobe. But whether measured by power consumption or by contribution to war production, the secondary cities were relatively unimportant except for a few distinct factories. Under conditions existing by July 1945, it is clear that the impact of these secondary urban attacks had as much psychological and political significance as it did direct effect on aggregate war production throughout the region.

Effects of Urban Attack on Osaka

Osaka, with a 1940 population of 3.2 million, ranked after Tokyo as Japan's leading industrial and commercial center. With a total of 16,155 registered factories and workshops and an industrial labor force of 505,000 before the March bombings, Osaka was regarded as particularly important for aircraft components, ordnance, marine engines and shipbuilding, machine tools and general machinery. Although no aircraft assembly plants were located within the city more than one-fourth of Osaka's industrial workers in some 4,600 factories and workshops contributed directly to the aircraft industry. Two thousand and four hundred manufacturing units employing more than a fifth of the industrial labor force contributed to ordnance production while 1,000 concerns and a sixth of all industrial workers were related to shipbuilding.

An additional 12 percent employed by 1,800 shops were engaged in machinery and metal fabricating work not exclusively assignable to one of the three war industries previously mentioned. In addition to the more than 75 percent of all industrial labor thus accounted for, such priority items as electrical equipment and instruments, industrial belting and butyl alcohol loom impor-

tautly among the wide range of manufacturing for military and civilian use performed by Osaka's remaining 6,200 registered factories and workshops.

Many of these manufacturing units were very small. More than 9,000 of the 16,000 in operation before the March attack employed less than 10 productive workers each and accounted for only 10 percent of total industrial employment. On the other hand 46 concerns with more than 1,000 workers each (including the Osaka Army Arsenal with more than 38,000) together employed a third of the city total. From the standpoint of area attacks, the critical element in this industrial pattern is the very widespread dependence of large and middle-sized concerns on components and maintenance items supplied by Osaka's small producing units. The disruption of this complex and highly vulnerable pattern is generally agreed to have been one of the most crucial results of our attacks.

Altogether some 4,200 industrial structures are officially listed as destroyed or seriously damaged in the 14 March attack, which burned out more than 8 square miles in the heart of the city, killed almost 4,000 inhabitants and deboused 500,000. Almost 2,000 factories and more than 50,000 employees were removed from police rolls at once, but during the 10-week period before Osaka was again attacked, another 1,700 manufacturing units were found to be completely out of operation, and an additional 16,000 workers were dropped from payrolls. Of more importance than the number of individuals carried on payrolls is the drop in attendance rates, since workers who failed to report after attacks were normally carried for a month or two by concerns still in business. Attendance in most plants prior to bombing had varied between 80 and 90 percent, with a city-wide average of 82 percent. Although the March attack did not take place until the 14th, average attendance rates for the city as a whole dropped to 71 percent with no subsequent improvement. In terms of manpower actually available, the average number appearing for work in March dropped to 10 percent of the previous normal in the most heavily hit district (reflecting shutdowns as well as evacuation) and to 80 percent in near-by industrial sections which drew on such districts for labor. By May, attendance figures were only 12 percent of the pre-bombing normal in the hardest

hit district of the city as against 86 percent in those near by. Employment actually increased during the raid period at many priority suburban plants. Ordnance factories in particular managed to maintain a preferred position until the surrender.

Industrial power consumption offers the best available measure of what effects the physical damage, absenteeism, and disruption of the production structure resulting from area attacks had on industrial output. With a considerable but normal seasonal fluctuation, monthly industrial power consumption in Osaka City had remained from late 1943 through November 1944 at around 76 million KWH. After a slight increase in December 1944, there was a drop to 72 million KWH in January and to 69 million in February, reflecting seasonal power stringency as well as the first marked decline in activity. Although there were two weeks of normal operations before Osaka was attacked on 14 March, industrial power consumption for the whole month amounted to only 52 million KWH and the figure for April was slightly less. Lack of further bombing provided still another month for indications of recovery, but May consumption was only 51 million KWH.

Similarly, industrial gas consumption, which had averaged 12 million M³ per month until mid-1944 and then declined gradually to 10½ million by February 1945 under a rationing system that eliminated all consumers except those contributing directly to priority war items, dropped to 7½ million M³ in March and remained practically the same in April and May. To summarize, this mid-month raid in March was followed by roughly a 25 percent drop in the monthly average of industrial consumption for gas and electric power with no appreciable recovery during the following two and one-half months when no attacks occurred.

The June attacks on Osaka extended the area of damage beyond the 8 square mile central section of the city into the heavily industrialized districts to the southwest, west, north and northwest. A total of 8,538 tons were dropped on 1, 7, and 15 June, burning out slightly less than 8 square miles, killing about 5,650 and debousing an additional 500,000. As in the case of gross damage area, the number of industrial structures listed as destroyed in these three attacks was slightly less than the March figure—4,200. In terms of floor-

space destruction to larger plants, these missing were far more effective. Of ten million square feet of industrial roof area (as measured from aerial photographs) destroyed in Osaka by urban attacks, almost 9 million was destroyed in June. Among major categories, aircraft propellers, ship-building and marine engines were most severely affected. In terms of current output the very heavy decline in electrical equipment, machinery and components which was enforced by direct plant damage, deserves consideration. Along with general damage to production equipment this deflected all prospects for carrying through effective dispersal and repair of even the most urgent facilities or reorganization of critical subcontracting networks.

Another 2,450 of the city's 12,350 factories and workshops still in operation before 1 June were eliminated from police records that month and an additional 1,300 were scratched in July. Official factory payrolls declined from 439,000 on 1 June to 376,000 at the end of the month with another 70,000 workers being dropped from the records during July. Attendance figures declined accordingly. From a pre-bombing average of 82 percent which dropped to 70 percent after attack, city-wide attendance in June was only 63 percent with a further decline in July to 61 percent.

Monthly industrial power consumption had dropped 25 percent in March after the first area attack with a slight continuing decline in the months of April and May. Industrial gas consumption followed almost exactly the same pattern. The June raids were followed by a less than 20 percent decline for the month from the previous level of industrial power consumption, but a 50 percent drop in the industrial use of gas. In July gas consumption dropped again to 25 percent of the pre-June level and the electric power figure tumbled to 7 million KWH or 16 percent of the pre-June level and 7 percent of the rate prior to the first area attack in March.

Altogether area raids on Osaka destroyed or seriously damaged an estimated 25 percent of total industrial floorspace, some 8,400 industrial structures and 5,000 factory units of all sizes. During the period of January-July 1945, industrial payrolls dropped from 505,000 to 307,000 and average worker attendance roughly from 475,000 to 190,000. The level of general industrial activity as reflected in utility data indicates decisive de-

clines following each attack with no significant recovery.

KOBE ATTACKS

Osaka's experience under area attack differs in several respects from that of Kobe, port and industrial center located 25 miles west at the north-west margin of Osaka Bay. Japan's sixth largest city with a 1940 population of slightly under one million, Kobe had been particularly important as a transshipment point for overseas and coastal traffic but also had large marine engine and shipbuilding enterprises, with related steel fabricating facilities, and major producers of ordnance, electrical equipment and railroad rolling stock and rubber tires. Along with these few large units, there were many small plants engaged in production of machinery and machine tools and components for the aircraft, shipbuilding and ordnance industries. Compared with Osaka, however, Kobe industry was highly concentrated. Two-thirds of the Kobe industrial labor force worked in tea factory units and 80 percent in fifty units employing more than 500 workers each. A third of Osaka's total labor force was in 46 plants but only 41 percent were in units with more than 500 each while 28 percent were in workshops employing less than 50 each. Of some 155,000 registered industrial workers, 57,000 worked in shipyards, 24,000 in metal fabrication, 22,000 produced aircraft components and 18,000 were in ordnance.

A small trial of incendiaries against one Kobe district in February damaged several important factories, but the main attacks occurred on 17 March and 5 June. Some spillover residential damage resulted from operations against nearby objectives on 11 May and 5 August. Altogether 7.2 square miles were burned over with 6,400 inhabitants killed and more than 450,000 deboused. Almost 40 percent of total industrial floorspace was burned out. Industrial labor carried on factory payrolls declined from 188,000 before the attacks to 133,000 in April and 86,000 by the war's end.

Monthly industrial electric power consumption dropped from a pre-attack average of 30 million KWH to 23 million in February (as a result of damage to one major industrial complex) and to 17 million KWH in March. Consumption dropped slightly in April and recovered to 18 million KWH in May during the 13 week lull between attacks, and industrial use of power again

plummeted following the 5 June raid. Consumption that month was 7 million KWH and a further slight decline occurred in July with only 4 million KWH being consumed in August. Physical damage to major plants was very heavy and labor problems seriously reduced prospects for recovery after March.

Conclusion

Against the background of general inadequacies in the Japanese war economy, it is clear that the urban area attacks on Osaka and Kobe had a decisive and continuing effect on the level of industrial activity in these major war production centers. The consequences of these attacks were communicated to other industrial towns in this region with varying force and rapidity in accordance with their relative position in the war production structure.

The area attacks on Tokyo and other major production centers had repercussions on essential activity in Osaka and Kobe, just as production failures there made themselves felt elsewhere. For example, output at the Osaka Army Arsenal, that city's largest producing unit, dropped almost 50 percent from the previous level in April 1945 and continued declining thereafter not because of physical damage or shortages in basic materials but due to the breakdown in its elaborate subcontracting system. Production of anti-aircraft guns, the arsenal's top priority item in 1945, was reduced drastically because fire-control apparatus manufactured in Tokyo was no longer received after the March area attacks on that city.

As was emphasized at the outset, area attacks had their impact on economy dominated by shortages of almost every kind, with no surplus available to use in preparation for or adjustment to the tremendous shock of area bombing. This economy was further handicapped by administrative confusion and a lack of realistic planning which greatly exaggerated the difficulties inherent in a situation where heroic measures of emergency readjustment were required. At this moment communications and internal transportation in the main cities were temporarily paralyzed and many of the controlling administrative offices destroyed.

The decline in Japan's raw material position and the breakdown in the coal program had already resulted in considerable declines in basic production before March 1945. It is clear that these would have been a decisive element in reduc-

ing over-all industrial activity within a few months. But as measured by electric power consumption, the level of activity in the intermediate and final assembly levels of war production remained at a relatively high level. Examination of individual factory data provides the complete breakdown in the repair and dispersal program after heavy attacks provide one important yardstick of Japanese capacity and resilience. There was virtually no recovery in general industrial activity even where a considerable period intervened between area attacks. Labor problems were generally regarded as of first magnitude, along with dislocations of local supporting services.

The following reports discuss the complex intereffects of such elements as breakdown in the system of labor and materials allocation, the creeping effect on basic production of coal and the reduction in supply of many industrial materials and the inability to make emergency reallocations of these crucial items. The effect attendance and labor efficiency of dehousing, food shortages, and transport delays is discussed along with a host of such underlying problems as the decline in freight movement and the heavy destruction in warehouses of semi-finished and finished goods. There is no

question that many of these factors would have been operative to a considerable extent in the absence of area attacks. But it is also clear that their cumulative impact on war production was magnified substantially as a result of the enormous destruction and disruption in the main cities.

Finally, it must be pointed out that while the analysis has largely been confined in these reports to the effects of area attacks on industrial activity, there is no question but that the growing disintegration of public discipline as reflected in the growth of industrial absenteeism and black market operations was a factor of real official concern in the last months of the war, quite aside from its economic implications. Post-raid absenteeism was usually even higher among administrative and management personnel than among workers, and many concerns made no effort to get back into production after the June attacks. These considerations are also of crucial importance in assessing the country's position in the critical last days of the war. Economic collapse was imminent but the prospects for securing capitulation prior to the scheduled ground invasion may very well have hinged on popular reactions to our overwhelming application of air power.

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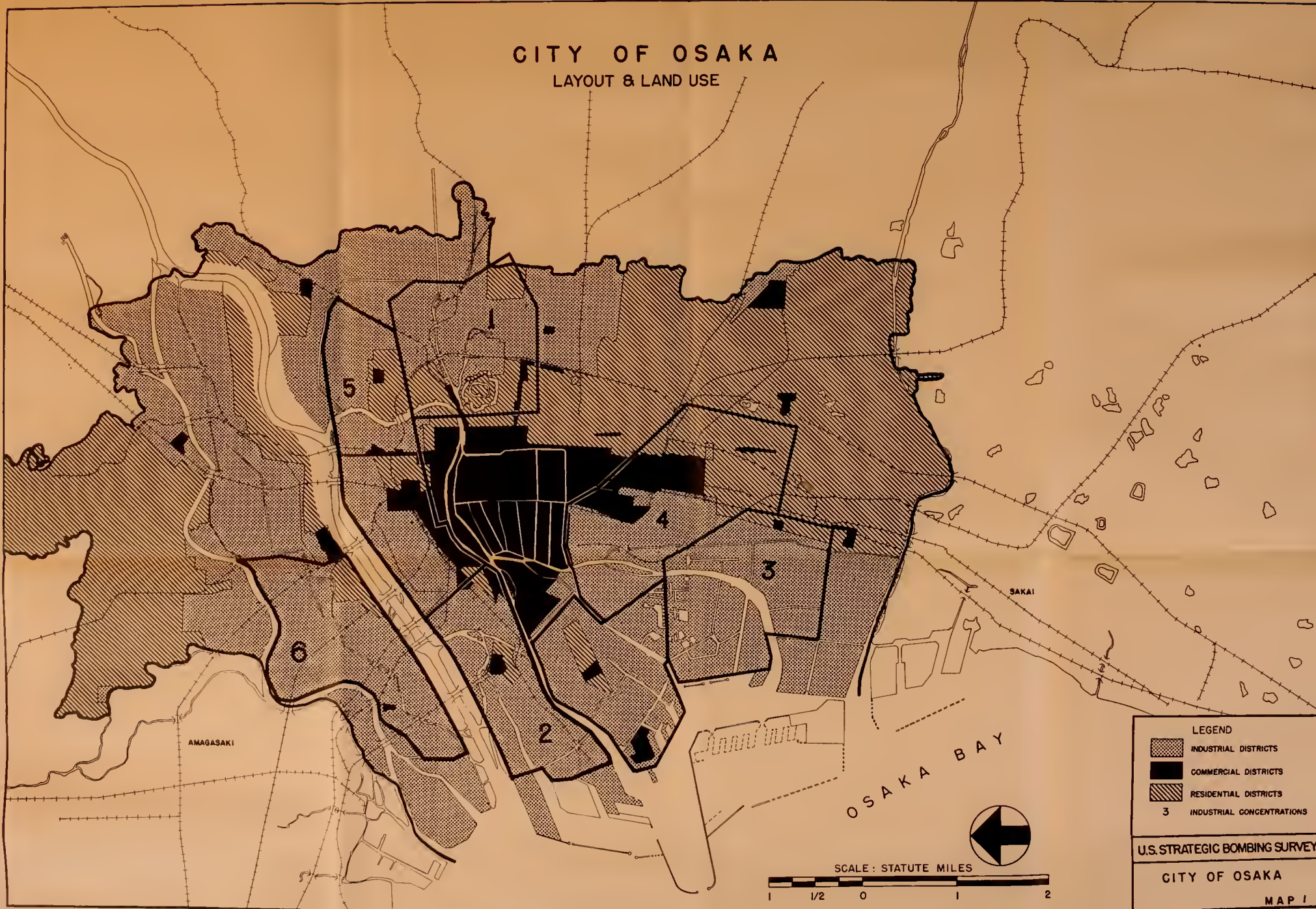
PHOTO 1.—Offices and public buildings in central Osaka, looking northwest. A prewar photograph.



PHOTO 2.—Osaka city hall. Crowds pouring from subway exit. Looking north toward main railroad station.

CITY OF OSAKA

LAYOUT & LAND USE





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THE CITY

Osaka, after Tokyo the leading industrial and administrative center and most populous city of Japan, had also become, by 1941, the third largest port. Situated on the northeastern shore of Osaka bay, which forms the eastern limit of the Inland Sea, the city had long been the economic focal point of the central Honshu region. In addition to the adjoining industrial suburbs of Sakai and Amagasaki, two of Japan's six largest cities—Kyoto and Kobe—and several smaller cities of particular significance for war production, are located in the populous lowland area surrounding Osaka and along near-by shores of the Inland Sea. Osaka's location, midway between Tokyo and Shimonoseki on the main Tokaido railroad and at the head of the Inland Sea, made it the commercial and industrial heart of Japan. In addition, the harbor and industrial facilities of Kobe, the most important prewar port of Japan, were less than 20 miles to the west. Osaka was thus ideally situated to process and transship articles moving directly overseas or through the protected waters of the Inland Sea as well as those moved by rail from other regions.

Osaka's highway connections with Amagasaki, Kobe, Akashi and Himeji to the west and with Kyoto to the northeast were the best in Japan. In addition to a complex suburban and regional rail network, through rail facilities out of Osaka were also of the highest caliber. The following table gives the rail distance from Osaka of some key centers:

	<i>Miles</i>
Tokyo -----	345
Shimonoseki-Moji -----	335
Hiroshima -----	240
Nagoya -----	118
Kyoto -----	28
Kobe -----	20

Osaka, like the five other major Japanese centers, averaged roughly 1,300 miles from the Marianas bases where strategic air attacks originated. If the war had continued until Okinawa based B-29s were over Osaka, the distance would have averaged about 650 miles, as against almost 850 for Tokyo and 750 for Nagoya. In contrast to other major urban centers, Osaka was a poor radar target for the types of equipment available during most of the operations period. The following table gives approximate air distances from various

U. S. bomber bases to Osaka:

	<i>Miles</i>
Chengtu -----	1,625
Guam -----	1,350
Saipan -----	1,270
Iwo Jima -----	660
Okinawa -----	660

Osaka is at the mouth of the Yodo river, which provides water access and a road-rail corridor to Kyoto some 30 miles northeast. Mountain ridges approximately 15 miles north and east of the city converge around Kyoto and limit the densely settled Osaka plain. A continuously built-up coastal strip extends west to Kobe. The built-up area of Osaka city itself is roughly elliptical and extends some 10 miles east from the waterfront and almost 13 miles north-south, merging with Amagasaki and Sakai. Total area within the city limits is 59.8 square miles.

In addition to the various delta arms of the Yodo river which segment much of the city area, there is an elaborate canal system which is essential to the city's internal transportation. This canal system also provided the basis for Osaka's futile plan of defense against incendiary attack. Osaka, unlike Tokyo, had never suffered serious earthquake damage and there has been relatively little modern reconstruction. The medieval patterns of narrow streets (usually 20 feet or less) prevailed everywhere except for a few main avenues cut through at intervals on a rectangular plan. Wide avenues are limited in number, the most important being Midotsugi which bisects the central commercial district. This 144-foot avenue was constructed in 1927 to connect the main Osaka railroad station at the north edge of the central commercial district with the Namba railroad station at its south edge. In 1935, Osaka's one subway was constructed under the full length of this thoroughfare. In built-up Osaka, for all of its size, there were but three very small parks and few other open spaces, aside from waterways.

Layout of the City (Map 1)

The land-use pattern in Osaka was relatively simple—a large central commercial area with its cluster of modern multistory fire-resistant structures, surrounded on the northeast, north, west, and southwest by industrial zones, and by less congested better class residence areas on the east and southeast. All sections of the city had large



PHOTO 3.—Typical pre-attack view of congested Osaka industrial district. Practically all such structures proved highly vulnerable to incendiary attack.

residential populations, with the greatest densities in the commercial and adjoining industrial sections. Factories and workshops using up to 15 horsepower were regularly permitted in commercial and residential zones.

Adjoining the wharf and warehouse district on the waterfront were the main clusters of heavy industry along the Aji and Kizu arms of the Yodo river. Warehouses and factories extend along tributaries and canals almost to the commercial heart of the city, where key landmarks are the public buildings on Nakano island in a river tributary running through the center of the city, and the western-type buildings in the business district surrounding the island. Around this central group of multistory fire-resistant buildings, there was a larger district of commercial and light industry structures. The city profile was flat and marked by the short chimneys of the thousands of small factories and workshops scattered through the commercial and residential sections. The city's most conspicuous landmark is the moat-surrounded Osaka castle to the east of the business district. Clustered around it were the numerous factory buildings of the Osaka Army arsenal as well as extensive Army depot and administrative facilities. Main prefectural buildings were also located near the castle, as was the local radio broadcasting headquarters.

The Firebreak Pattern (Map 2)

The rivers and canals of Osaka had always served as natural firebreaks, and the wartime protection program was based on them. In the con-

struction of all firebreaks, a total of 77,568 houses and 815 other buildings were pulled down. Fire-break activity was under Home Ministry instruction and fell into four distinct periods. The first dated from January 1944, when rather leisurely work on about 5 miles of breaks, each about 150–200 feet wide, was started. These were intended primarily to protect the central core of the city, and at the same time served to break up densely built-up areas. Special firebreaks were constructed around a few plants and utility installations.

The second period of firebreak construction, starting in June 1944, was carried on with greater energy. Most of the work during this period was done in the waterfront heavy industry area for the protection of the main Sumitomo works and the Hitachi shipyard, the city's two largest industrial units in the aircraft and shipbuilding categories. A few lineal firebreaks also were added at this time, and work on others was speeded up.

The third period of construction was started in February 1945, after B-29 attacks were well under way and a trial use of our light incendiary bomb on the Kobe waterfront had indicated what might be expected in mass urban attacks. A few lineal firebreaks were started and the natural protection of the canals was utilized in the hurried creation of additional firebreaks within the central commercial residential district. The industrial section to the north of the central commercial residential area and the interurban railway stations were also given attention. Work under this program was not completed by 14 March, the date of the first attack.

CITY OF OSAKA

FIREBREAK PLAN



LEGEND

MAJOR FIREBREAKS IN CONSTRUCTION DURING

- 1ST PERIOD - JANUARY - JUNE 1944
- 2ND PERIOD - JUNE '44 - JANUARY '45
- 3RD PERIOD - FEBRUARY - MARCH '45
- 4TH PERIOD - APRIL - AUGUST 1945

U.S. STRATEGIC BOMBING SURVEY

CITY OF OSAKA

MAP 2

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PHOTO 4.—Two-story row structures typical throughout Osaka. Note concrete water tubs for fire protection.



PHOTO 5.—The most ambitious firebreak in Osaka. An extremely wide clearance designed to prevent firespread in the congested northwest industrial section.

POPULATION STATISTICS OSAKA CITY

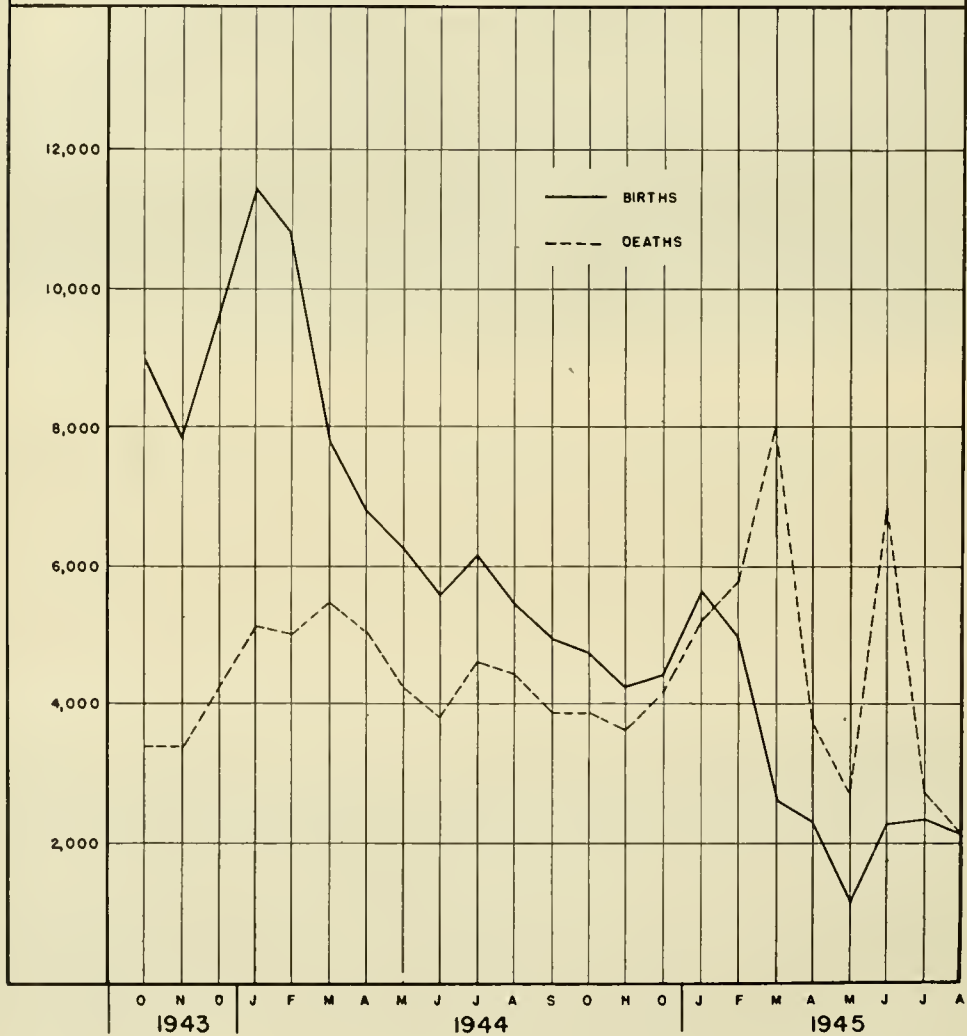


EXHIBIT I

Fire protection efforts continued on a larger scale after the March 1945 raid and extended into August. The work done in this period was mainly limited to railroads (by clearing bands along the right-of-way through congested areas) and around individual key plants (ordnance, aircraft components and utilities), hospitals and district police offices. The work was still done under prefectural officials, but the Army and Navy selected the factories to be protected. Large numbers of temporarily idle factory workers were used and most of the results were obtained between March and June. After June, there was progressively less concern with what appeared to be futile efforts.

The following table lists the number of buildings torn down in the firebreak program:¹

Period	Number of houses	Number of other buildings
1st (Jan.-June 1944)	9,046	34
2d (June 1944-Jan. 1945)	14,582	252
3d (Feb.-Mar. 1945)	9,757	280
4th (April-Aug. 1945)	44,183	249
Total	77,568	815

In the firebreak construction program, concrete buildings in the path of the firebreaks were not torn down. The owners of the destroyed frame buildings were recompensed at the rate of 200 yen per tsubo, a fair prewar price for new construction but quite inadequate for replacement at prevailing black market rates in 1945.

The firebreak and fire defense program proved unsuccessful. Until March it had been carried out on the assumption that only a few planes could penetrate any urban area at one time and that bombs would be aimed at small scattered targets. However, the March and June attacks blanketed whole districts, generating conflagration-type fires on both sides of firebreaks that merged and frequently spread far beyond the hit areas. Authorities were utterly unprepared to cope with the first attack or improvise new measures. Firebreaks and organized protection for individual plants, however, were sometimes effective, especially in limiting damage to warehouses and auxiliary buildings.

Population and Housing (Map 3, Exhibit 1)

Second only to Tokyo in population, Osaka was

in many respects the commercial heart of the Japanese empire, playing a major role in textiles and other export industries. However, as Japan turned from overseas trade to war preparations in the five years from 1935 to 1940, Osaka showed only a slight increase in population as compared with the large increase in many other cities and secondary war industry centers. The population of Osaka was 3,254,380 in 1940 but decreased 13 percent to 2,833,344 in February 1944 and another 3 percent to about 2,736,000 in November, when B-29 operations against Honshu got underway. Aside from conscription, most of this drop reflected the decline in commercial activity and civilian industry and a parallel growth of new industry in the suburbs and in near-by "boom" towns where aircraft and ordnance plants had been established.

On the eve of the March 1945 attack, Osaka's population had dropped considerably below the 2.7 million figure of the previous November, due to some further transfer of labor to war plants in the suburbs and near-by towns, and to large-scale pre-raid evacuation of children and "unemployables." At that time, the birth rate was 2.3 per thousand of population, and the death rate was 2.8 per thousand. The apparent decline in births from the rate of 3.9 per thousand in February 1944, was partly due to the policy of early evacuation of pregnant women. The death rate increase from the rate of 1.8 per thousand in February 1944 is attributed to wartime increases in accidents and disease. (Exhibit 1 presents vital statistics for the October 1943-August 1945 period.)

As of February 1944, the last date on which accurate population figures are available, slightly less than 4 percent of the total population of Japan lived in Osaka city. Almost 9 percent lived in the surrounding districts including suburban Osaka, Hyogo and Kyoto prefectures.

With an average population density of about 45,000 persons per square mile, Osaka ranked among the three most densely populated cities of Japan. Most compact were the central commercial district and the mixed residential-industrial districts directly to the southeast, south and southwest, where the population density was estimated to average 81,000 persons per square mile. The population density of the most congested areas of Tokyo in 1940 ranged up to 130,000 per square mile, and densities almost as high were to be

¹ Source: Osaka police bureau, November 1945.

found in limited sections of Osaka. The most reliable data on population density is based on the 1940 census and Map 3 presents data for each ward as the boundaries were then defined. (Comparative material is presented on Map 4 of the Kobe report for Kobe and the adjoining suburbs of Amagasaki and Sakai, as well as for Osaka.) Densities for parts of the large Osaka wards located on the northeast and southeast outskirts were much higher than their average figures indicate.

Relative densities tended to remain the same during the 1940-1945 period in Osaka although the northeast sections experienced considerable expansion of light industry and some population, while the more congested areas were most affected by the wartime shifts of population out of Osaka. Concerning these changes, Map 5 and accompanying table should be consulted. In part, these present material not directly comparable with Map 3 because several of the larger prewar wards were divided in 1942. Comparable population data for the congested central wards whose boundaries were not changed, follows:

Ward	Population		Percent change
	1940	Nov. 1944	
Nishi	117,229	120,931	+ 3
Minami	104,638	80,850	-23
Naniwa	139,806	127,002	- 8
Tennoji	119,117	101,901	-14
Taisho	137,931	105,721	-11
Nishinari	215,828	185,081	-14

During this period, Osaka's total population dropped about 15 percent.

In February 1944, when accurate statistics were last collected, Osaka had 691,867 residential units. Exact data on the number of residential buildings were not available but it is estimated by the Japanese that there was an average of $2\frac{1}{2}$ dwelling units per building or a total of 275,000 residential buildings in Osaka. While the better-class districts had many detached single-unit houses, most of Osaka's populace lived in 2-story multi-family row-type structures. With the firebreak construction policy resulting in a continual decline in the number of buildings, the prefectural office estimated that there were 538,000 residential units and 215,000 residential buildings in Osaka as of the end of February 1945, just before the first area attack.

In February 1945 the estimated population figure of 2,142,480 gives an average of 4 persons for each residential unit and about nine per structure. This slight decrease in average occupancy, which occurred despite the doubling up resulting from the firebreak program, represents wartime shifting of population, conscription for the military and emergency service, evacuation of school children, and increased deaths due to wartime disease.

Non-Residential Structures

Along with some 275,000 residential buildings in February 1944, there were 16,416 industrial units listed as occupying 120,900 industrial structures of all sizes, an average of 7.4 buildings per unit. Most of these units were, of course, small workshops occupying one structure each, many of which also housed the owner's family. In February 1945¹ there were 18,633 industrial units (reflecting expansion and dispersal) and 122,608 industrial buildings, an average of 6.6 buildings. In the same period, from February 1944 to February 1945, the number of other types of buildings (stores, theaters, commercial and unused buildings) decreased from an estimated 102,000 to an estimated 73,000. This decrease is largely attributable to the firebreak policy. Another yardstick by which Osaka's pre-attack stock of buildings can be measured is the Joint Target Group's roof coverage data obtained from aerial photography. Total roof coverage—industrial, commercial, residential and other—within the city was estimated at 603 million sq ft, of which 161 million sq ft, or slightly more than 26 percent, was determined to be industrial. Comparable data for other Japanese industrial centers, in millions of square feet, follows:

	Total	Industrial	Percent
Tokyo	1,270.0	193.8	16.5
Kawasaki	141.4	71.1	50.2
Yokohama	127.7	25.1	19.6
Nagoya	324.5	96.0	29.5
Kobe	149.7	35.6	23.7
Osaka	603.4	161.2	76.7

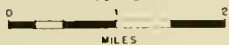
These industrial floorspace estimates were carefully checked on the ground in Nagoya and de-

¹ For that month, prefectural police records list 16,155 manufacturing units, the balance of 2,478 including roughly 500 utility units (power plants, car barns, repair shops etc.) and 2,000 separate dock and warehouse facilities.

OSAKA

DENSITY OF POPULATION

1940



RESTRICTED



LEGEND

PERSONS PER SQUARE MILE

- 20,000-30,000
- 50,000-70,000
- 70,000-80,000
- 95,000-100,000

U.S. STRATEGIC BOMBING SURVEY

MAP OF OSAKA
MAP 3

terminated to be accurate within 2 percent. The estimates of industrial roof coverage include only industrial-type structures, warehouses and auxiliary facilities. Home workshops, schools, etc., are excluded.

Building Construction

In the central commercial use zone, aside from the new ferro-concrete structures, many Osaka buildings were of wood construction with tile roofs—precisely the type for which our small incendiary bombs were designed. There were also some equally vulnerable brick buildings with load-bearing walls, wooden floors and rafters, and tile roofs. Outside the central business district, only school and police buildings were concrete or brick, except for factories.

The industrial sections contained a few scattered "fireproof" ferro-concrete structures, but aside from these, the larger factories and warehouses had main buildings of brick and wood or light-steel framework with composition or corrugated-iron siding. Most of the auxiliary and smaller industrial buildings were indistinguishable from the residential and home-industry variety—wood frame, wood or mud walls, and tile roofs.

Residential buildings almost without exception were of wood construction with tile roofs. In the more congested districts, practically all such structures were small 2-story warehouses for residential storage. These warehouses had foot-thick walls of mud and straw, wooden floors and tile roofs. Unless hit directly with a fire bomb which pierced the roof, these warehouses generally survived area attacks even where all surrounding structures were levelled.

Few steps had been taken for protection of essential buildings against incendiary attack, although various protective measures had been ordered. Some vital equipment in power plants, substations, gas works, etc., were protected by so-called bomb-proof walls. Many key industrial plants also undertook some measures. Most of these walls were made of wooden planks filled in with sand, but some were made of reinforced concrete with walls about ten feet high. Such measures were generally successful in protecting compact equipment against high-explosive fragments but were of little use where incendiaries found combustible materials to feed upon. Incendiary-proof roofs were to be built over power plant equipment, but the

deficiency of iron made this impossible and only 2 or 3 samples were finished. The most effective defensive measures for industrial establishments, however, proved to be the clearing of peripheral firebreaks and the isolation of essential workshops within each plant compound through removal of storage and auxiliary buildings.

Summary: The Osaka Urban Complex

Despite its shortcomings as a radar target, the urban area of Osaka obviously offered one of the most vulnerable and valuable objectives for large-scale incendiary attack. The densely built-up central core of the city was the commercial and administrative nerve center of central Japan and housed almost a third of the city's population. Surrounding this most congested central area—only a small section of which had fire-resistant ferro-concrete buildings—were Osaka's industrial sections, most of which also contained a high percentage of vulnerable residential and small factory areas. With few exceptions, Osaka's larger industrial enterprises and warehouse facilities were susceptible to incendiary damage and were located in these congested districts. Even more subject to damage were the thousands of small factories and workshops which supplied components to Osaka's key war plants.

The city's port facilities, which had been developed so extensively just prior to the war, had played a major role in supporting Japan's operations in the South Pacific and Southeast Asia. The volume of traffic through the port had declined heavily in 1945. But what shipping could still be maintained through the protected Inland Sea route was of critical importance to the Nagoya and Tokyo regions as well as to Osaka, when convoys could no longer be pushed through the open waters to those eastern ports. Osaka's ability to handle water-borne freight depended in large part upon a lighterage system using storage and transshipment facilities along canals within the most built-up sections of the city. These same facilities played a critical role in the city's internal transport system, the effective functioning of which was particularly important because of the high degree of subcontracting prevailing in Osaka war industry.

Osaka's industrial significance is discussed in detail in subsequent sections. As Japan's second largest manufacturing center, the city had become

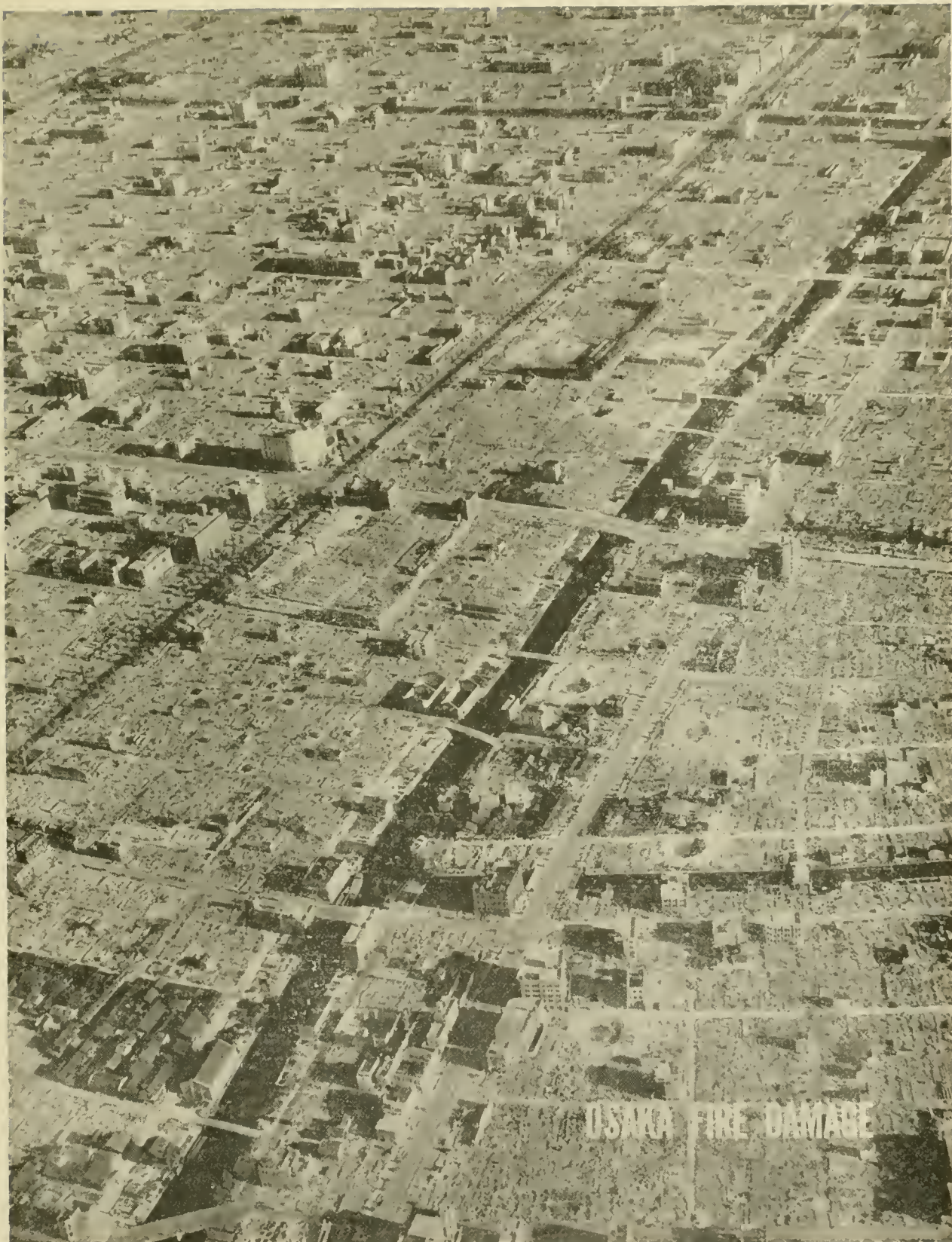


PHOTO 6.—The commercial heart of Osaka. Looking south.

one of the key points for war production. The site of a principal aircraft propeller works, a large Army arsenal and important shipbuilding and repair yards, Osaka played a major role in these fields. But its peculiar importance to the Japanese war economy stemmed from its production of components, machinery and machine tools required for aircraft and other end-military products assembled elsewhere. Disruption of Osaka's industrial output could be expected to have important repercussions on the activity of many key war plants in near-by suburbs and other cities.

As the major center for general industrial equipment, Osaka had a crucial role in the dispersal and repair program forced upon Japan by our initial pattern of precision air attacks. Osaka's continuing contribution was essential if, despite growing shortages of materials and skilled labor, Japan attempted to organize its war industry for a sustained and costly resistance to invasion.

AIR OPERATIONS AGAINST OSAKA

The Pattern of Air Attacks

Initial B-29 operations from the Marianas did not touch Osaka or the Osaka region. During late 1944 and early 1945, operations were concentrated on aircraft plants but only one of these in this region was hit. In February, Kobe had a sample of what was to come. But not until March did the pattern suddenly change. Along with Tokyo, Nagoya, and near-by Kobe, Osaka was attacked in mid-March in the XXI Bomber Command's first series of large-scale incendiary operations. But the city was not visited again until June. After this lull of more than 75 days, the other three Osaka area attacks were mounted on the 1st, 7th, and 15th of June. Aside from scattered tactical fights, the only subsequent air operations were precision attacks directed against Osaka's large Army Arsenal and the important Sumitomo aircraft propeller works on 26 June, 24 July, and 14 August.

Altogether, 10,270 tons of bombs (92 percent incendiaries) were dropped in area attacks on Osaka—1,732 tons during the night of 13 March and 8,538 tons in the three June daylight attacks. The three subsequent precision attacks on two Osaka targets accounted for some 3,344 tons of high-explosive. Listed below are the attacks which were carried out by the Twentieth Air Force against Osaka. Of the 1,586 B-29s over Osaka in the four urban attacks, only 16 were lost—12 in

the 1 June daylight mission, which was heavily challenged by Japanese fighters, and two each in the other attacks. Twenty-four planes were claimed by our gunners on 1 June. Only two B-29s were lost in the subsequent precision attacks, out of 562 participating.

Four area attacks

1. Date	13 March 1945 (night)
Number of planes	275 (7,000 altitude)
Duration	3 minutes, 28 seconds
Type and weight of bombs	1,732—6 tons IB
2. Date	1 June 1945 (day)
Number of planes	458 (24,000 altitude)
Duration	1 minute, 32 seconds
Type and weight of bombs	81.2 tons HE 2,706.9 tons IB
3. Date	7 June 1945 (day)
Number of planes	409 (20,500 altitude)
Duration	1 minute, 19 seconds
Type and weight of bombs	796.6 tons HE 1,795 tons IB
4. Date	15 June 1945 (day)
Number of planes	444 (21,500 altitude)
Duration	2 minutes, 11 seconds
Type and weight of bombs	3,157.3 tons IB

Three precision attacks

A. Date	26 June 1945 (day)
Number of planes	68 (22,000 altitude)
Duration	1 minute, 36 seconds
Type and weight of bombs	382.0 tons HE (Objective: Sumitomo Light Metals Company)
Date	26 June 1945 (day)
Number of planes	112 (23,000 altitude)
Duration	58 seconds
Type and weight of bombs	758.0 tons HE (Objective: Osaka Army Arsenal)
B. Date	24 July (day)
Number of planes	82 (21,000 altitude)
Duration	31 seconds
Type and weight of bombs	488.0 tons HE (Objective: Sumitomo Light Metals Company)
Date	24 July 1945
Number of planes	153 (21,500 altitude)
Duration	43 seconds
Type and weight of bombs	1010.0 tons HE (Objective: Osaka Army Arsenal)
C. Date	14 August 1945 (day)
Number of planes	147 (23,500 altitude)
Duration	45 seconds
Type and weight of bombs	706.5 tons HE (Objective: Osaka Army Arsenal)

Source: Twentieth AF, Operational Summaries.

In addition to these heavy area and precision attacks, B-29s also dropped mines in the approaches to Osaka harbor. Fighter sweeps were conducted over suburban sections during the last weeks of the war by both carrier-based planes and Army craft based on Iwo Jima. These tactical operations did not involve any substantial bomb

BOMBING RAIDS ON OSAKA

1945

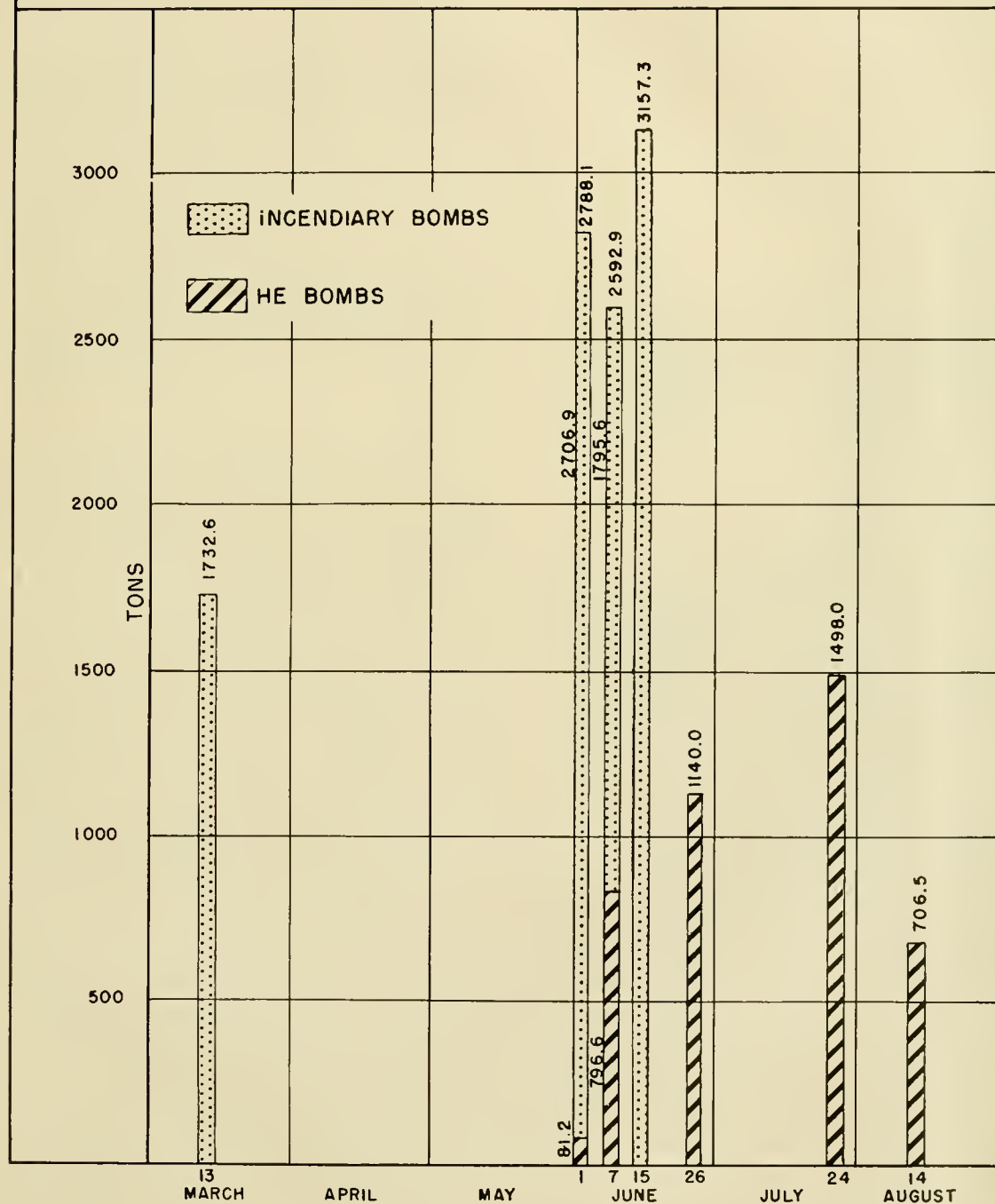


EXHIBIT 2

tonnage, but were effective in causing brief alarms and frequent interruptions in activity. The Osaka area attack of 15 June caused considerable damage in near-by Amagasaki. An area attack of 10 July against the town of Sakai, directly south of Osaka, also caused some slight damage in the southern margin of Osaka. The following table summarizes data on all attacks, warnings, and alerts:

Period	Attacks	Alarms	Alerts
1942		1	15
1943			6
1944	1		20
Dec. 1944	1	1	7
Jan. 1945	3	10	23
Feb. 1945	4	9	56
Mar. 1945	1	1	27
Apr. 1945			29
May 1945			32
Jun. 1945	4	4	23
Jul. 1945	4	¹ 16	32
Aug. 1945	2	² 6	22

Note. "Attacks" include all occasions when HE or incendiaries fell within the city. "Alarms" include all occasions when warnings of imminent bombing attacks were sounded. "Alerts" cover all periods when enemy planes were officially reported approaching over the district, including the many false alarms following the Doolittle raid. Practice ARP drills are not included.

¹ Includes 6 strafing attacks in suburbs.

² Includes 2 strafing attacks.

Source: Osaka prefectural police.

Effectiveness of Effort (Map 4)

The March attack against Osaka was concentrated on the heart of the city including the areas of greatest housing density, the bulk of the commercial section, and adjoining small industrial districts. The 1,732 tons of incendiaries dropped in a period of three hours burned over an area of roughly 8.1 square miles—by far the most effective per ton, in terms of casualties and gross physical damage, of the four area attacks. A third of the air-raid deaths and roughly half of the total burned-over areas in Osaka dated from this initial attack. Prefectural casualty figures list 3,987 dead, 8,466 injured, and 678 missing—a total of 13,131 or about 7.5 casualties per ton. Slightly more than 501,000 persons were dehousing—almost 25 percent of the pre-raid population—and some 425,000 left the city during the 11-week period before Osaka was again attacked. Exactly 134,744 residential and industrial structures were listed as totally destroyed and 1,363 partially destroyed—a total of 136,107 or almost 80 per ton of bombs dropped.

The urban area attacks of 1, 7 and 15 June aimed

at extending damage to the mixed residential-industrial districts surrounding the central section destroyed in March and also affected Amagasaki city directly north. The 1 June attack of 2,788 tons, which burned out a gross area of 3.1 square miles to the west and north of the March damage, resulted in 3,112 killed and total casualties of 14,084, with another 218,680 being dehousing. An estimated 66,817 structures were destroyed or seriously damaged. An area of 2.2 square miles—mostly in the northern sector—was affected by the following week's attack of 2,592 tons, in which 2,059 persons were killed among total casualties of 8,873 and 56,576 structures of all types were destroyed or damaged. This was the only area attack including a sizable amount of high-explosive bombs. Osaka's last area attack of 3,157 tons on 15 June was divided between the southern and northwestern sections and also caused considerable damage in adjacent Amagasaki city. The damaged area added in Osaka totalled 21½ square miles with 475 killed out of 2,927 casualties, 53,327 buildings destroyed or damaged and 181,636 dehousing.

Additional damage to Osaka occurred in connection with precision attacks on 26 June, 24 July and 14 August. Spillover from the 10 July urban attack on Sakai dehousing another 3,500 in Osaka. Altogether, these area and precision attacks, along with isolated bombing by reconnaissance planes and some eight tactical strikes, brought death to 12,620 Osaka residents in a total of 45,881 casualties. According to police records, some 321,935 buildings including 8,500 industrial structures are listed as totally destroyed and 1,224,533 persons were dehousing. At the end of the war about 950,000 Osaka inhabitants were still in residence out of a prewar population of 3.2 millions and a pre-attack population estimated at 2.2 million.

The principal impact of the March attack fell on the administrative and human resources of the Osaka war machine and its supporting public services, while the June attacks were most effective against the city's productive facilities. The destruction in March of most business offices, including several control association headquarters and the regional offices of the Munitions Ministry, had a paralyzing effect on the city and region which was never overcome. But many small shipyards and important factory districts on the southern and western edges of the commercial zone were also destroyed in this first attack. Aside from

CITY OF OSAKA

DAMAGE BY AIR ATTACK

AMAGASAKI

SAKAI

OSAKA BAY

LEGEND

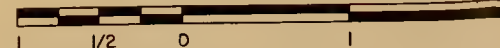
- JULY 10 AREA ATTACK ON SAKAI
- MARCH 13 AREA ATTACK
- JUNE 1, 7, 8 15 AREA ATTACK
- JUNE 26, JULY 24 8 AUG. 14 PRECISION ATTACKS
- 3 INDUSTRIAL CONCENTRATIONS

U.S. STRATEGIC BOMBING SURVEY

CITY OF OSAKA

MAP 4

SCALE: STATUTE MILES



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PHOTO 7.—Aerial view of Osaka just before the first attack. The most conspicuous landmark is Osaka Army Arsenal and military and prefectural headquarters. West of the Castle, a rectangular network of canals and thoroughfares marks out the central commercial district. Surrounding this district are the city's various industrial sections.

the disruption of communications and administration and the elimination of many suppliers of critical components and special industrial equipment, the March attack caused heavy damage to internal transport and storage facilities. Despite the 2½ months lull after this attack, the dislocation of internal transport resulting from the attack never was alleviated. Nevertheless, the city's major productive facilities remained in the greater part intact. But for the dependence upon small subcontractors, these would not have been seriously handicapped, except for temporary absenteeism. After the March attack, the main municipal prefectural and military headquarters were still functioning. The principal war plants were in run-

ning order. Through rail facilities were unhampered and practically all the port installations were untouched. The ensuing 75-day period provided an opportunity for recovery and preparation for further attacks that contrasted sharply with the experience of Tokyo-Kawasaki and Nagoya, where heavy attacks followed each other at frequent intervals.

The June attacks extended the area of damage into all the industrial districts surrounding the burned-out central section. Although the total area burned over in the three June attacks only equalled that achieved in one March attack, the level of industrial damage was much greater. Of Osaka's total industrial roof coverage (over



PHOTO 8.—Osaka after the March incendiary attack. More than seven square miles was burned over, including most of the central business district and industrial areas to the south and southwest.

160,000,000 sq ft as calculated from aerial photographs). 25 percent was destroyed in all air operations, but almost 90 percent was estimated to have been intact until the June attacks. If the larger war plants had not depended upon small factories and workshops for components and could have

coped with other indirect effects of the March attack, there should have been little decline before June in essential activity or a prompt recovery. Even as a result of the June attacks, the degree of decline was far beyond the level of physical damage to productive facilities.



PHOTO 9.—Over the Osaka waterfront 1 June 1945. Two Japanese anti-aircraft phosphorous bombs are seen bursting. Many large vessels are visible at anchor within the harbor.

There still remained undamaged target areas of limited size but considerable industrial importance after the June attacks. The precision attacks dealt with the two most important war plants in Osaka, although area attacks had already cut their output drastically—more by indirect means than by plant damage. But especially in northern Osaka, on both sides of the Yodo river, sizable districts of small and medium-sized factories remained. The priority urban industrial concentrations as established by the Joint Target Group are identified and outlined on Maps 1 and 4. The accompanying table indicates their estimated target value after the June area attacks. Concentrations No. 1 and No. 2 suffered heavily in the subsequent precision attacks.

Osaka industrial concentrations

Code number ¹	Location	Extent of area damage	Comment
Osaka #1	Castle district.	Moderate	NW and SW part of area heavily damaged, but Osaka Arsenal, groups of small factories and residential districts in remainder of area relatively undamaged.
Osaka #2	N waterfront	----do----	Doubtful target for area re-attack; important targets only slightly damaged but of fair and low combustibility; other small groups of factories remain.
Osaka #3	S waterfront	----do----	Northern part heavily damaged; several significant targets along S and SE side relatively undamaged but have low combustibility.
Osaka #4	S central	----do----	NW part heavily damaged; SW part only slightly damaged but has very low target value.
Osaka #5	N central	Heavy	Entire area heavily damaged; remaining installations too isolated for area attack.
Osaka #6	NW district	Slight	Area has been lightly damaged throughout, but large districts of relatively dense industrial residential occupancy remain.
Osaka #7	Central waterfront.	Heavy	Bulk of area destroyed; the few remaining installations in S part have low target value.

¹ Refer to Maps 1 and 4.

Compared with other major industrial and population centers, total extent of physical damage in Osaka was approximately half that sustained by Tokyo and from 1½ to 4 times that achieved in the four other major cities. Percentagewise, however, the level of damage in Osaka was lowest of the six key centers attacked—35 percent, as compared with 56 percent in near-by Kobe and 57 percent in Yokohama. Gross damage to industrial floorspace in Osaka was 20 percent less than in Tokyo, slightly more than in Nagoya and three

to five times that achieved in the other key cities. But Osaka ranked next to the bottom in terms of percentage of total industrial floor area damaged—25 percent as compared with 37 percent in Kobe and 40 percent in Nagoya. The following table summarizes physical damage data for the six centers as calculated from aerial photography by Joint Target Group:

Physical damage
[In millions of square feet]

	Total roof area damaged	Percent of total	Industrial roof area damaged	Percent of total
Osaka-----	211	35	40	25
Kobe-----	83	56	13	37
Nagoya-----	130	40	38	40
Tokyo-----	508	40	50	25
Kawasaki---	56	35	16	22
Yokohama---	73	57	8	31

Physical Damage

Damage to Buildings.—In the nine raids under discussion, 310,095 residential buildings were destroyed and 11,582 residential buildings were badly damaged. In the same raids 8,531 industrial buildings were destroyed or badly damaged (no breakdown of these two categories was possible), 1,855 buildings of other types were destroyed and 108 were badly damaged. Out of a total built-up area of 59.8 square miles, of which 20 square miles represented the planned target area, 15.6 square miles was burned over. A tabulation of damage by raid follows: (Source: City Questionnaire, November 1945.)

Date of Raid: 13 March 1945 (8.1 square miles destroyed or damaged)

	Number of residential buildings	Number of industrial buildings	Number of other buildings
Completely destroyed---	134,744	} 4,222	{ 1,556
Badly damaged-----	1,363		

Date of Raid: 1 June 1945 (3.5 square miles destroyed or damaged)

	Number of residential buildings	Number of industrial buildings	Number of other buildings
Completely destroyed---	64,152	} 1,629	{ 91
Badly damaged-----	934		



PHOTO 10.—Osaka on 10 June. The first two June incendiary attacks extended damage generally throughout the northern and western industrial districts and along the waterfront. The last attack on 15 June extended damage to the southwest, north of Osaka castle and north of the broad Yodo river.

Date of Raid: 7 June 1945 (2.21 square miles destroyed or damaged)

	Number of residential buildings	Number of industrial buildings	Number of other buildings
Completely destroyed___	54,287	} 1,022	{ 24
Badly damaged_____	1,240		

Date of Raid: 15 June 1945 (2.49 square miles destroyed or damaged)

	Number of residential buildings	Number of industrial buildings	Number of other buildings
Completely destroyed___	50,135	} 1,479	{ 111
Badly damaged_____	1,580		

Date of Raid: 26 June 1945 (11.3 percent of roof area of Sumitomo Light Metals destroyed or damaged; no appreciable damage to Osaka arsenal)

	Number of residential buildings	Number of industrial buildings	Number of other buildings
Completely destroyed---	5,351	155	25
Badly damaged-----	5,394		13

Date of Raid: 24 July 1945 (77.5 percent of roof area of Sumitomo Light Metals destroyed or damaged; 10.2 percent of roof area of Osaka arsenal destroyed or damaged)

	Number of residential buildings	Number of industrial buildings	Number of other buildings
Completely destroyed---	417	15	28
Badly damaged-----	237		3

Date of Raid: 14 August 1945 (44.5 percent of roof area of Osaka arsenal destroyed or damaged)

	Number of residential buildings	Number of industrial buildings	Number of other buildings
Completely destroyed---	1,009	9	20
Badly damaged-----	834		0

Distribution of Damage (Map 4)

The 13 March 1945 raid, aimed at the center of Osaka city, hit approximately the same area as was zoned for commercial use. The exact pattern of raid damage is indicated on Map 4. A total of 140,522 buildings of all kinds (3 percent classified as industrial) was destroyed. It should be noted parenthetically here that those buildings used both for dwellings and for small industries are entered under the industrial category only if they have 10 or more employees. Those employing less are classed as residential buildings. In this raid, most destructive of all those aimed at Osaka, 1,732.6 tons of incendiaries were used; an average of 81.1 buildings was destroyed or damaged per ton. Thereafter, no bombs were dropped on Osaka for more than 75 days—until 1 June.

The 1 June 1945 raid was aimed at the area to the west and north of the section hit in the first area raid. This was classed as industrial and commercial and was built up solidly with small factories and dwellings intermingled. The western area, lying between the center of the city and the waterfront, was particularly important to

Osaka's war economy. In this attack 65,872 buildings of all kinds were destroyed, 2.5 percent of which were classed as industrial, in addition to many large wharves and warehouses. With 2,788.1 tons of bombs (97 percent incendiaries) being used, an average of 23.6 buildings was destroyed by each ton of bombs. An area of 3.15 square miles was destroyed or damaged. The decline in effectiveness is partially due to the fact that areas burned out in March prevented the conflagration from spreading east with the wind.

The 7 June 1945 raid hit the area to the north of the central commercial zone, at points overlapping the northern areas affected by the 1 June raid. Most of this area also was zoned as an industrial area. In this raid, 55,333 buildings, of which 1.8 percent were classed as industrial, were destroyed by 2,592.2 tons of bombs, 44.4 percent of which were incendiaries. The physical effectiveness of the attack can be measured by the fact that an average of 21.3 buildings was destroyed by every ton of bombs. An area of 2.21 square miles was destroyed or damaged.

The areas hit on 15 June 1945 were more scattered. Some lay in the extreme northern section of the city and in adjoining Amagasaki and were classified as industrial; others were in the southeastern and southern sections and were mostly classed as residential, although there were many older home-industries in that section. A total of 51,275 buildings, 2.9 percent of which were industrial, were destroyed by 3,157.3 tons of incendiary bombs or an average of 16.2 buildings per ton. An area of 2.49 miles was destroyed or damaged.

The 26 June 1945 attack consisted of twin precision raids aimed at Sumitomo Light Metals Company in the western section of the city and at Osaka arsenal, immediately to the east of Osaka castle. Bad visibility was responsible for considerable dispersion of effort. The Osaka arsenal provided no effective radar response and bombs intended for it were scattered widely over the industrial district to the north and east. Of the 5,351 buildings destroyed, 2.8 percent were industrial. About 1,140 tons of high explosives were used in these attacks. An average of 4.69 buildings was destroyed by each ton of bombs. Although no appreciable damage was inflicted on Osaka arsenal, 11.3 percent of the roof area of Sumitomo was destroyed or damaged.

The 24 July 1945 attacks were again aimed at

BOMB DAMAGE TO BUILDINGS IN OSAKA CITY

NUMBER OF BUILDINGS DESTROYED & BADLY DAMAGED

1945

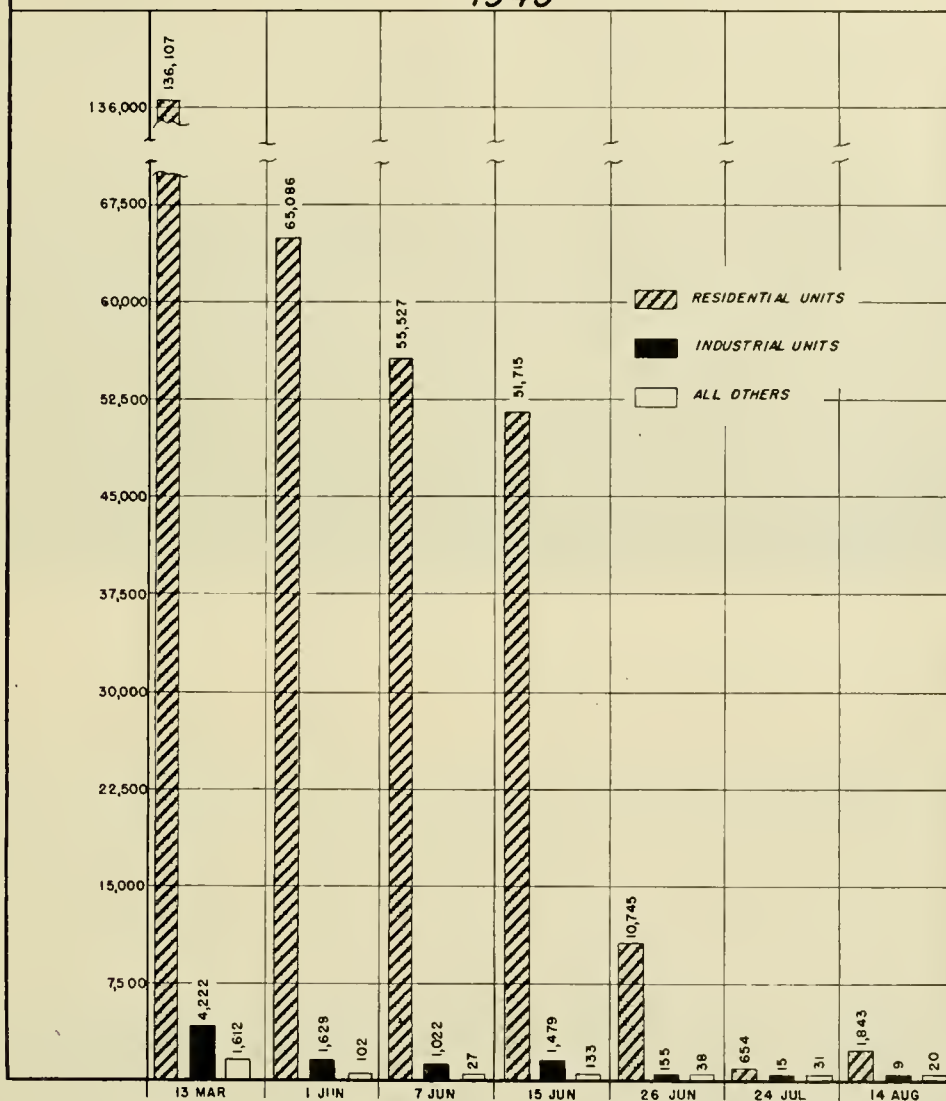


EXHIBIT 3

Sumitomo and at Osaka arsenal. A total of 460 buildings, of which 3.3 percent were industrial, were destroyed by 1,498 tons of high explosives. Bombs were effectively concentrated with visual and radar aiming. About 77.5 percent of the roof area of Sumitomo was destroyed or damaged and 10.2 percent of the roof area of Osaka arsenal was destroyed or damaged.

The attack of 14 August, just before the close of the war, was aimed at Osaka arsenal once again. A total of 706.5 tons of high explosives destroyed

an additional 44.5 percent of the arsenal roof area as well as 1,038 other near-by buildings—practically all warehouses and barracks.

Compensation for Damage

The government made a flat payment of ¥1,000 to the owner of each destroyed house and ¥500 for the loss of household possessions, unless the losses were covered by insurance. Partial payments were made for partially damaged houses. The receipt of this government compensation or insurance, paid promptly after the raids, contributed to war-



PHOTO 11.—The Minato district. Looking northeast toward Osaka castle across almost eight miles of uninterrupted destruction. Photo taken from center of densely populated southwest industrial district. Concrete firehouse was gutted but remained standing.



PHOTO 12.—The Minato district. A closer view of gutted machine shops in the same district pictured in Photo 11. Construction was uniformly wood, composition, and sheet metal throughout this section. Damage dates from the 1 June attack. Note shacks built by former residents out of salvaged sheet metal.

time inflation. Payments for damage to factories and the equipment in home-industries were to be made after the war.

Operation of Protective Measures

It is sufficient to summarize the reasons why measures taken previously for the protection of buildings against area attacks proved remarkably ineffective. Within target areas that were effectively blanketed, firebreaks did not halt the progress of the flames because bombs fell on either side of the firebreaks and kindled fires of conflagration proportions. The fire department had organized volunteer groups throughout the city to supplement its facilities but these proved woefully inadequate. In all there were about 350 of such groups with an average membership of 190 each. Each group had 3 or 4 portable gasoline-powered pumps, buckets of sand and water, hooks and ropes for pulling down wooden buildings, and other simple equipment. Only the engines were supplied by the city, the rest being provided by the volunteer group itself. Individual house owners were required to have water tanks which could be kept either on the roof or at the entrance door. A container was required for each dwelling unit in the multi-family buildings.

In many congested areas and alongside important buildings, concrete static water ponds were built by the city. Moreover, along the city's rivers and canals, which are generally shallow, provision was made to provide deep water sumps for use in fire fighting. Because of the general distribution of canals, no attempt was made to rely upon the city water system.

Factories were supposed to be protected not only by the volunteer groups but also by fire watchers who slept in the factory. A quaint note in fire fighting was indicated by the suggestion that the quilts in which they slept could be wetted and thrown over a fire bomb to help extinguish it. All factories were further protected by water containers and fire extinguishers, but only a few of the more important plants had modern fire fighting equipment or trained crews for its operation.

In areas of mixed factories and residences, three-fourths of the regular fire engines were assigned to the protection of factories, and one-fourth aided by the volunteer groups, to dwellings. Facilities assigned to the houses did not have much function other than attempting to prevent the fire

from spreading. Attempts to quench the flames of the individual house were left to the attention of the individual householder, aided by his neighbors in the volunteer group.

Classed by types of buildings, it can be said that most flat-roof ferro-concrete buildings were not structurally damaged in the attacks, even though many of these, apparently intact on the exterior, had been gutted where bombs had entered the buildings through windows or where fire spread from adjoining structures. Brick buildings with tile roofs were burned out, and steel-frame buildings with light-steel framework and composition or corrugated-iron siding were generally destroyed, where contents were at all combustible. Many of the residential warehouses of mud and straw construction were not destroyed.

Emergency groups, police and fire units and Army forces were used for street and debris clearance. However, the lines of authority were not clear, and the work was done grudgingly and slowly. For example, police would take responsibility for a wall only after it had fallen and obstructed the public highway. If it were tottering and endangering passers-by, they did not consider it their responsibility. For reasons such as this, clean-up work did not progress very rapidly, and was completed only on the main highways leading through the city and on streetcar routes. Factory damage was in most cases the concern of the staff.

Rebuilding and Reconstruction

No detailed statistics were obtainable, but the amount of rebuilding and reconstruction after the raids was very slight compared with the average of construction for the period from October 1943 to September 1944. This decline was attributed to an acute shortage of building materials and manpower. Most material was destroyed. Use of building materials for residential structures was prohibited from the beginning of 1945 except for emergency barracks for factory workers.

Because of the critical shortage of building repair materials, an allocations system had been set up with the prefectural police passing upon all requests for building materials and certifying the amounts needed. However, after approval had been obtained, allocations were usually made on a "first come, first served" basis, and supplies proved to be critically inadequate, especially in



PHOTO 13.—The Nishi district. School building in south industrial district that appeared in aerial photographs to be intact following the March attack. The steel-frame plant on the right was also gutted but appears to be intact.

June. No generally effective policy of government aid for labor on bombed-out buildings was established. Nor was there any organized policy on debris clearance. What little was done was handled by the individual householder and factory owner except along main streets and in a few priority factories.

Casualties and Evacuation

Summary of Casualty Data (Exhibit 4).—Air attack casualties in Osaka totalled 45,881, of whom 12,620 were listed as dead or missing. In the 7 operations under discussion, a total of 9,914 persons were killed, 27,037 were injured and 2,115 were missing. In addition 1,134,552 were de-housed and 891,347 were evacuated. It should be noted that most of the evacuated group came from those who had been previously de-housed. A tabulation of official casualty statistics by raid follows:¹

Date of raid: 13 March 1945.	
Killed	3,969
Injured	8,466
Missing	678
Dehoused	500,404
Evacuated	425,343
Date of raid: 1 June 1945.	
Killed	3,083
Injured	10,035
Missing	877
Dehoused	218,508
Evacuated	122,731

Date of raid: 7 June 1945.	
Killed	1,468
Injured	5,454
Missing	260
Dehoused	195,682
Evacuated	156,330

Date of raid: 15 June 1945.	
Killed	425
Injured	1,371
Missing	56
Dehoused	173,923
Evacuated	147,835

Date of raid: 26 June 1945.	
Killed	373
Injured	792
Missing	51
Dehoused	40,782
Evacuated	34,665

Date of raid: 24 July 1945.	
Killed	201
Injured	466
Missing	193
Dehoused	2,069
Evacuated	2,522

Date of raid: 14 August 1945.	
Killed	396
Injured	122
Missing	0
Dehoused	2,284
Evacuated	1,921

¹ Source: City questionnaire, November 1945.

The Decline in Population (Map 5)

At the end of the war Osaka had only 30 per cent of its 1940 population of 3,254,380. From a population of about 2,736,000 in November 1944

AIR RAID CASUALTIES IN OSAKA CITY

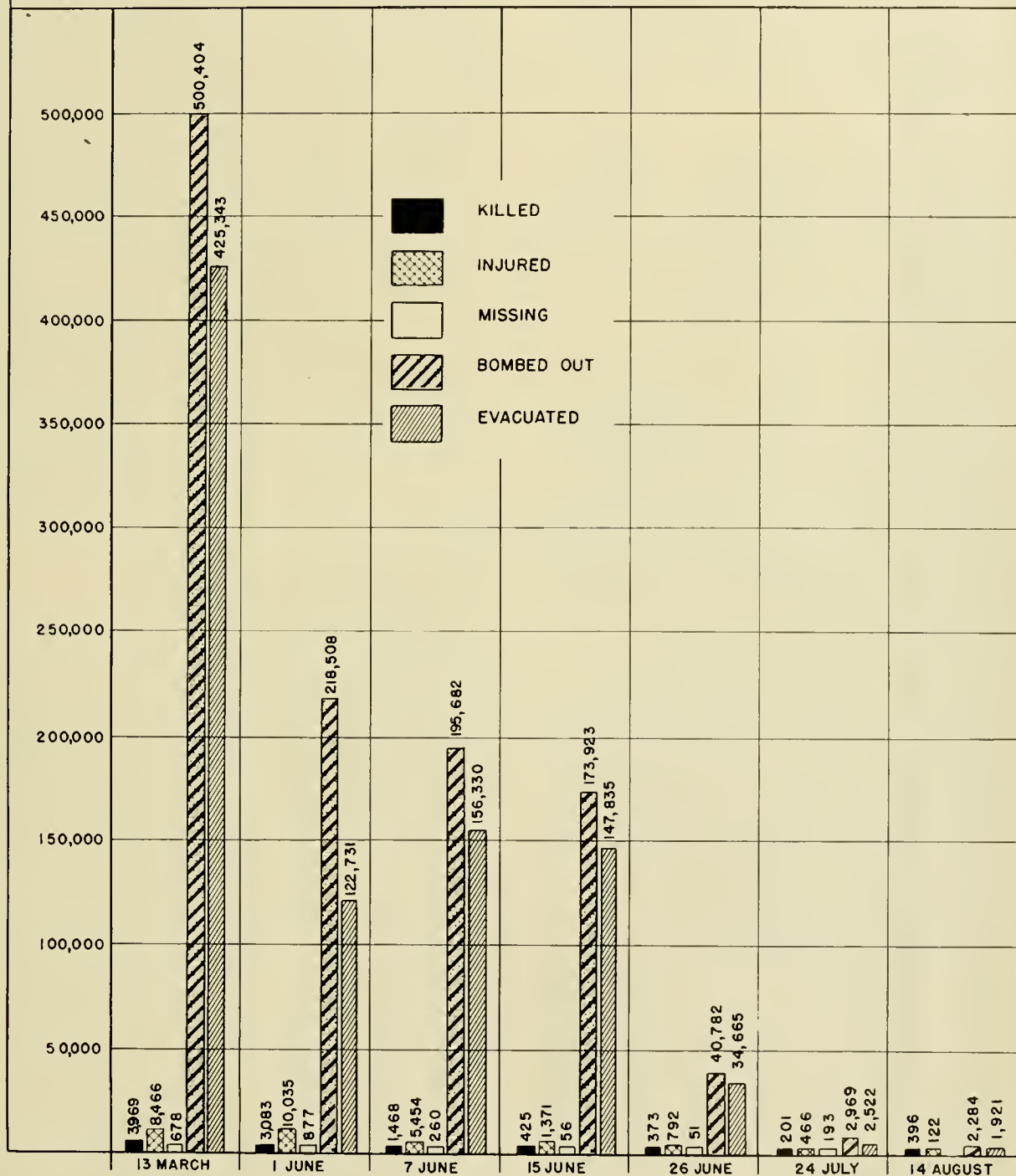


EXHIBIT 4

when B-29 operations started, and of about 2,142,000 at the end of February 1945, there was a further decline in the city's population of about 505,000 as a result of the 15 March raid. This resulted from the dehousing of more than 500,000, the death of almost 4,000, and the disappearance of 700. The June area attacks brought a further decline of approximately 635,000, including about 629,000 who were dehoused, 5,000 killed and 1,000 listed as missing.

The effect of these operations was supplemented by decline resulting from the later precision attacks, with the result that at the end of hostilities in August, the total population of the city of Osaka was only 988,281, less than half its March 1945 population and about 38 percent of its November 1944 population, which had already been thinned by voluntary evacuation during the war years. Different wards lost varying percentages of population from a maximum of 96 percent in the central district most completely destroyed (Naniwa) to a minimum of 20 percent in the southeast outskirts (Higashisumiyoshi). Detailed figures are presented in the table accompanying Map 5. Of the pre-raid population, 53 percent were dehoused and 42 percent were evacuated. About one-half of one percent were killed, one and one-third percent injured and one-tenth of one percent listed as missing.

Effectiveness of ARP Measures (Exhibit 5)

The first area raid on Osaka (13 March), besides causing the heaviest property damage, also resulted in the largest total casualties as well as the heaviest per ton of bombs. The decline in casualties in subsequent raids came in part from the scattered patterns of attack and from burnt-out areas which served as refuge areas for persons who might have otherwise been overcome. But the change in official policy and popular behavior was a primary factor. Before the first attack, the populace was told to stay at their homes and fight the flames. Thereafter, people were advised to save themselves when a heavy attack developed. Professional firemen and volunteers also became more concerned with saving their equipment, personal property and lives than in preventing the spread of the flames. The air-raid shelters, little more than covered foxholes, were generally unused, and were totally inadequate in size, number and protection. The situation in Japan thus dif-

fered basically from that in Germany. There was no use of the shelters night after night, so no efforts were made to make them habitable. A detailed study of civil defense problems in Osaka is presented in USSBS Pacific Report No. 8.

One of the most serious problems that developed in connection with air defense administration was the question of air alert and warning policy. After frequent B-29 appearances were initiated, it became gravely disrupting to essential production and public services to have frequent alarms sounded. Exhibit 5 summarizes data on elapsed time and number of alerts and alarms in the Osaka district. The lull during April and May and the subsequent barrage of warning and interruptions are clearly indicated.

The civil defense system proved inadequate for the job involved. It had been set up on the assumption that the bombs would be aimed at limited target areas. The officials, therefore, were not prepared for an attack of the size of the 13 March raid and even if they had been, they would have been unable to cope with such an attack with the equipment available. Loss of equipment and personnel in the first raid fatally disorganized subsequent civil defense organization.

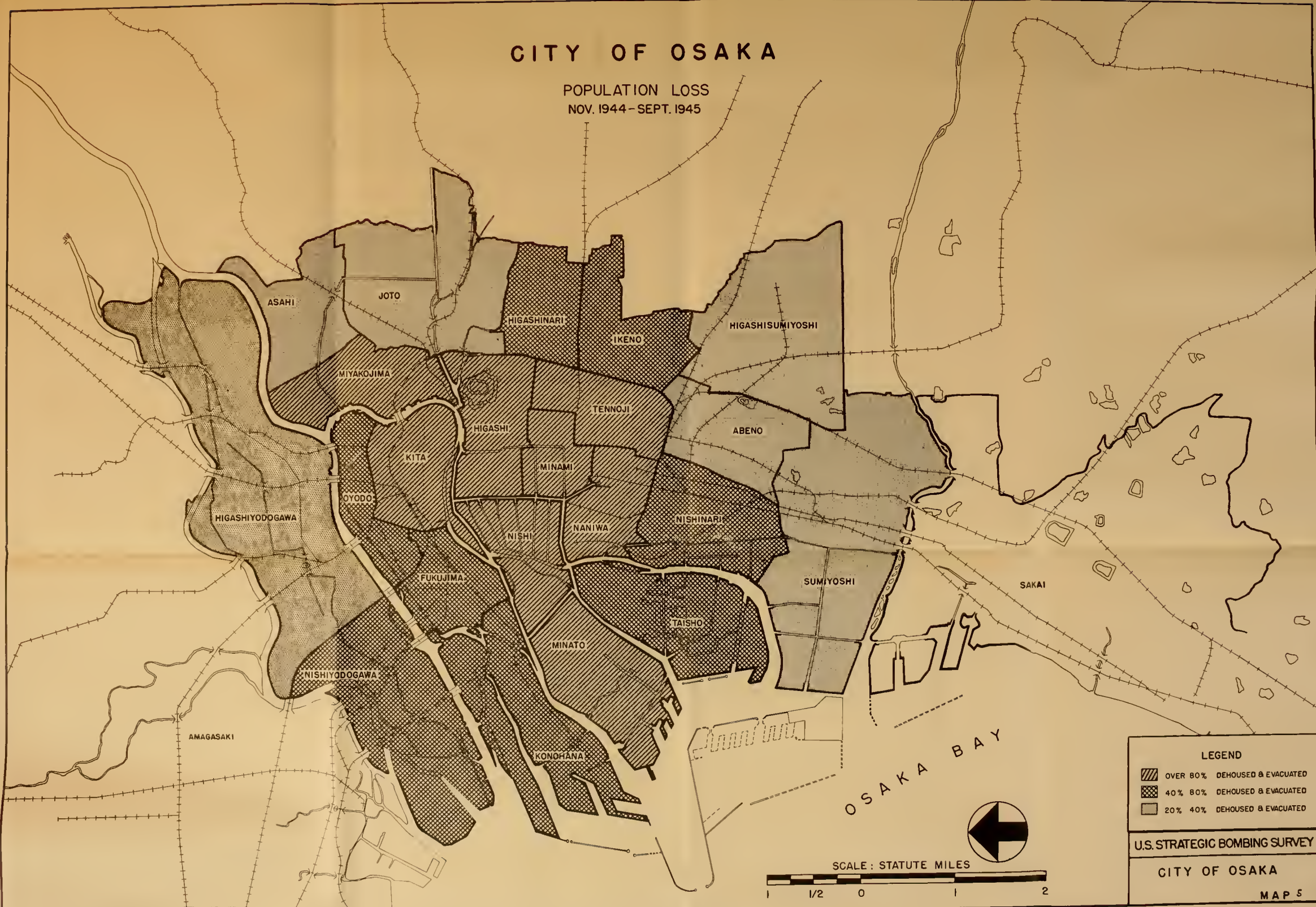
Emergency Evacuation and Rehousing

Evacuation both before and after the raids was on a voluntary basis except for the evacuation of certain school groups which had been made mandatory during the latter part of 1944. Voluntary evacuation of those unnecessary for the economic life of the community was urged, but only a few left before the raids. For example, 80 percent of those dehoused by the firebreak construction policy continued to live in Osaka, thereby adding to the overcrowding of the remaining buildings. It should be noted that the mass evacuation following the March and June attacks increased black-marketing, shortages of food in the cities and transportation difficulties. These indirect consequences of the attacks had a drastic effect on the morale of industrial workers especially when their families were evacuated.

Plans for emergency housing were made after the raids but were never carried out. Some temporary housing was provided for a few days in buildings still intact. A few large emergency lean-to's were set up in some districts, but it was necessary for those who were dehoused either to

CITY OF OSAKA

POPULATION LOSS
NOV. 1944 - SEPT. 1945



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District names	Estimated population Nov. 1944	Population decrease	Remaining population Sept. 1945	Remaining	Reasons for decrease ²	
					Bombed-out	Evacuated
				<i>Percent</i>		
Kita	110,357	88,341	22,014	20	48,094	40,249
Miyakojima	114,638	94,660	19,978	17	66,525	22,135
Fukujima	122,022	77,276	44,746	37	25,871	51,405
Konohana	121,045	94,382	26,663	22	46,418	47,964
Higashi	76,639	67,642	8,997	12	51,864	15,778
Nishi	120,931	107,742	13,189	11	87,143	20,599
Minato	210,915	197,999	12,916	6	157,153	40,846
Taisho	105,721	77,228	28,493	27	50,222	27,006
Tennoji	101,901	83,447	18,454	18	62,299	21,148
Minami	80,850	70,375	10,475	13	50,559	19,816
Naniwa	127,002	122,253	4,749	4	102,310	19,943
Oyodo	95,365	73,804	21,561	23	32,771	41,033
Nishiyodogawa	100,244	51,415	48,829	48	17,515	33,900
Higashiyodogawa	173,840	56,729	117,111	67	25,917	30,812
Higashinari	128,625	63,288	65,339	51	27,513	35,773
Ikono	179,583	78,497	101,186	56	24,693	53,804
Asahi	92,763	33,190	59,573	64	13,410	19,780
Joto	123,481	44,902	78,579	64	7,271	37,631
Abeno	114,791	43,889	70,902	62	114,635	29,194
Sumiyoshi	122,614	27,532	95,082	78	6,006	21,526
Higashisumiyoshi	127,446	25,662	101,784	80	7,108	18,554
Nishinari	185,081	105,764	79,317	43	38,041	67,723
Total	2,735,954	1,686,017	1,049,937 ¹	38	963,398	722,619

¹ Police records indicate 998,000 in the city 14 August 1945.

² Inhabitants "bombed-out" include those killed, injured and de-housed. Those "evacuated" include all others who left before and during the attack period.

Source: Osaka prefecture.

find permanent shelter with relatives or friends in other unburned sections of the city or to be evacuated to the country. Post-raid transportation was provided free for those being evacuated. Transportation of household goods was limited to what could be carried.

Emergency food and some clothing were provided from government stocks for periods of from 5 to 10 days after the raids. Supplies proved inadequate during the June raids, however. A comparatively rudimentary first-aid system was maintained, but was handicapped by a lack of medicines, ambulances, and bed capacity in those hospitals which survived the raids.

UTILITIES AND PUBLIC SERVICES

Summary

Aside from the enormous destruction of housing and factory buildings, the most serious direct effects of the Osaka urban attacks were sustained by the city's public services, including transport and communications facilities. There were wide differences in the extent to which the various services suffered physical damage and were disrupted. Likewise, there was considerable variation in the effect of such disruption on the city's ability to

continue essential war activity at the necessary level. In addition, factors other than the local area attacks placed differing limits on these activities during the attack period. The present chapter discusses effects of the attacks on Osaka's utilities and public services other than transportation.

In February 1945 electric power consumption in Osaka was only slightly below the average rate for the previous 18 months. But it declined almost 30 percent in March despite the fact that the urban attack that month did not occur until 14 March. In other words, use of electricity continued at a high level until the attack but was only 40 percent of normal for the rest of March. There was significant recovery from this low rate during early April, but on a monthly basis consumption did not move far above the March average before the June attacks, after which it again tumbled. But only to the slightest extent can these drops in activity following the attacks be ascribed to direct physical damage to power distribution and generating facilities. Rather it reflects the decline in consumption of electricity by industry, mass transportation and households. By far the greater part of this decline was in industrial consumption.

There was considerable evidence that repair of damage to electrical equipment within factories was a major obstacle to restoration of production in plants hit by incendiaries, but in practically no case was essential production held up by fail-

AIR RAID WARNINGS

(OSAKA CITY)

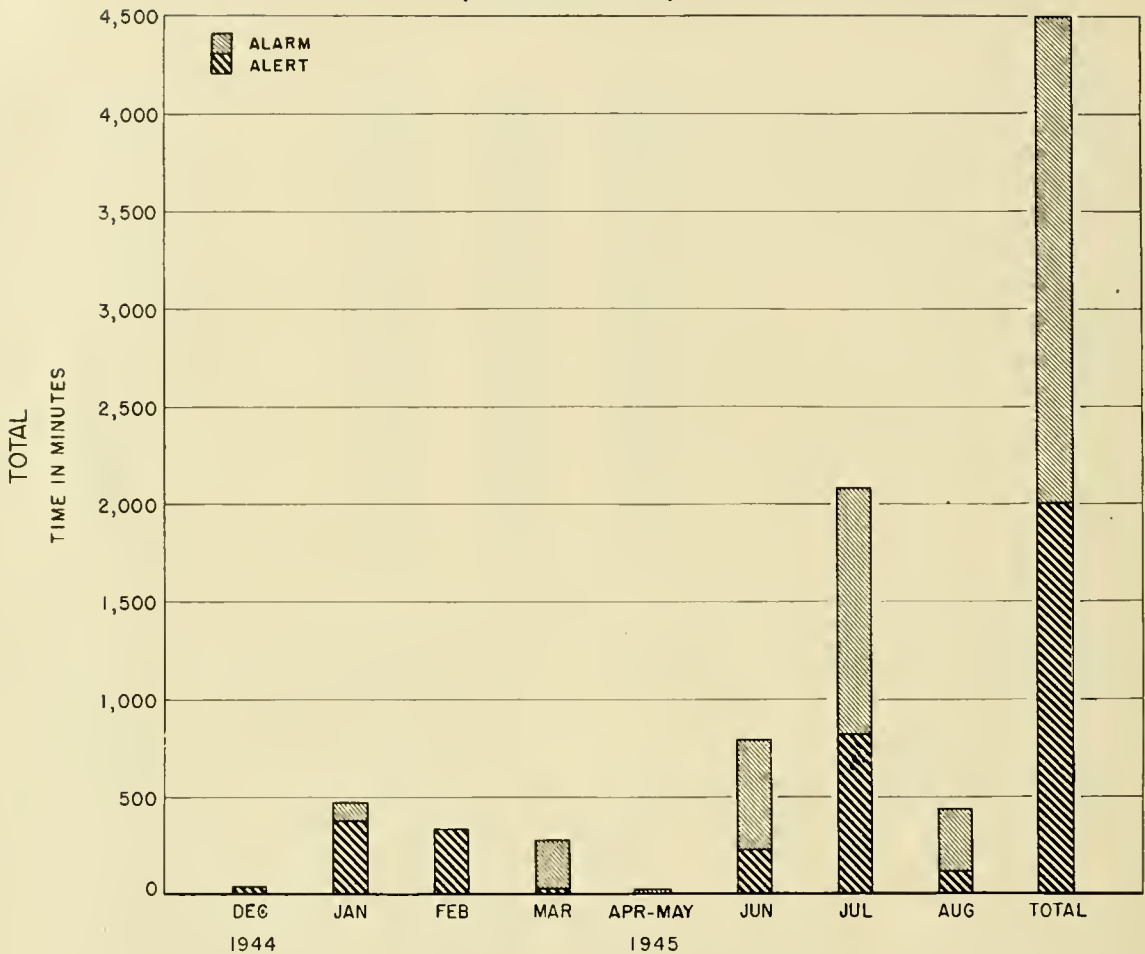


EXHIBIT 5

ures in the power distribution network. Damage to utility facilities in burned-out areas was heavy but could usually be restored long before essential users in the district were able to resume production, although it may have delayed plant repair activities initially in some cases.

The net effect of the initial urban attacks on Osaka and Kobe was such that an enormous power surplus existed in this region after March. Large thermal generating stations in and around Osaka, formerly vital to war industry, did ultimately sustain heavy damage as a result of precision and area attacks but all such stations had closed down after the March urban incendiary operations because outlying hydro plants could thereafter supply far more power than was required. Thus, in spite of the fact that only 49 percent of all generating facilities in the power system supplying

the Osaka region were able to function after the June raids, this heavy physical damage had no effect in Osaka or elsewhere on industrial production or essential public services.

The area attacks on Osaka did cause a very critical shortage of utility gas, despite a somewhat comparable decline in total demand. Gas was already being severely rationed so that essential war industry was directly affected when widespread leakage following the March attack considerably reduced available gas supplies. Since all fuels were critically short, including coal suitable for gas-making, this loss of fuel gas was most serious but there was insufficient labor to cope with the thousands of leakage points. No satisfactory means of cutting off leakage areas and still supplying key plants was possible either. But as in the case of electric power failures, many consumers



PHOTO 14.—Waterfront industrial area. After factories and row houses in this congested section were destroyed in the 1 June attack, large lean-to structures were erected to shelter survivors until evacuation could be completed.

suffered other damage that prevented production. The main impact of this gas problem accordingly fell upon suburban war plants that depended on gas for heat-treating and kindred processes, mainly in the production of ordnance items and aircraft components.

This gas problem became much more serious after the June attacks when heavy leakage was extended to all parts of the system, and was further aggravated by considerable damage to gas-holders and gas works. Many other factors were then operating to limit production for many plants but the gas shortage was the direct production-loss factor for a limited number of critical war plants.

The water system suffered comparably from leakage and was completely inoperative for two weeks after damage to pumping equipment in the 7 June area attack. But many key plants had independent sources for industrial use, so the main effect of water shortages fell on individuals, who had to cue up at available wells or take their chances on the highly contaminated surface water. With its many canals, Osaka placed no reliance on the water system for fire fighting.

Of profound effect on the city and regional economy was the serious breakdown in all forms of communications. Already under great strain, these were totally incapable of continuing a semblance of normal service after the area attacks. Thus at a time when the central records of many

firms, trade associations and administrative agencies were destroyed or damaged, when major changes in production schedules were necessary and a dispersal program was underway, it became necessary to depend upon runner instead of normal communications channels. Because of the concomitant breakdown of internal transport, the time required for the simple business operations often became a matter of hours or even weeks.

Other public services—including sanitation, welfare and educational facilities, then largely converted to war works—and the normal functioning of public offices, also suffered heavily as a result of urban attacks and all this contributed to the breakdown of essential services. Of special importance was the destruction of one of two main public markets and heavy damage to the other, coupled with damage to local food distribution centers and warehouses. This destruction had a major part in the breakdown of food rationing and the consequent growth of the black markets and industrial absenteeism.

Electric Power

There can be no question about the immediate and decisive effects of urban attacks on the use of electricity in Osaka. Exhibit 6 makes that clear. In February 1945, electric power was being consumed in Osaka at a daily rate only slightly below the average for the previous eighteen months. Power consumption had reached a record peak of

ELECTRIC POWER CONSUMPTION OSAKA

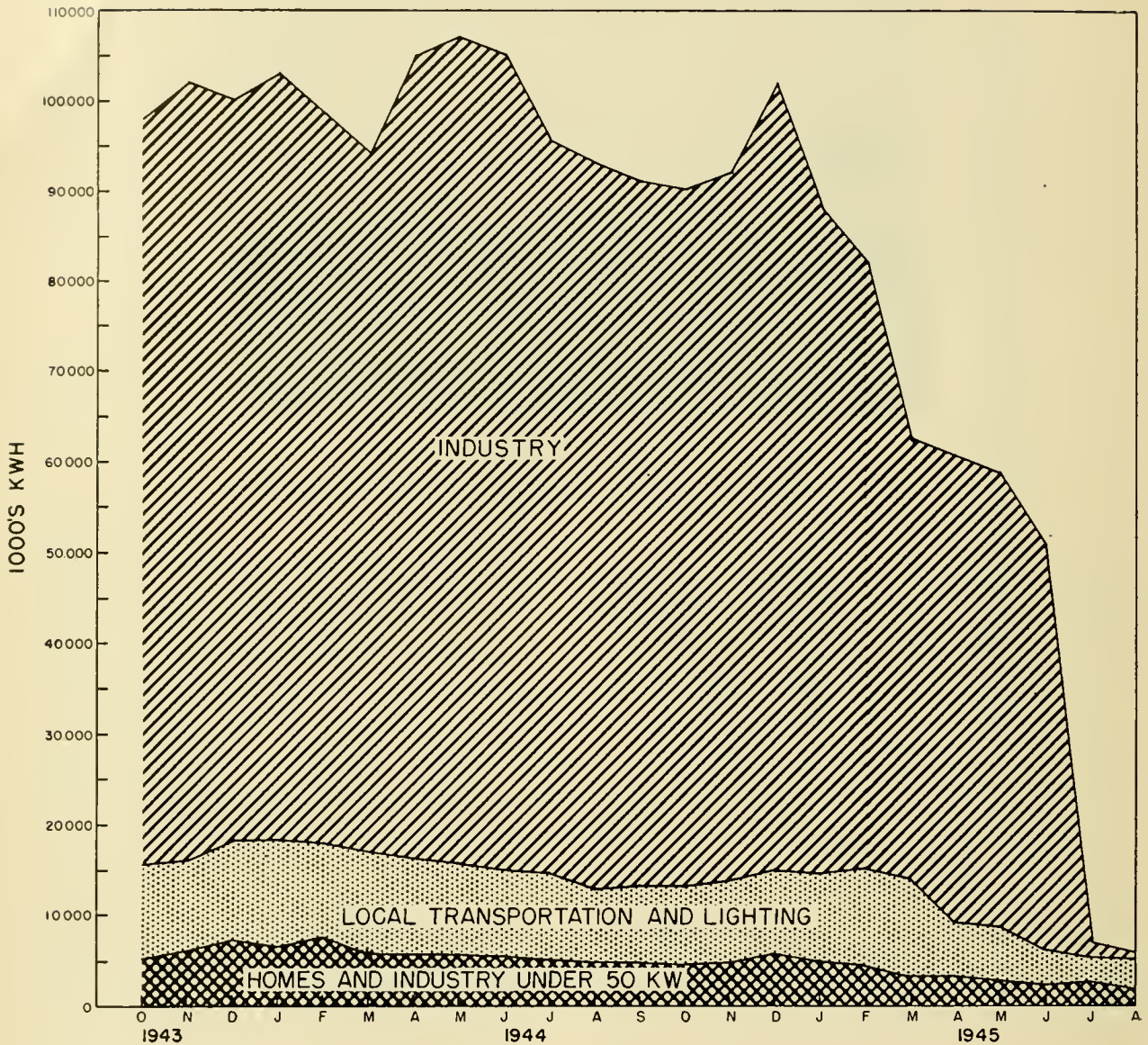


EXHIBIT 6

100 million kilowatt-hours in December 1944 with the all-out production spurt of that month, and had dropped back almost to 90 million kilowatt-hours in January, as every effort was made to curtail non-priority power use during the dry season period of greatest stringency and as production cutbacks were forced on some basic processors. But considering the shorter month, electric power was used at a slightly higher rate in February and likewise through the first 13 days of March. Nevertheless, the effect on power consumers of the 14 March area attack was such that

only 62 million kilowatt-hours were used in Osaka during the whole of that month. Average daily electricity consumption for March was thus almost 30 percent less than in February. Industrial consumption during the first thirteen pre-attack days of March had averaged more than twice that for the rest of the month.

Even more spectacular declines occurred after the June attacks on Osaka. Industrial consumption of power in July was only one-sixth of the May level and barely 7 percent of the rate prevailing before the March attack. But in neither case

can these abrupt declines be attributed to a breakdown in the system of power supply. In fact, the direct consequence of area attacks—not only in the case of Osaka but in all Japanese urban centers—was an immediate and sharp drop in manufacturing and the creation of an enormous surplus of electric power. Before the mid-March incendiary attacks on Tokyo, Nagoya, Osaka, and Kobe there had been strict rationing of electric power in all these regions, even though scarcities in such basic materials as salt and bauxite had already begun to reduce some of the nation's high-priority bulk power requirements. But after these initial attacks on the four major war production centers, there was such a widespread and immediate decline in industrial power consumption that all the large thermal generating stations in central Japan were shut down at once. After mid-March, outlying hydroelectric stations were more than able to meet all remaining demands, especially as their output was then rising to a maximum during the spring run-off period. By July, when stream-flow began to slacken, further attacks on the main centers had already reduced power consumption far below the minimum level of hydroelectric output and thus the power surplus continued to grow. In fact, a number of priority factories in the Osaka region were by that time trying to install electric heating elements in their boilers so as to become entirely independent of further coal deliveries. Many other end-product firms considerably reduced their coal consumption during this period through greater use of electric furnaces and electric welding.

The decline of electricity distribution, then, was a reflection of industrial collapse of Osaka, not the direct result of damage to the power network. Although damage to local distributing facilities, including secondary transformer stations, was very heavy in burned-out sections of the city, the factories served by such facilities also were usually damaged. Important high-tension lines were repaired or replaced within a few days after each attack, even where that involved stringing new circuits to individual priority plants. Such interruptions of priority service were relatively few and caused little disruption of production, since activity in the plants so affected was usually disorganized by absenteeism and other factors for a few days following each attack even where the plants themselves sustained no direct damage.

The local power company took understandable pride in its record of maintaining service to priority plants during the attack period, in spite of inadequate stocks of replacement materials and far too few skilled linemen. But in many cases, the prompt restoration of service did not mean that essential production could be as promptly resumed, for the power company's responsibilities ended at the factory boundary and there were many cases where plant damage was limited to auxiliary buildings which included the plant's own transformer and switchboard apparatus. Repair and replacement of such equipment was up to the factory officials in the case of priority plants. While a system of "flying squadrons" to survey and repair such damage in priority plants had been organized in Osaka under the regional office of the Munitions Ministry, the scheme operated mainly on paper, especially after the June attacks. The only skilled electricians actually available for such work were those not already employed in large war plants—independent artisans and small shop workers. While some effective emergency work was done after the March attack by such "flying squadrons," the organization broke down completely in June because fixtures and equipment were scarce and most of the skilled workers relied upon either disappeared or were pre-empted through black market channels.

Thus, plant interviews established that damage to electrical apparatus was relatively high within factories hit by incendiaries and that such damage proved to be much harder to repair than most other types. But the electric power problem in Osaka was a matter of internal plant damage—there was relatively little evidence of delay on the part of the power company in restoring service to essential users after attacks. Furthermore, as discussed above, the decline in industrial power consumption following urban attacks created a large over-all surplus of electric power in the Osaka region. Thanks to this surplus, Osaka and other sections of this region were not at all affected by the very considerable damage to power generating facilities in or near the city.

Osaka obtained its electric power from a generating network which supplied all of central Honshu west of the Tokyo region, including nearby Kobe, Himeji and Kyoto as well as Nagoya to the east and various points along the Japan Sea including the Maizuru naval base. Roughly

half the generating capacity in this network was accounted for by many hydroelectric plants located along mountain streams 50 to 150 miles northeast. The remainder of electric power needs was generated by large coal-burning plants in Nagoya and key cities of the Osaka region—principally in Amagasaki, directly adjoining Osaka on the north. In part, these steam generating stations were operated to supplement variations in hydro output but as the Osaka industrial region expanded in prewar years it has been necessary to add large “base-load” steam plants for year-round operations. However, due to the wartime coal stringency, power consumption in Osaka and neighboring cities still tended to follow the seasonal variations in hydroelectric output, with peaks in the spring and fall “wet” months and lows in August-September and the “dry” months of January, February and March.

A system of rationing and priorities for electric power had been instituted in December 1939. Increasing demands of war industry and the prospect of reduced coal supplies led to more severe rationing in October 1943, with the result that only the more important plants received all the electric power they needed while many had to observe power “holidays” or stagger load peaks. Under this decree, unessential users were cut off altogether or severely restricted. The priority system was thus used as a device for restricting non-essential industry as well as the means of conserving coal.

Because of this need to save coal, the older low-efficiency thermal stations within Osaka city were used as little as possible during the war but the city depended heavily on three high-efficiency steam plants located on the waterfront in near-by Amagasaki. These three units had been steadily expanded in the immediate prewar years and represented one of the world's largest concentrations of power-generating capacity. Until the March attacks on Kobe and Osaka, these plants were all operating at a high level. Their importance to the local war economy can be gauged by the enormous coal stocks on hand, with deliveries being continued well into 1945 despite other priority claims for the declining supply. As will be discussed later, only a fraction of these stocks were ever reallocated to priority war plants, even after the March attacks had made it obvious that the plants would never again operate.

Generating facilities in the urban centers proved highly vulnerable. In spite of precautions such as the building of blast walls around some generating and substations' equipment and iron roofs over two or three pieces of generating apparatus, air attack damage to generating facilities was very heavy. One of the very large thermal plants in Amagasaki was virtually destroyed and the two others seriously damaged in high-explosive spillover from the precision attack on a near-by oil refinery in May 1945. Another thermal generating plant in Osaka was 20 percent destroyed in the 7 June area attack. But as previously explained, none of these plants were operating or could have been needed after the March urban area attacks.

The Osaka power authorities accordingly feared most of all the destruction of four primary substations controlling all incoming hydroelectric power. If all four, located in the suburbs around Osaka, could have been put out of commission simultaneously, industrial production depending on electric power would have been affected, even after the March area attack. Each area raid did cause damage to several secondary substations but no lasting effect resulted, since either remaining capacity at the substations sufficed for the required load or tie-lines to other undamaged substations could be utilized. The only damage to one of the primary substations occurred in a July sweep by carrier planes:

Gas (Exhibits 7, 8)

In one sense, the growing shortage of coal may be regarded as the basic reason for the decline in Osaka's production of utility gas. It may be argued, however, that there was always ample coal available to permit a much higher rate of production, provided the authorities would choose so to allocate existing tonnages. But the fact is that supplies of coal with proper gas-making properties were not always available in sufficient quantity. Furthermore, the Osaka gas plants lacked large stocks, such as were provided the key electric power plants, and they were accordingly dependent on steady deliveries. Thus even temporary disruption of port and rail activity forced precautionary curtailment.

In general, it must be concluded that the limits on gas production before the attacks were the consequence of a decision to ration gas supply far



PHOTO 15.—Two standby power plants in western Osaka loom up over surrounding burned-out industrial area. One plant sustained considerable damage.

more rigorously than electric power, even for high-priority users. Primarily because of the area attacks, there was never sufficient gas to meet essential requirements after March 1945. This shortage had its main effect upon producers of military end-products. Non-industrial users who before the war took 80 percent of production were reduced to 40 percent by the end of 1944. From May 1944 until February 1945 gas consumption fell by over 25 percent, but the cut represented principally forced reductions in non-industrial use. After March, practically all industrial use was accounted for by large ordnance and aircraft component plants and domestic consumption was brought to a halt in June.

Contrary to the situation in electric power, consumption fell during the attack period because insufficient gas was available, not on account of reduced demand. The primary reasons for this were leakage after the area attacks and damage to plant facilities. The coal supply for gas production also declined during the attack period both in quantity and quality, as lower grades of Kyushu coal replaced former Hokkaido and other supplies. Production of gas in Osaka fell from 19 million cubic meters in the month of February 1945 to 15.2 million in April and 6.4 million in July. Consumption, however, fell even more during this period, from 18.3 million in February to 11.1 million in April and to 2.4 million in July, the difference between production and consumption being the result of leakage in the distributing system.

This leakage was due to extensive damage to individual outlets, to gas-holders and to pipelines

in the area attacks of March and June. The March damage was restricted to a few gas mains and to innumerable service outlets, but extensive damage was also done to the three local generating works in the June attacks. The main Osaka works was approximately 25 percent damaged in the 7 June and 15 June area raids, heavy damage occurring mainly to gas-holders with a total capacity of 3,000,000 cubic feet and to auxiliary equipment. The Seimi works was 10 percent damaged in the 1 June incendiary raid and again there was heavy damage to gas-holders of 2,000,000 cubic feet capacity. The precision attack against the near-by Sumitomo complex on 26 June inflicted 20 percent damage on the Torishima gas works. These estimates of damage were supplied by the Osaka Gas Company officials. Though damage to production facilities was relatively light, output was temporarily reduced even at current low levels, and subsequent operations were continually jeopardized by the loss of storage facilities.

The system leakage caused by the air raids was a definite and serious aggravation of the existing shortage. This shortage was felt even by the most essential consumers, especially those in the outskirts not otherwise subject to many effects of the area attacks. Due to leakage it was often impossible to maintain sufficient pressure to suburban plants for days at a time during the last months of the war. As a consequence, ordnance and aircraft components production was seriously curtailed in certain large plants.

According to gas company officials, repair activities were handicapped by shortages of skilled

GAS CONSUMPTION IN OSAKA CITY

(SOURCE : OSAKA GAS COMPANY)

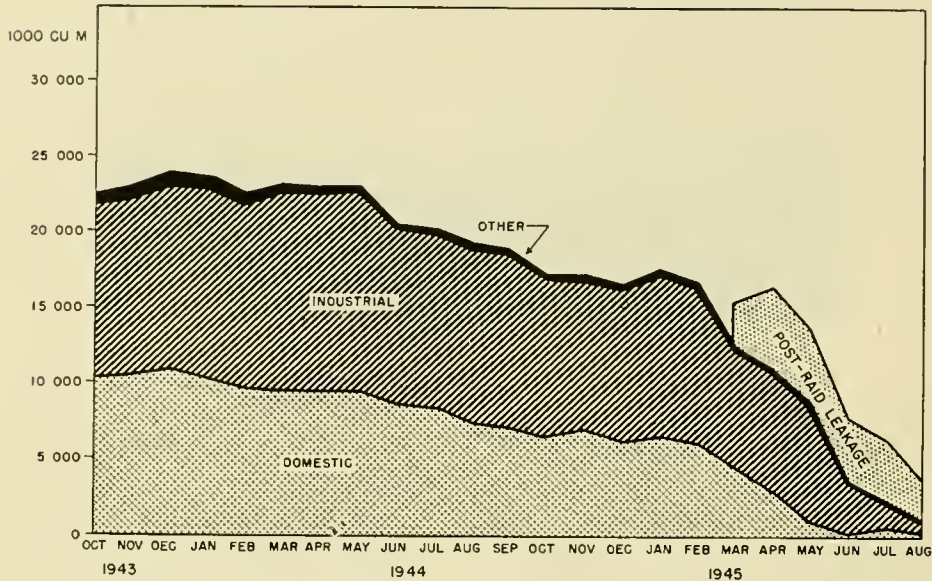


EXHIBIT 7

labor, but much more severe in its effects was the increased absenteeism for which the raids were largely responsible. The task of pinching off service outlets in burned-out areas was enormous. A shortage of repair materials and service equipment also played some part in the failure to repair lines promptly. However, the few breaks which occurred in high-pressure lines serving key war plants were normally repaired within three to seven days. Among priority users, only a few in the suburbs were cut off for longer intervals. In most cases their gas difficulties grew out of inadequate pressure and they were often able to continue operations at a reduced rate.

Water

The urban attacks would have had little significant effect on the city's supply of water except for the raid of 1 June, which resulted in a complete shutdown of the Osaka water system for two weeks. The effects of this shutdown were minimized, as far as essential industry was concerned, by the supplementary water systems which many large plants possessed. The effects on fire fighting in subsequent raids was unimportant because there was little reliance on the public system for that purpose anyway. Even the human consequences of this catastrophe were regarded as mi-

nor compared with other post-raid problems. The adverse effect on public health which might have been expected from complete disruption of the city water system was not evident although great inconvenience resulted in many residential sections.

The water supply made available in Osaka until the raid period sufficed for industrial use but called for strict economy in domestic use. It was, however, practically impossible to ration the distribution of water because of the inter-connection of mains and branch lines in both residential and industrial districts. A system of valve control and reduction of service periods in residential districts was used in an attempt to insure adequate pressure for top priority military plants, but was not very successful. The basic difficulty was not shortage of water but fuel rationing. The entire water system depended on pumps, of which there were 23 operated by electric power and six by steam turbines. Coal priorities limited the use of steam turbines to two before the March raid, resulting in lowered pressure despite capacity use of the electric pumps.

Public fire fighting authorities relied for water, not on the public water system, but on canals and static water ponds. Events in 1945 justified this procedure for, immediately after air-raid warnings, individuals drew upon the system for so

much water to fill tubs and wet down possessions that the pressure dropped practically to zero in many sections. The March and June raids caused relatively few breaks in mains and branch lines, but widespread leakage occurred wherever buildings burned. Thus there was a very heavy rise in water "use" for a week or more after each attack. But aside from main fractures, which did cut off service to large districts on several occasions, leakage at individual outlets in burned-out areas was by far the most important problem and required an enormous amount of "repair" effort.

The 7 June urban attack destroyed the power lines to electric pumps serving the entire water system. These pumps were unable to operate for three days and the same raid severely damaged the six standby steam turbines which provided the only alternate means for maintaining operations. After this attack, Osaka's water supply was totally paralyzed. The period 11 June to 20 June was a testing period during which major leaks

were located and repaired, and service was not resumed until 20 June. The 15 June attack occurred during this testing period and further delayed repair efforts.

In all, the March and June air attacks fractured major supply mains in 19 places and branch mains in over 300. Although a large part of the leakage was curbed within a week or ten days, repair work on some principal main fractures took as much as two months. In spite of priorities for labor and materials there was a serious material shortage for such repairs since many water service warehouses had burned. Repairing and cutting off the many branch lines amid the debris of burned-out areas was a longer and more difficult task than repair of main lines. The two July and August precision attacks caused further local damage to mains. As in the case of the gas system, leakage at thousands of individual outlets continued to be a major problem and much of the repair work still remained to be done at the time of the survey.

GAS PRODUCTION, OSAKA, 1945

SOURCE : OSAKA GAS COMPANY

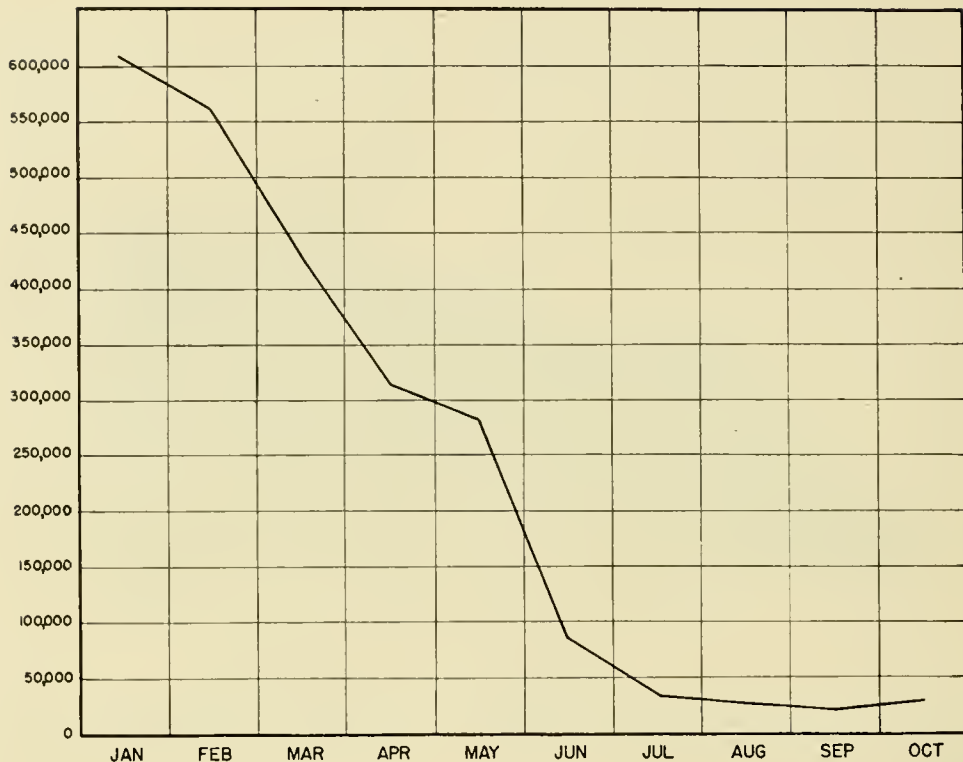
(DAILY AVERAGE BY 10-DAY PERIODS)



EXHIBIT B

LONG DISTANCE TELEPHONE CALLS

OSAKA CITY



1945

EXHIBIT 9

Communications (Exhibits 9, 10)

The large area raids had very serious effects on all mail, telephone, and telegraph services in Osaka. The disruption of these services played a significant part in the collapse of administrative controls and in the general inability of government and industry to make necessary adjustments after attacks. Such disruption enormously intensified the impact of breakdowns in transportation.

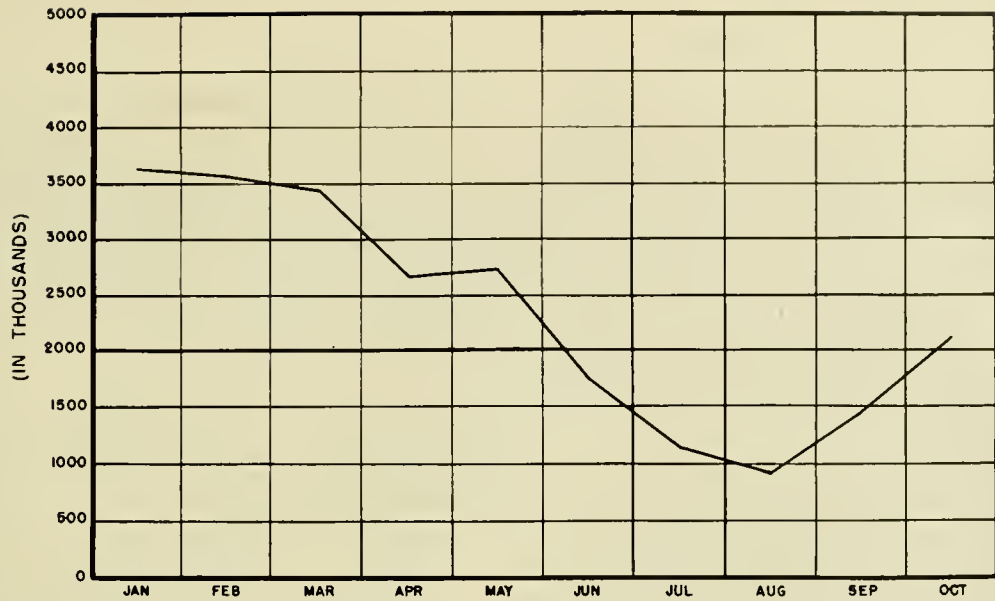
Many local post offices were destroyed, and mail shipments by train were held up for days after each raid. The population movements after the March attack so disorganized addresses that personal mail thereafter was delivered only to local neighborhood assemblies and frequently was destroyed or lost. Hand carts were substituted for motor vehicles in the delivery of mail, adding further to delay. After the March attack, no one could have confidence that messages or documents would ever be delivered by mail—even locally.

Many miles of telephone and telegraph wires

along with much equipment were destroyed in each raid, and shortages of material and labor made repair both difficult and slow. Only high priority telegrams and long distance calls could be made after March and these were usually official messages or appeals for help from air-raid victims. Most business matters necessitated personal travel or reliance on very slow mail. The total of long distance calls handled in Osaka fell from 576,000 in February to 430,000 in March, the month of the first area raid. Because of damage to facilities elsewhere, long distance calls fell to 280,000 in May, when the last area attacks took place in Nagoya and Tokyo-Yokohama, to 79,000 in June when heavy damage occurred in Kobe and Osaka, and to 40,000 in July.

An even more serious breakdown occurred in local telephone facilities, reducing the number of serviced subscribers—in most part government agencies, factories, or residences of managers and officials—from 110,000 before the March raid to 10,000 by August. To try to meet the equipment

MONTHLY TELEGRAMS HANDLED OSAKA



1945

EXHIBIT 10

shortage, 30 percent of Kyoto's telephone cables and auxiliary facilities were taken up and transferred to Osaka and Kobe. This highly wasteful measure was necessary because of damage to equipment producers and local stocks of materials. No new equipment was obtainable and, despite this effort to substitute Kyoto equipment, service could not be maintained even to many of the most urgent subscribers.

Records of telegrams handled monthly in Osaka do not demonstrate a significant failure of services in March. No damage occurred to the central telegraph exchange. However, from 3,458,000 telegrams handled in March, the total dropped to 2,709,000 in April, to 1,745,000 in June, and to 1,152,000 in July. This decline did not equal the breakdown in telephone services. These monthly figures do not indicate the effect of temporary delays in service after each attack, however, or the uncertainties about delivery.

Wireless communication services suffered at the same time, since sending and receiving stations were located some distance from Osaka, and messages had to be relayed by mail, telephone, or telegraph.

Labor problems in the communication services added to the disruption. There were very few skilled maintenance crews. Some workers were

killed or injured; others suffered from lack of transportation; others were engaged in evacuating their families and goods to the country. Absenteeism rose sharply in March but recovered in two to three weeks. But attendance after the June attacks averaged only 30 percent and recovered only partially and slowly. Officials attempted to solve the housing problem by allowing workers and even their families to sleep at the central offices. Public telephone service locally was still in chaotic condition at the time of the survey, with few subscribers connected and no means of reaching most suburban points. During the raid period, railway and military communications were maintained fairly well but these were overburdened and unavailable to other officials.

Business officials and governmental authorities agreed that the breakdown in communications was a major factor in the collapse of Osaka as the effective directing center for the region's war industry. It must be concluded that along with transport problems, communication failures had a catastrophic effect on the attempts of industry and government to carry through the emergency dispersal program, to make essential repairs and to readjust production, increasing many-fold the time required to transact business in this major administrative center. Almost every effort on the

part of industry in this region to obtain materials, labor, repairs, transport priorities, or anything else needed to restore production, required repeated contacts with various government agencies in Osaka. These, in turn, had to deal with each other and with Tokyo. When communication facilities were impaired, the effect on industrial and business activity was thus immediate and substantial.

Other Public Services

Perhaps the most serious consequences of the urban attacks among other public services was the widespread destruction of food stocks and food distribution centers. But damage occurred to many public administrative buildings and to various services under prefectural and municipal jurisdiction. Although the main prefectural buildings and the city hall escaped, Osaka's three other principal municipal office buildings were burned out, as were 6 of the 11 other large buildings in which principal wartime administrative offices were located. Also, nine of the 18 ward offices, four of the seven labor exchanges, four of the eight main warehouses for city supplies, as well as the most important general municipal workshop, were destroyed. Furthermore, six out of ten dormitories for city employees and 1,900 of some 4,000 other dwellings—many of them also minor offices—provided for men employed at various municipal posts were also on the burned-out list. Both principal public markets and many food distribution centers were destroyed or damaged. Of 163 facilities having to do with public health and welfare, 74 were completely destroyed, as were 25 of the 43 clinics and emergency hospitals, six of the city's 16 general hospitals and 48 of the 87 day-nurseries for children of working women.

Prior to air attacks over a third of the city's 409 main school buildings had been converted for war industry or were being used as public offices and industrial training centers. The dispersal program continued to utilize additional structures throughout the war period. But 211—more than half—of these structures were rendered unusable by bombing, including 126 totally destroyed. Fire damage usually included records and equipment, so that re-establishment of such functions elsewhere was most difficult.

While a mere catalogue of facilities destroyed

provides only the roughest measure of the disruption to municipal services, it does give some indication of the magnitude. Taken by itself, no one type of service is critically significant but when considered in light of concomitant disruption to other public utilities and services, the picture of general organizational collapse becomes clear. In this setting the decline of all supporting services takes on broader significance. Each factor helped contribute to the growth of confusion, general war-weariness and absenteeism. Each contributed to the steady reduction of the city's resilience and its ability to maintain even a minimum level of essential war production.

TRANSPORT AND STORAGE FACILITIES

Summary

While several of the essential public services already discussed were seriously disorganized by urban attacks, damage to local transport and storage facilities undoubtedly had the most severe consequences on the general economic life of Osaka and in particular on essential production. Among the various public services, local transportation is treated separately in this chapter in connection with general transport facilities. Our first concern is with the breakdown of passenger traffic facilities within the city, but the local movement and storage of goods was even more severely disrupted. The effect of the attacks in this respect fell upon one of the weakest underlying elements in the Japanese industrial picture—the growing shortages of basic commodities and of bulk transport facilities. But local transport and handling difficulties following the attacks affected all stages of production. Their immediate and drastic effect on current output of end military items caused the greatest concern.

Direct damage to Osaka transport and storage facilities had repercussions on production within and around the city as well as elsewhere in the region. Indirectly also, urban damage to ship and rail repair facilities and the administrative and manpower problems growing out of these attacks, aggravated otherwise existing difficulties with maritime and rail transport facilities throughout the region. In appraising these general shipping and rail transport problems during the attack period, both the decline in urban industrial activity and local consequences of the



PHOTO 16.—Bus terminals proved highly vulnerable to incendiary attack.



PHOTO 17.—Streetcars dispersed along an Osaka thoroughfare. Dispersal aimed at minimizing losses in terminal fires proved ineffective in districts where conflagrations developed. Remains of three modern high-capacity streetcars may be seen along the street behind this burned-out factory.

B-29 mine-laying program and other external pressures on transportation will require consideration.

Osaka's mass transport system suffered the gravest disruption, which contributed in large measure to the alarming growth of absenteeism among those industrial workers remaining after the attacks, and thus played a conspicuous role in reducing economic activity. This breakdown in the normal means for movement within the city was also a major factor intensifying the effects of damage to business and government offices and to communications. The process of replacing destroyed records, relocating offices and substituting manual transfer of orders and information for the normal reliance on central files and control systems and communication by telephone, telegraph and mail—all this would have been difficult enough had transport facilities been unimpaired. Since many districts were no longer served by streetcar after the March attack and travel delays of several hours were routine on those routes still operating, it became extremely difficult even to trace the movements of offices and individuals or to organize the many group conferences that were essential to Japanese administrative and business procedure. The extensive destruction of bicycles ruled out even this basic Japanese method of travel and communication to a considerable extent. After March, little use could be made of motor vehicles due to damage and to fuel and repair problems.

But aside from the movement of people and papers, wartime Osaka also had a stupendous task in the movement of goods. Practically every major producer in Osaka relied on a large number of smaller factories and workshops for the production of components and accessories, with materials being supplied by the parent company in exchange for finished items. In many cases such subcontractors in turn farmed out part of their operations. Thus there had developed an enormously complex system for delivering materials and semi-finished items which could permit of no interruption if end-product output were to be maintained.

Few subcontractors had large storage facilities, and the only means of enforcing allocation and production schedule and minimizing black-market diversion was to keep inventories at a minimum throughout the subcontracting network. Such a system necessarily meant that materials and semi-

finished items were scattered among thousands of small factory warehouses. In addition Osaka had many large warehouses connected with the port and with large enterprises and military agencies. These facilities were used extensively for storage of materials and semi-finished goods as well as for the assembly of military shipments.

In addition to incendiary destruction of many small storage sheds which had been required in the movement of materials and semi-finished items to and from subcontractors, over 60 percent of Osaka's large harbor warehouse facilities, including their contents, were burned out or heavily damaged. These warehouses had been constructed primarily to serve the port and rail transshipment movements, but they also serviced many local producers. Altogether, more than 207,000 tons of food, finished goods, and materials-in-process were destroyed in these central warehouses—roughly 30 percent in the March area attack and the remainder in June. Coupled with the enormous damage to goods stored at factory sites, such losses had a large part in bringing on the collapse of war end-product output in Osaka.

In Osaka's internal transport system, motor vehicles had always played a minor role. Aside from motor tricycles, wheelbarrows and horse-carts which moved a surprising amount of all smaller metal components and civilian goods—freight movement was primarily by barge on the city's many canals. In addition to internal transfers, most bulk items were also lightered to and from ships in Osaka harbor, and to the near-by towns of Sakai, Amagasaki and Kobe. Over half the available tugs and 40 percent of available lighters were heavily damaged in area attacks. Coupled with damage to ship repair facilities, this destruction resulted in a critical transport breakdown.

Overseas and coastal shipping through Osaka held up remarkably well as compared with other ports until 1945, when reallocation of available shipping to safer routes was considerably extended. Much of the decline in tonnage receipts during the latter part of 1944 had been related to the decision to halt steel production at Osaka and concentrate such operations elsewhere. Freight transshipment through Osaka also fell steadily. The decline during 1945 was especially serious with respect to receipts essential to local industry and in this decline the B-29 mining program was the decisive element.

The effect of the raids on rail and rail-ship movements through Osaka city and port was less severe than on internal transport. Little direct damage was done to rail equipment or right-of-way, although there were some delays during June and July and in train movements through Osaka from damage to rail communication facilities. Post-raid declines in rail activity were very serious, especially in June, but principally reflected damage to plants, stores, and internal transport facilities and general urban disruption. The main impact of the attacks on rail freight movement was thus due primarily to the decline in lighterage and trucking facilities to move freight to and from stations and transit sheds, which tied up cars and delayed in and out movements. The port was already operating at a much reduced rate in 1945 because of the shortage of shipping and the effect of mining. Except when there were insufficient hands to load and unload cars, the railway authorities were always able to clear the wharves and freight stations of incoming goods and usually could make deliveries to key plants and port areas promptly. However, the attacks did contribute to delays in handling, both through damage to port facilities and through absenteeism, which aggravated the critical shipping shortage by increasing the time required to load and unload vessels.

Street Railway and Motor Transport

The disruption by area raids of the various facilities for internal transportation probably was more important in its effect on essential industry than any factor other than direct plant damage. The post-raid food crisis, industrial absenteeism, and the collapse of repair and dispersal efforts are all traceable in part to failures of internal transportation caused directly by the urban attacks. The results of the four area and three precision high-explosive attacks on Osaka are summarized in the subsequent discussion, since damage breakdowns by individual raids are unavailable, but practically all damage was of incendiary origin.

In addition to streetcars and the city's one subway, the Osaka transportation bureau, a branch of the prefectural administration, had supervision over all other means of mass transportation serving Osaka except the main steam and interurban railways. Under its direction were:

(1) A truck association made up of 29 trucking companies.

(2) A bus association comprising 11 bus companies.

(3) A passenger car association made up of 30 taxi companies.

(4) Ferries connecting the various waterfront industrial districts.

A general priority system had been enforced as to use of trucks, buses, and passenger cars. Requests for transportation were submitted by the factory or business to the private associations, which had to obtain official approval before granting service. Aside from the military, only a few priority industrial concerns had their own motor vehicles and adequate fuel allowances.

Prior to the first area raid in March, the operation of buses, trucks and cars had fallen to inadequately low levels as a result of shortages of parts, labor and fuel. Even streetcar maintenance was already under great strain, only 433 of all 833 passenger streetcars in the city being in top operating condition before the March attack. However, the subway system was in good shape and over 300 of the surface cars in use were modern high-capacity types. Skilled repair labor was especially scarce for other types of local transport, and had caused drastic reductions in the volume and quality of repair work. Bus lines had been curtailed and no regular public lines were instituted to serve the new plants established during the war in the outskirts of Osaka. However, buses, trucks, or cars were specially allocated to specific plants and factory areas as deemed necessary by the prefectural authorities.

The area attacks of March and June 1945 virtually paralyzed the existing system of mass transportation facilities by destruction of rolling stock, trolley wires and supports, and other equipment. Furthermore, the attacks considerably delayed resumption of service by aggravating labor difficulties and destruction of repair facilities, materials and parts. Besides heavy damage to equipment, 15 of the 45 Osaka supply warehouses and central repair shops in Osaka for streetcars, buses, trucks, and cars were destroyed. After the March raid, repair delays occurred while 15 other warehouses and repair works were hastily dispersed to new locations. Nineteen of the ferries moving people and light vehicles between the various segments of the industrial waterfront were destroyed or

damaged. Destruction of boat repair yards and other shipping delayed their replacement. This loss was particularly serious as it forced detours of several miles for workmen and for those moving goods from one industrial district to another.

The trucking situation is illustrative of the three-way impact of urban attacks—on equipment, repair facilities and administration. Prior to the raids scarcely one-fourth of all trucks in Osaka were operating regularly, due to fuel restrictions and the need for repairs. About 20 percent of all trucks were destroyed in air raids, including many being held for emergency use, and of those remaining, the percentage able to operate was even smaller than before March.

The shortage of trucks already had constituted the weakest link in Osaka's local transportation system, although of relatively minor significance in total freight movement. However, trucking had a vital auxiliary role and thus contributed in large measure to the decline in railroad efficiency—especially in June—since insufficient trucks were available to move priority goods to and from rail freight stations. Lack of trucks also greatly complicated the local food transport and distribution problem after March, thereby intensifying labor troubles and general administrative collapse. The trucking shortage made dispersal of equipment or materials all but impossible for most firms and handicapped industrial repair activity after raids.

In spite of the official priority system, a large part of available trucking facilities—especially after the March attack—operated in the black market, usually for unessential purposes. Under existing conditions, the official controls proved ineffective. After each incendiary attack, there was much illegal use of trucks for removal from the city of personal belongings and raid victims and for black-market food handling. Moreover, allocation of trucking facilities for priority freight movement had never been uniform or fully integrated, since some private companies as well as Army and Navy plants owned and controlled their own vehicles. In general, local needs seem to have been sacrificed to interurban movement of priority items in the emergency allocation of trucking after March.

The collapse of local mass-transportation facilities was far more important, however, than disruption of auto and trucking service. Osaka industry, as Maps 1 and 4 indicate, was located around

a central commercial-residential district, and required a twice-daily cross-town labor migration of wholesale proportions that the streetcar system never provided after 14 March 1945. With the most congested districts depopulated, those who did not flee altogether had to relocate in the outer sections. Thereafter, delays of hours were entailed in getting to and from work. Even for suburban workers relying on the mainline and interurban railway facilities, which were not hindered seriously in their operation, it was necessary to hike long distances or queue up for local service. The collapse of local public transportation was thus a major factor in industrial absenteeism and the general decline in efficiency that grew steadily until the surrender. Previous to 14 March the streetcar system had also been used extensively in movement of rationed food and priority freight during off-peak hours. Since telephone and telegraph facilities were severely disrupted by the area raids, much more travel for communications purposes also became necessary at the same time that it became almost impossible. Only the one subway line remained as an adequate transportation link, and it served only a limited area in the center of the city, traversing one part of the commercial-residential area which was largely destroyed in March.

The disruption of street railway services was so complete because practically all lines in the extensive network crossed the areas damaged in March and others burned over in June. Since practically all buildings along the main streets collapsed or burned to the ground, overhead wiring, supports and auxiliary electric apparatus were all destroyed or rendered unusable. Altogether, over 90 percent of street railway mileage was located in burned-out areas and most of the essential auxiliary equipment was totally destroyed or required very extensive repairs. In addition, trackage was destroyed where 16 bridges burned out and at 30 other points where high-explosive damage was sustained.

Very heavy damage also occurred to rolling stock, 358 cars out of a total of 833 being destroyed by incendiaries, many of them in car-shed fires. In addition to the heavy damage to repair shops, car barns and material yards discussed previously, employees' barracks were also burned at three terminals, contributing seriously to desertions and absenteeism, and thus delaying repairs even further.



PHOTO 18A.—One of many Osaka streetcar terminals severely damaged in urban attacks. This pre-attack photo of the Minato terminal clearly indicates the building density prevailing in this important industrial section.

After the March attack, the street railway system was almost completely paralyzed and weeks passed before even a skeleton service could be restored except on “stub” lines outside the areas of damage. Another period of paralysis covered most of June, although a few lines through the central section previously destroyed were soon able to start moving workers across town. But only a few districts were served at all and it was common practice at peak periods for hopeful patrons to queue up for one or more hours as an alternative to walking for miles to and from work. Through service continued to be seriously handicapped until the surrender. Even as late as November 1945, only half of the city’s routes (totalling 116 kilometers) had been restored and there were only 30 percent as many cars available with less than 20 percent the carrying capacity of those operating before the March attack.

Interurban passenger traffic was very important for Osaka and the many electric lines connecting other cities in the region were not seriously interfered with by the attacks. These lines not only aided considerably in servicing peripheral and suburban sections of the city after internal facilities collapsed but proved extremely important in maintaining the flow of food supplies for remaining inhabitants.

Warehouse and Harbor Facilities

Osaka had become one of the most important ports of Japan in spite of a shallow harbor which required lighterage of most freight. During the war, deep-water wharfage was reserved for priority military shipments, and in any event, much of the bulk shipments moving to or from Osaka plants depended on use of lighters and local canals. Tonnage handled through Osaka harbor reached a peak of 1,322,000 tons in May 1944 due to particularly heavy outbound military shipments. Osaka had been one of the principal overseas ports during the period of southward expansion, but as military shipments declined and raw materials imports were cut off, traffic inbound and outbound each fell considerably below the wartime peak before the March urban attack. Relatively, however, this drop was far less than at Kobe and other major ports. The principal reason for the subsequent catastrophic decline lay in the Twentieth AF Inland Sea mining program, and resultant Japanese administrative decisions diverting relatively more of what shipping was left to other ports. However, delays in handling freight at Osaka did cut down on the utilization of that shipping which continued to reach the port and so added further to the decline in unloadings and loadings.



PHOTO 18a.—Aerial views before and after 1 June 1945 of the Minato district and streetcar terminal shown in photo 18a. Scattered damage resulting from the March attack may be observed. Note extensive firebreaks around terminal.



PHOTO 19.—Carts drawn by horses and oxen handled much of the heavy freight haulage between factories and terminals in Osaka during the attack period.



PHOTO 20.—Elaborate canal systems permitted most bulk commodities to move to and from factory districts by water.

Prior to 1945 lighters handled most of the cargo moved by large steamers, only 15-20 percent of the tonnage, principally military supplies, being handled at wharves. In 1945, with the great decline in maritime activity, wharves were used for 20-25 percent of the tonnage. But during the last two weeks, B-29 mine laying of the inner harbor forced all steamers to be loaded and unloaded by lighter.

Available lighters and dockside labor were being used to the limit before the air attacks were instituted. The following data supplied by the Osaka harbor commissioner gives some idea of the relative growth prior to air attacks of port congestion due to cargo handling problems and the importance of these two factors in such growth, despite the decline in total tonnage movements.

Ship days lost in loading and unloading—Osaka harbor

Month	Total cargo handled (000's met. tons)	Total delays	Lighterage delays		Labor delays		Other delays ¹	
			Days	Per-cent	Days	Per-cent	Days	Per-cent
July 1944----	1,010	80	21	26	19	24	40	50
Oct. 1944----	825	106	68	65	25	23	13	12
Feb. 1945----	639	236	78	33	32	13	110	47

¹ Delays in arrival of scheduled shipments, convoy-assembly, equipment breakdowns, etc.

After March these shortages played an increasingly important role—despite the progressive decline of shipping—right up until the surrender. The June attacks only reinforced difficulties that had already become critical after March.

Lighterage facilities in Osaka harbor had been deficient throughout the war period as a result both of an insufficient number of lighters and a shortage of labor and materials for repair and upkeep. This situation was affected critically by area attack damage to 200,000 tons of lighters out of a June 1944 total of 512,000 tons and to 162 out of 307 towboats.

Despite the substantial delays attributed to lighter deficiencies, port authorities considered that labor problems constituted the greatest single factor limiting the effective use of Osaka port facilities during the raid period. Food shortages, the shortage of skilled labor, and the general disorganization resulting from air raids caused severe drops in harbor labor efficiency. Taking 90 to 100 (for individual and seasonal range) as an index of prewar labor productivity—freight handled per man-hour worked—the pre-attack efficiency of harbor labor was placed at 80 by the Osaka harbor

commissioner. Thereafter, efficiency was estimated to have dropped as follows:

<i>Labor productivity—Osaka harbor</i>	
Month	Efficiency
March 1944 -----	80
April 1945 -----	¹ 75
May 1945 -----	70
June 1945 -----	² 60
July 1945 -----	50
August 1945 -----	45

¹ First month after March area attack.

² Three area attacks.

In addition, absenteeism and desertions rose to an alarming extent after March and much time was lost in air alerts. Attempts were made to alleviate the situation by the use of Chinese and Korean coolies and war prisoners. Also, efforts were made to keep labor by paying extra-legal wages and giving special benefits in the way of extra rations. After 1 June, there was no housing or transportation left in the main port district, so these measures were generally unsuccessful in their aim of insuring an adequate harbor labor force, even for the much reduced level of activity.

The raids had other and more direct effects on freight handling. Unloadings and loadings stopped for a minimum period of 48 hours at the time of each attack. Also, over one-third of the heavy cranes in the harbor district and 13 of its 22 mechanical loading and conveying facilities were permanently put out of action. Destruction of some water pumps in the harbor district caused inundation of those parts of the area below sea level, causing some damage to warehouses and forcing many dock workers to move out of emergency barracks that had been erected after the attacks of 13 March and 1 June.

Moreover, destruction or damaging of 60 percent of Osaka's warehouse facilities in the four large area raids often left insufficient storage and handling space for incoming and outgoing cargoes even at the reduced volume of traffic. The situation was grave after each of the attacks, and even worse cumulatively for it led to considerable spoilage during periods of disruption. After June, ship-shore transport through Osaka port was so disorganized that the prompt transshipment of goods became almost impossible. Altogether 4,360,000 square feet out of 7,500,000 square feet of port warehousing was damaged or destroyed. In addition, 207,000 tons of goods were rendered unusable when damage occurred to these warehouse facilities. About 30 percent of such goods were destroyed in March and the remainder in June.



PHOTO 21.—The 1 June attack was particularly heavy to warehouses and plants in the harbor area. Note many lighters used to transship goods from vessels at anchor.



PHOTO 22.—In addition to heavy destruction of goods in storage and on wharves, industrial damage was also severe. No attempt was made to salvage equipment in shops such as this.

These losses were classified by the Osaka harbor commissioner as follows:

Destruction of goods in harbor warehouses

Type of commodity	Tonnage destroyed	Estimated value
	<i>tons</i>	<i>yen</i>
Machinery and metal products	70,000	135,000,000
Clothing and textiles	50,000	15,000,000
Foodstuffs	20,000	14,000,000
Other	67,000	84,000,000

These include only items under jurisdiction of the harbor commission at time of destruction. In addition, there was extensive damage to military stores, foodstocks and other essential items controlled by Osaka Army arsenal and by other official agencies. Likewise, damage to factory warehouses and contents is not included.

It is difficult to isolate the effects of the damage to port facilities just discussed from external factors limiting maritime traffic through Osaka, such as mining, and from the indirect effects of the area attacks on port operations, including intensified labor problems and lack of lighters for unloading. All of these were interrelated and simultaneously operative during the attack period. However, it is clear that, directly and indirectly, the urban raids played a significant part in the deterioration of port activity, for they prevented the efficient use of what large-draught shipping was still available to move priority tonnage to and from Osaka.

The effect of damage to lighters, warehouses and handling facilities did reduce the important but dwindling amount of traffic through Osaka port. But of far greater influence on essential manufacturing and other activities in the city was the concomitant breakdown of internal transport by water. As previously discussed, Osaka's elaborate canal system permitted bulk movements by water between most key factories and many of their subcontractors as well as to rail and harbor transshipment points.

The breakdown of land transport in March and the pre-emption of facilities thereafter in dispersal efforts placed even greater burdens on this service in connection with component and finished product movements. But a significant fraction of available lighterage was also destroyed on 17 March and a total of 40 percent by June. The concurrent destruction of boat repair facilities magnified the effect of this loss on internal freight movement. Because of simultaneous widespread damage to

goods in storage and to manufacturing facilities, this disorganization was observed especially in growing delays in the movement of essential freight. Even with a greatly reduced total demand for local freight service, remaining facilities proved gravely inadequate throughout the rest of the war.

Shipping

Japan's shipping position as it affected Osaka—and as it was in turn affected by developments within the city—will be considered from two standpoints. The over-all decline in maritime traffic through Osaka must be examined in relation to local and regional activity. But also, the external factors responsible for this decline must be reviewed, particularly the decision in January 1945 to divert traffic to other and more protected ports and the B-29 mining program initiated in local waters at the beginning of May.

Exhibit 11 presents tonnage data on maritime shipments in and out of Osaka harbor during the period of analysis. Whereas such other major Japanese ports as Kobe, Yokohama, Tokyo and Nagoya had lost heavily as compared with pre-war years, Osaka continued to be a major point for receipts of imported industrial materials and organization of outbound military convoys. In 1944 maritime activity reached new wartime peaks as practically all mainland and South Seas traffic was diverted away from Nagoya and Tokyo bay ports in response to the submarine menace. As discussed in the Kobe report and in the report of the USSBS Transportation Division, transshipment through Osaka permitted such traffic to move by way of the protected Inland Sea and China coast routes.

With the appalling loss of overseas tonnage on southern convoy routes, it became increasingly urgent to avoid the unnecessary risks involved in the Pacific ocean approaches to major industrial centers east of Osaka. Osaka thus took on much of the essential traffic that otherwise would have moved eastward by water, but also overshadowed near-by Kobe, whose extensive harbor and transit facilities had always formerly been more extensively utilized. This concentration of port activity at Osaka rather than Kobe permitted a somewhat shorter rail haul for transit traffic to eastern centers but it was primarily the consequence of Osaka's dominant role in processing essential war

items. Thanks to the network of canals, goods could be lightered directly between many Osaka plants and the harbor. Thus, at the expense of port congestion, Japanese authorities preferred to minimize the rehandling involved in transshipment via Kobe.

Osaka's relatively limited prewar wharfage could not be much extended but deepening of the harbor area made possible accommodation of considerable tonnage at anchor. As long as sufficient lighterage and handling facilities were available, incoming cargoes could be lightered directly to factories, to large central warehouses and railway terminals, or to near-by industrial suburbs. Osaka offered similar advantages for outbound traffic and, accordingly, had become the center of much Army and Navy forwarding activity. But the great bulk of Osaka port activity depended on

effective lighterage. As developed in the preceding section, these facilities were never adequate after the urban attacks started, despite the heavy decline in traffic after January 1945.

Exhibit 11 clearly indicates the relative predominance of incoming traffic, which represented approximately two-thirds of the total throughout the peak period of 1944-1945 except for one month when outbound military shipments were particularly heavy. Incoming receipts during the first half of 1944 included an unusually large proportion of transshipment traffic diverted from other ports. There was a sharp decline in July to a new level of receipts which was then maintained through January 1945. In part, this lower level was the consequence of reduced imports from mainland areas but primarily it followed from the decision to concentrate basic metals produc-

TOTAL SHIPBORNE FREIGHT - OSAKA CITY



EXHIBIT 11

tion at large integrated plants farther west and thereby to economize on the amount of shipping needed for bulk commodity movements.

Military events in the south had much to do with the first serious decline in outbound shipments which did not occur until December 1945. At this time there was a general reorientation in Japanese transport strategy as remaining merchant tonnage had to be withdrawn from southern waters and was pressed into the inner zone shuttle service and the support of remaining defensive outposts. As a part of this program, all possible maritime traffic was diverted away from the Inland Sea route, which up to this point had offered protection from American submarines, but were now being regularly invaded by Marianas-based B-29s. Thus, in February, much of the mainland tonnage destined for the Tokyo and Nagoya districts began to move through ports along the Japan Sea although traffic originating in the Inland Sea and including considerable Kyushu coal, was still transshipped through Osaka. Similarly, much outbound military traffic had even earlier begun to move by rail to Hiroshima or to Moji and other Kyushu ports.

The critical period for maritime traffic was 1945. Through January, receipts continued at about the level maintained since mid-1944. In February, there occurred the first big drop of almost 100,000 tons but this included a 60,000 ton decline in coal transshipped through the port to eastern points. There was an even greater drop in March although total waterborne coal receipts, which now represented almost a third of all incoming tonnage, improved slightly. Thereafter the coal traffic slumped, although other receipts improved considerably in April. The B-29 mining program had a drastic effect on May receipts of all types and by June, coal receipts represented barely 20 percent of the March figure. The decline continued through July and early August. Throughout 1945, total traffic through Osaka harbor was about evenly divided between large vessels and small motor schooners.

Outgoing tonnage dropped severely in January as hasty reassignments were made in military shipments. From then on, practically all priority military items were moved by rail to Hiroshima and to Kyushu points while much industrial tonnage continued to rely on small boats. Outgoing tonnage remained comparatively steady until

June, when urban attacks severely disrupted port activity and caused so great a level of industrial decline that even priority rail shipments were drastically curtailed along with items moving by water to Inland Sea points.

A final comment on the B-29 mining program is called for. As already suggested, maritime traffic had been increasingly diverted away from Osaka for three months before the main aerial mining effort got started. Transshipment through Osaka had largely been eliminated in favor of ports on the Japan Sea. Nevertheless, mining had a drastic effect on residual traffic of relatively great direct importance to local industry. Had it not been for the effect of the June urban attacks on local activity, May and June sinkings from B-29 mines and the consequent delays for sweeping and convoy reorganization would have had serious immediate effect on several types of priority activity. The initial sinkings contributed to already serious confusion among responsible production and allocation officials and those operating port and shipping facilities. The campaign swamped local ship repair yards with work they were in no position to handle under existing conditions. Combined with port handling delays discussed previously, the mining program seriously reduced the tonnage that could otherwise have been pushed through with the amount of shipping allocated for Inland Sea traffic.

Detailed analysis of the B-29 mining program is provided in USSBS Pacific War Report No. 78. It will be sufficient here to point out that the main program was not initiated until May 1945. A first phase effort at the end of March in support of the Okinawa campaign was directed against the Kure and Sasebo naval bases, the west Kyushu port of Fukuoka and the Shimonoseki Straits area so vital for bulk commodity traffic from the mainland and the north Kyushu industrial area. After this initial effort of only 45 sorties, the B-29 mine laying campaign, like other aspects of the strategic air program, was largely deferred during April in favor of immediate support for the Okinawa campaign.

The main program got started at the beginning of May and was directed against Inland Sea traffic between Shimonoseki and Osaka. Most of the mines were dropped in the straits and in Osaka bay, but also west of Kobe. In mid-May, north coast ports were added to the target list, and

OSAKA REGION R.R. FREIGHT TRAFFIC

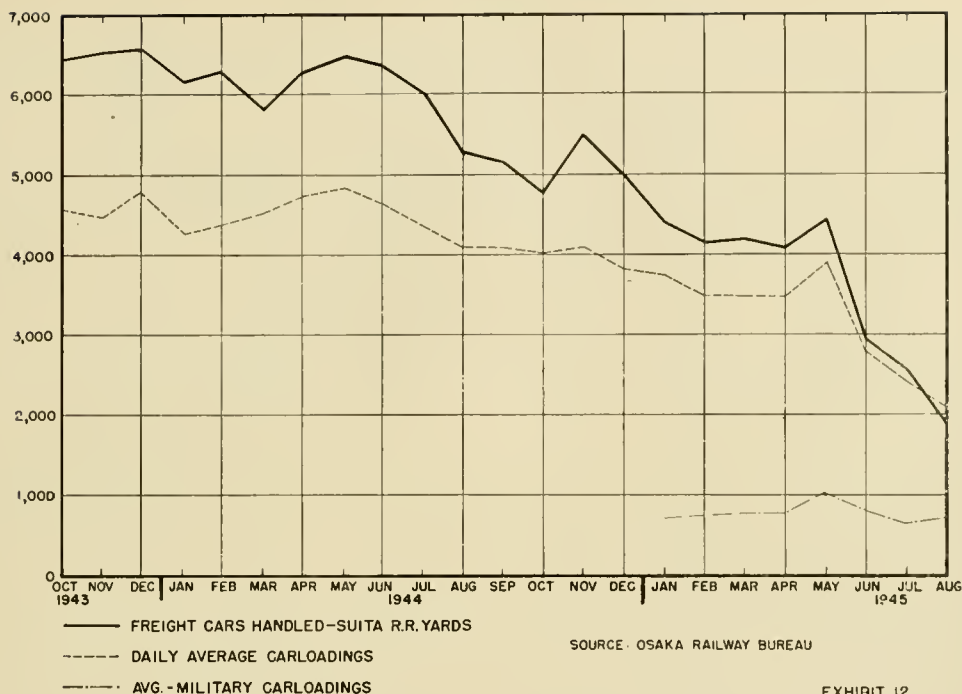


EXHIBIT 12

thereafter the campaign was steadily maintained at a rate of more than 300 sorties per month. Altogether, half the B-29 mining effort was expended against the crucial Shimonoseki Straits area and 25 percent against north coast ports—by that time of the greatest significance for residual mainland traffic. But some 59 vessels totalling 108,000 deadweight tons were sunk in Osaka bay and 11 in the southern approaches between Osaka and Wakayama. Eighteen major vessels and many smaller craft were damaged. Mines dropped within the inner harbors at Osaka and Kobe late in July forced all handling thereafter to take place by lighter from the open bay, thus further reducing port effectiveness.

Rail Transport

With the sharp decline in maritime traffic through the Inland Sea during 1945, a critical new burden was placed on Japan's railway system. Carloadings in the Osaka region, as Exhibit 12 indicates, stood at record levels during most of the war period, reaching a peak in May 1944. Total carloadings, of which Osaka originated over half and Kobe and Kyoto together accounted for almost one-third, declined during the latter part of 1944 as overseas imports and transshipment

through Osaka fell off. There was a further drop at the end of the year as maritime tonnage for eastern centers was diverted to Japan Sea ports.

For the region as a whole, carloadings remained fairly stable during the February-May period of 1945 as dispersal efforts supplemented other traffic. Data on direct military shipments by rail, including troop movements, is not available for the months before 1945 but Exhibit 12 clearly portrays their growing importance during most of the attack period. Military traffic by rail is believed to have been considerably lower before January 1945 and, from that point onward, ranked with coal as the critical rail transport responsibility in this region. Through military traffic originating in other districts and large coal movements from west Honshu and Kyushu are, of course, not reflected in these carloading figures but they do provide an index of regional activity and mark the decline of transshipments through Osaka and Kobe. Exhibit 12A supplements this regional carloading data with gross tonnage estimates of in and out movements for Osaka city itself. Later in this report more careful assessment is presented of local rail freight movements in connection with bulk commodity and fuel traffic, which represented a large part of the total.

TOTAL RAIL FREIGHT - OSAKA CITY

METRIC
TONS

700,000

600,000

500,000

400,000

300,000

200,000

100,000

0

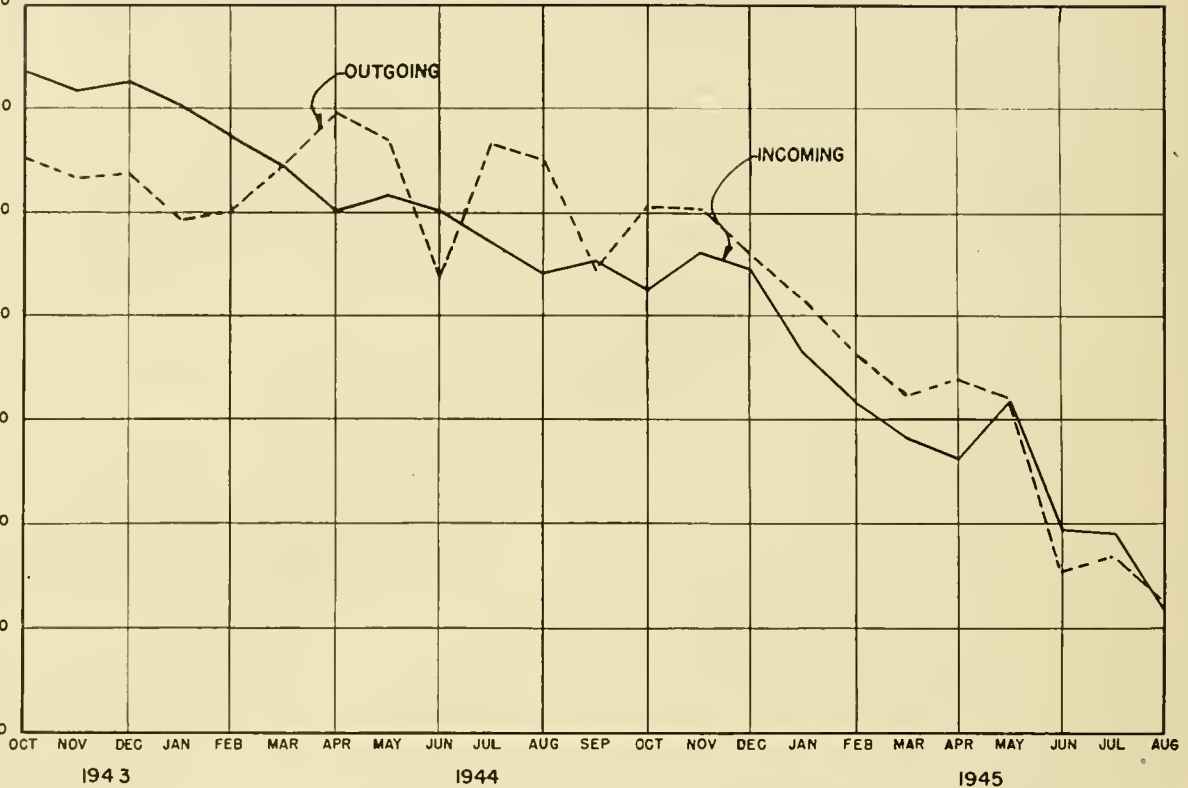


EXHIBIT 12 A

The coal traffic from west Kyushu was initiated by rail at the end of 1942 as a means of releasing colliers for the shuttle service in ore and coking coal from the mainland. Until October 1944 the volume of traffic remained below 7,000 cars per month from north Kyushu fields into the Osaka region. All such coal moved over the Sanyo line from Shimonoseki to Kobe which, for much of the distance, was only single tracked. From the ton-mile standpoint, the burden of traffic during 1944-1945 was even greater than indicated by Exhibit 13, for much of the increase represented coal moving on east of Osaka to other industrial centers. After March 1945, there was a substantial cut in such coal traffic to Nagoya and beyond.

Various efforts were made to improve car utilization and to reduce turn-around time as a means of compensating for longer hauls. Coal provided only the most conspicuous example of the general problem as the railways took on a larger share of long-haul traffic formerly handled by coastal shipping. Steps were taken, especially during 1944,

to increase loadings per car by removing safety limits and penalizing shippers for less than capacity shipments. For the country as a whole, average loads per car increased from 11.8 tons in 1941 to 13.7 in 1943 under relatively mild administrative pressure. Further efforts in 1944 raised this level to 14.4 tons but even more strict enforcement improved average loadings to 15.6 tons for the first part of 1945.

These measures were inadequate, especially in the Osaka region, to cope with ton-mile requirements. Maintaining sufficient motive power capacity was especially serious although shortages of gondola cars and other special types also became a problem. The following quotation from an official statement prepared for the Survey summarizes the situation in this area from the standpoint of the railway administration:

With the decrease of the bottoms and of the coastal shipping of coal, the most important goods for transportation between Kyushu and the Osaka region, as between Hokkaido and the eastern part of Honshu, was gradually converted to railway transportation. Consequently the dis-

COAL TRAFFIC BY RAIL

(KYUSHU COAL ARRIVING AT OSAKA DIVISION)

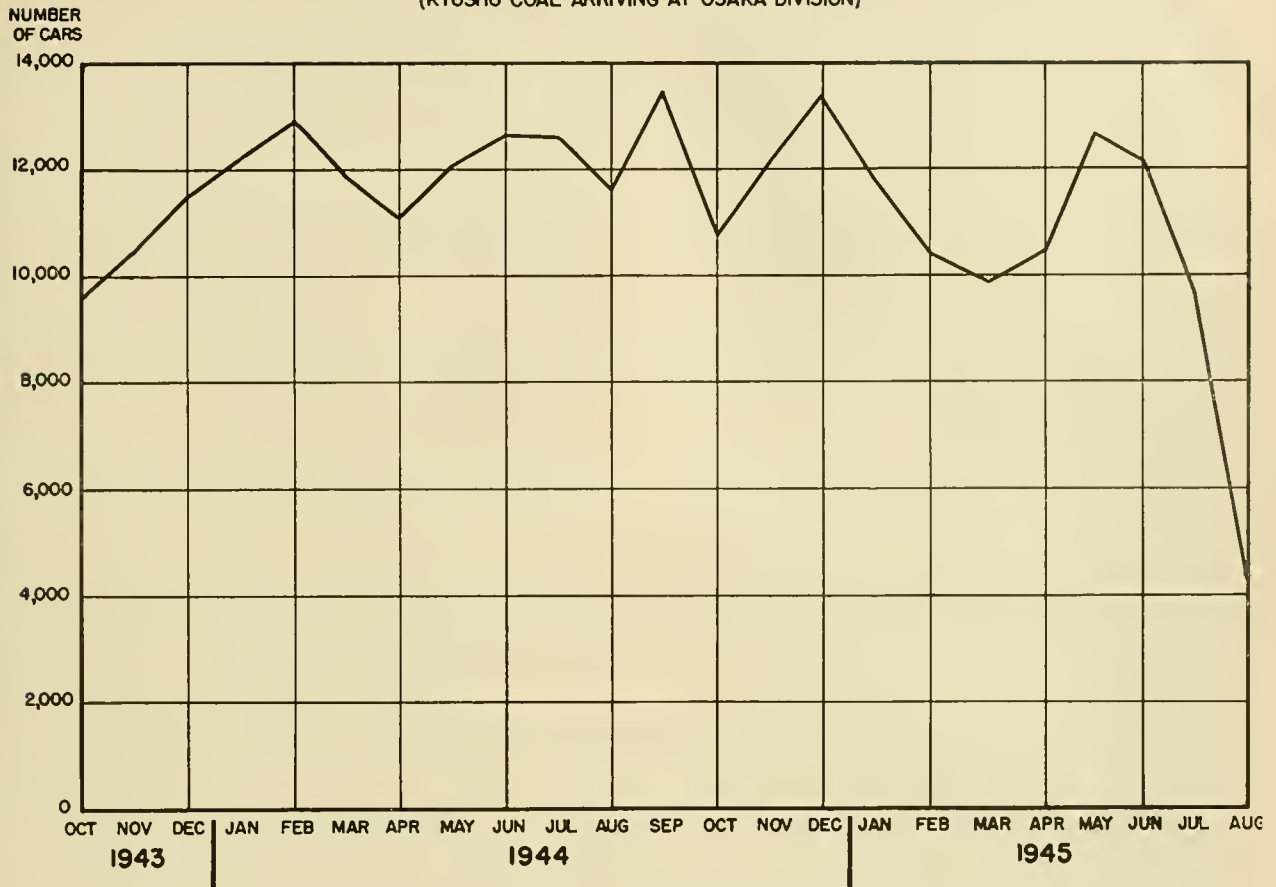


EXHIBIT 13

tance of traffic became about three times longer than before, demanding much more traffic efficiency, while the tonnage moved was scarcely increased. But the capacity of transportation equipments could not be improved as expected, so the government railways had to resort to these means: firstly, the ruthless curtailment of passenger trains; secondly, the reallocation of the existing equipments; and thirdly, the emergency overloading expansion of them. Even these means, however, could not secure the satisfactory efficiency of traffic, and rationing control had to be extended to all types of freight traffic. * * *

Thus, the transportation of materials and travel, both necessary to sustain the national life, was intensely regulated. In spite of all efforts, even the military transportation could be hardly carried out since the spring of this year (1945) on account of violent air raids.

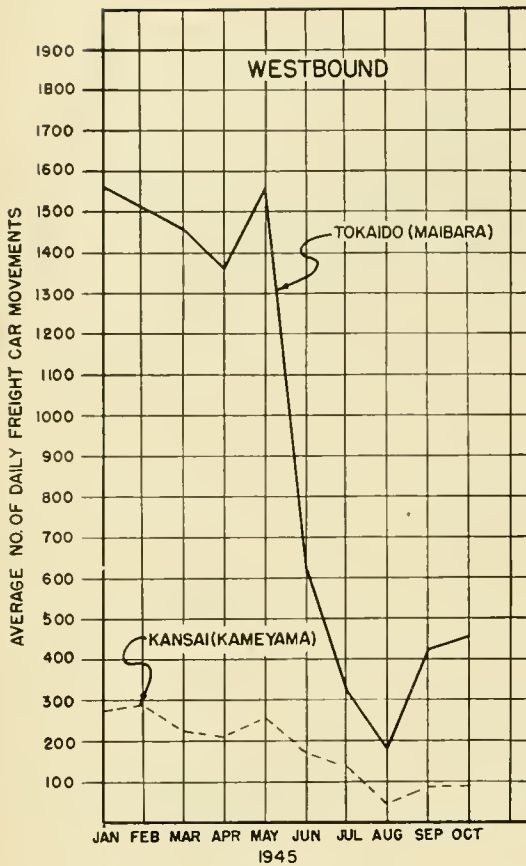
Despite this rather pessimistic account of rail traffic conditions, the railway authorities here could usually make good their boast to handle anything loaded on cars—even during the raid period. Labor discipline remained excellent in the railway service and there was no evidence of administrative disintegration. The rub came in 1945

when sufficient cars could not be provided—especially in connection with dispersal. Car shortages also developed at the north coast ports when maritime traffic was diverted from Osaka through the Japan Sea. The primary difficulties here were inadequate car maintenance facilities and lengthened turn-around time as a result of dispersal and urban damage. Relatively little rolling stock was seriously damaged in urban attacks.

Time lost in loading and unloading cars became a serious problem even before the March urban attacks, as key aircraft concerns made frantic efforts to disperse production equipment and stocks of materials and components. The March attack on Osaka had a sharp but only a temporary delaying effect on loadings and, for the region as a whole, this was compensated for by increased transshipment activity and dispersal.

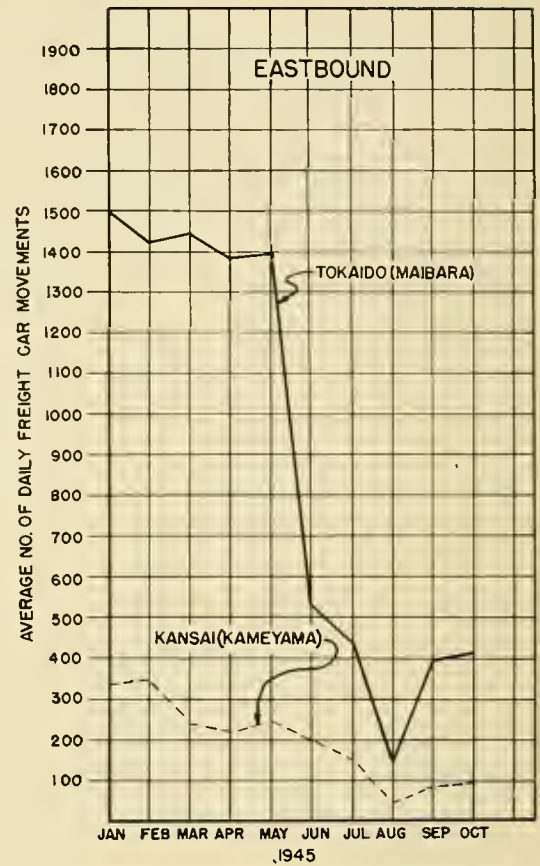
As maritime traffic at Osaka fell off, more rail movement of priority industrial freight was re-

RAIL FREIGHT TRAFFIC TOKAIDO & KANSAI LINES BETWEEN OSAKA & NAGOYA



NOTE

THESE ARE THE TWO RAIL LINES CONNECTING THE OSAKA AREA AND POINTS TO THE WEST WITH NAGOYA AND EASTERN HONSHU. MAIBARA AND KAMEYAMA ARE WAYPOINTS ON THE LINES BETWEEN OSAKA AND NAGOYA



SOURCE

OSAKA RAILWAY BUREAU, NOV. 1945

EXHIBIT 14

quired during the spring and at the same time military traffic greatly increased. The first big change did not occur until the severe collapse in carloadings and traffic after the June attacks on Osaka and Kobe. This time there was no significant recovery. The decline in freight car utilization during this period is indicated by the fact that prior to the March attack there was one daily carloading in the Osaka region for every three cars in use, whereas by June there was only one loading for every five cars in use. Thus despite the drastic traffic decline, car shortages and delivery delays increased. Damage to railway shops further intensified this problem.

Data on the direct effect of urban attacks on rail traffic is presented in Exhibits 14 and 15. The rail system in this region operated as a unit and Osaka-Kobe traffic with regional and outside points dom-

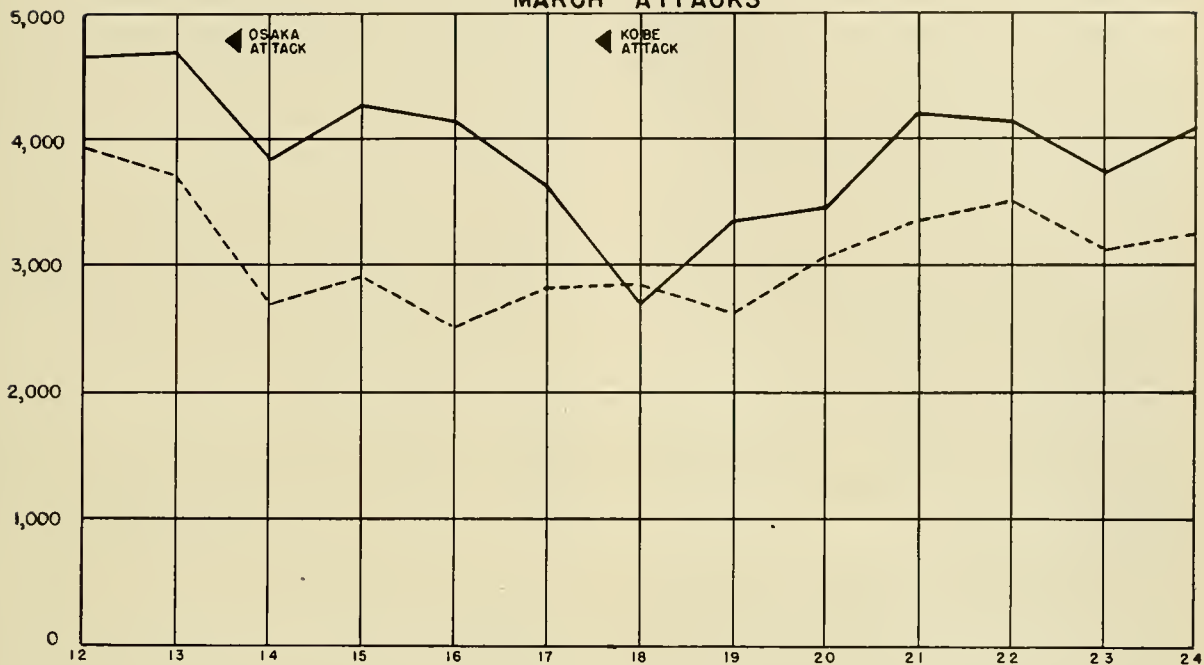
inated total traffic. Thus the true impact of the attacks can best be gauged only by measuring changes in total regional loadings and fluctuations in the amount of traffic handled on key lines and through the Suita railway yard. This marshalling yard, the largest in Japan, provides an excellent barometer of rail activity. It handled all interchange traffic between the Sanyo and Hokkaido trunk lines—the main routes to Shimonoseki and to Tokyo—as well as practically all traffic in and out of Osaka, Kobe and Kyoto, as freight trains were made up here for all of the region's through and branch lines.

Although the area raids on Osaka caused little direct damage to rail facilities, they did severely reduce traffic capacity indirectly in two respects. At the same time, of course, urban disruption and plant damage deeply reduced demand for rail fa-

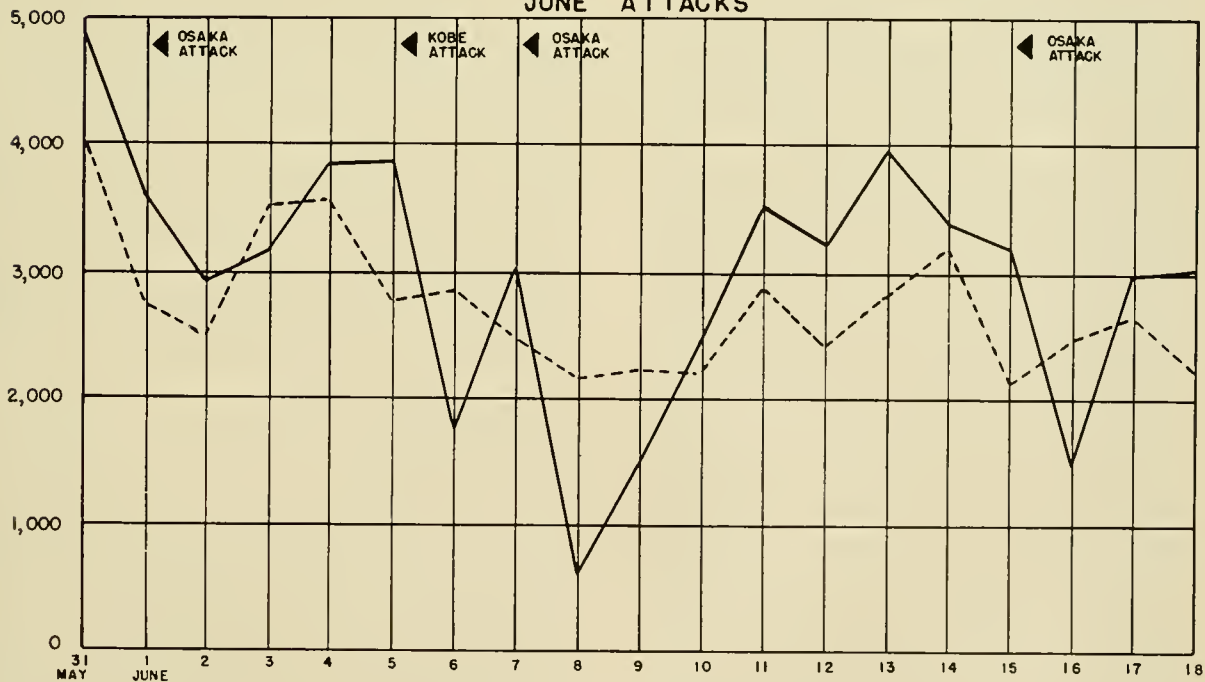
OSAKA REGION URBAN ATTACKS AND RAIL TRAFFIC

(REGIONAL CARLOADINGS AND NO OF FREIGHT CARS HANDLED AT SUITA YARDS)

MARCH ATTACKS



JUNE ATTACKS



— NO OF CARS HANDLED - SUITA R.R. YDS.
 - - - CARLOADINGS IN OSAKA REGION

EXHIBIT 15

cilities. Damage to rail communication and signalling equipment in Osaka caused some delays in train schedules for a few days after each attack and, in general, contributed to a decline in operating efficiency. Secondly, damage to repair shops hit what was already a serious bottleneck in railroad operations and gravely threatened the whole rail system in the region. Since most of this damage came in June its effects were not seriously felt before the surrender. But it is clear that right-of-way problems were never serious.

The 24 July precision attack on the Sumitomo complex in Osaka also did heavy damage to Kisha Seizo, the region's largest builder of locomotives and cars. Other rolling stock producers in Osaka and in Kobe had been hit in March and June. The Suita railway shops on the northeast outskirts of Osaka and the Takatori shops at Kobe were heavily damaged in the June area attacks, creating a maintenance problem of critical proportions that however was only beginning to make itself felt at the time of surrender.

The general rail system of Japan had been under considerable and increasing strain for more than a year before air raids on Osaka began. The intensification of Allied attacks on shipping threw an increasing burden on the rails even before the Inland Sea was mined. Freight trains had to substitute for ships in moving bulk commodities as incoming shipping was shifted from the ports of eastern Japan to those of the Inland Sea and, ultimately, almost replaced shipping on certain routes. But traffic demand was undermined at the same time that damage occurred to rail facilities and repair shops. Thus, the analysis of specific trends in traffic and activity is essential to assessment of the rail transport position during the raid period.

The main Tokaido line for through traffic east to Nagoya and Tokyo passes to the north of the central part of Osaka and there is a by-pass around the main Osaka station. In March, traffic levels on this line were substantially unchanged from February since most of this traffic originated in undamaged sections of Osaka and elsewhere. There was a decline of 20 to 25 percent, however, in the traffic on the Kansai line, the alternate route to Nagoya and eastern points, which was due in large part to the 14 March raid. Osaka railhead and transshipment facilities for this line, as well as industrial sections relying upon it, suffered heavy urban damage.

This March attack had some indirect effects which caused slight delays of freight movements. Railroad communication lines were temporarily disrupted as a result of damage to certain telegraph and telephone lines, exchanges, and transmission mechanism, and this caused some delay. Shortages of skilled labor and of repair materials made restoration of this damage more difficult. But the main effect of the raid was to aggravate the local casual labor and trucking situation, making even more difficult the transportation of goods to and from railheads. Every effort was made to cope with these problems, however, and they met with considerable success. Thus carloading statistics for the Osaka region show relatively little over-all decline as a result of the March raid despite a temporary slump in loadings and yard activity. Every effort was made to speed priority end-product output and complete dispersal, and activity was soon pushed back to previous levels. Rail traffic in the area improved in May after a lull in April partly reflecting the March attacks, and then fell precipitously in June when the raids had much more serious effects on rail traffic than in March.

The June attacks on Osaka and Kobe did play a major part in the decline of rail traffic in the region. Perhaps the greatest disruption resulted from severe damage in the June urban attack on Kobe to the Takatori government repair shops which prior to this had been handling 60 to 70 percent of all locomotive and car repairs in the region. The Suita shops were also hit. From January through May of 1945, an average of 80 steam locomotives a month were repaired in the Osaka region with 78 repaired in May. In June only 30 were repaired, in July 44, and in August 36. Similarly, freight cars repaired in the region fell from 1,043 in May to 387 in June and 530 in July as a result of damage to the Takatori shop in Kobe and the Suita shop in the northern outskirts of Osaka.

Only 10 locomotives were substantially damaged in all raids in the Osaka area in June. But these June raids did much more damage to trackage and to railroad communication lines than did the March attack. Disruption of auxiliary transportation facilities this time caused a much larger number of freight cars to lie idle. There was little recovery for from three days to a week after each raid as freight yards were paralyzed for lack of trucks and labor to unload and remove goods.

Consequently, goods piled up and were thus damaged in the successive attacks. In July there was further disruption of rail traffic as a result of direct attacks on rolling stock by P-51s and P-47s of the VII Fighter Command at Iwo. Ninety-five locomotives were damaged in the Osaka region as a result of air attacks during this month.

This review of urban damage to rail transport facilities must be viewed in relation to the general industrial damage that occurred. There were serious transit delays after the June attacks as after those in March. But this time there was no prompt recovery. Damage to factories and to finished goods, and the serious disruption of labor supply, must be considered when following the activity data on Exhibits 14 and 15. The lack of rail transport recovery can only be understood in terms of the general urban destruction. The following chapter will permit further assessment of transport problems in relation to the movement of essential commodities.

The Decline in Tonnage Receipts

From the standpoint of essential activity in the city and the adjacent region, the foregoing discussion of transport problems affecting Osaka can be concluded with a summary statement on freight receipts. This will lead directly to examination of the city's fuel position and its supply of essential industrial materials. For the first half of 1944 incoming freight averaged more than 1.6 million tons per month. As explained earlier, much of the tonnage received during this peak period represented maritime transshipments not consumed locally, but both fuel and basic materials deliveries for Osaka industry were then at top levels. Despite subsequent changes, these categories continued to represent well over half of all tonnage.

During the last half of 1944 the volume of overseas imports and transshipments through Osaka fell off considerably and total incoming freight tonnage was almost 20 percent below the average for the first six months. However, a large part of the drop was related to an over-all reorientation of basic industry which aimed at reducing transport requirements in the light of Japan's deteriorating basic materials and shipping position. As part of this plan, iron and steel allocations were cut back further, even on many priority categories of production, and the manufacture of iron and

steel was concentrated at the larger integrated mills located most favorably from a transport standpoint. Accordingly, modern blast furnace installations in Osaka and in neighboring Amagasaki were shut down in favor of those located at Hirohata, near Himeji, and at Yawata. Local steel production as well as primary steel fabricating was also sharply reduced. As discussed later, these changes not only brought an end to coking coal, iron ore and related bulk commodity receipts at Osaka but caused extensive readjustments of other basic materials movements to and from the city.

Thus, almost nine months before the first air attack on Osaka, important modifications were introduced into the pattern of local allocations and deliveries, both for coal and for other bulk industrial materials. After January 1945 there was a further sharp drop in freight receipts at Osaka, again partly related to diversion of remaining transshipment traffic to other ports but also reflecting the lower basic industry schedules for 1945. After hovering around a million tons per month from February through May 1945, there was a 30 percent drop in total incoming freight for June and a steady decline thereafter.

Except for the transshipment traffic involved, these successive declines had their main impact on the volume of fuel and bulk commodities delivered to industries in Osaka and its suburbs. As the total volume of freight movements fell off, the relative tonnage importance of other commodity classifications also changed. To an increasing extent, the railroads were forced to absorb the more urgent portions of the traffic in basic industrial materials which had formerly been handled principally by water. As a consequence, even stricter measures had to be taken to curtail types of freight movement normally depending in the main on rail facilities.

Incoming food shipments held up relatively well at Osaka. This city, like Kyoto and Kobe, was relatively well favored from the standpoint of local food production. The extensive farming districts around Osaka, including the Lake Biwa and Nara regions east and south of Kyoto and the Harima lowlands west of Kobe, constituted the second most important agricultural area in the main island. Most of this area is portrayed on Map 6, as is the well-developed transport network which made the rice and vegetables grown



MAP 6.—Terrain model of Osaka—Kobe—Kyoto area, showing railway and road network. Intensively cultivated lowland areas are clearly indicated.

in these sections readily accessible to the three major cities of the region. These cities were also relatively fortunate with respect to their normal protein sources—fish and seaweed. Food supplies from the Inland Sea and from Lake Biwa were not curtailed by threat of submarine activity, or to the same extent by fuel shortages, as were those obtained from the Pacific ocean, source of supplies for other major cities. Although few of the region's inhabitants could afford such fare, another protein source was available directly across Osaka bay on Awaji Island, Japan's most important dairy and cattle center outside of Hokkaido.

But despite a relatively favorable position with respect to local food supplies, the Osaka region shared with Japan as a whole a dependence upon the Asiatic mainland for rice and other staples. Food shipments at Osaka were maintained above

the average rate for the October 1943–September 1944 base period until the end of 1944. The total dropped to 40 percent of this average in February 1945 as imports from Formosa ceased and most shipments from Korea and Manchuria were diverted to north coast ports. There was a revival of Osaka receipts to 52 percent in March but a steady decline thereafter. In the last full month of the war, official food imports at Osaka were only a fourth of the base period average.

Transshipments through Osaka of imported foods formerly had constituted a large part of this traffic. These ceased altogether in February and thereafter waterborne food receipts represented local supplies brought by small craft from Shikoku, Awaji Island and various Inland Sea points. These local supplies were maintained at a better rate during 1945 than is indicated by official fig-

ures, for food receipts tripled at Sakai harbor, directly south of Osaka, and at other near-by minor ports. Also, black-market operations in food had become so prevalent by this time that it was impossible to trace movements of food into Osaka by rail and road transport. As described in USSBS Report No. 42, the practice of organizing food-purchasing expeditions to surrounding towns and farming areas by local householders, by factory representatives and by professional black-market operators had become so general by March 1945 that a considerable part of the rice and practically all of the other foods consumed in Osaka moved through informal channels.

During the attack period, then, rail traffic in foodstuffs represented the only firm element in an otherwise confused picture since overseas imports ceased at Osaka and produce from near-by areas seeped into the city with no adequate basis for estimation. Food imports from Korea and Manchuria were at record levels until the last few weeks of the war. As every effort was made to build up domestic food stocks with the volume of shipping still available, such imports were all handled through ports on the Japan Sea, including some in the Osaka region. Thus Osaka and Kobe began to receive some mainland imports by rail instead of themselves acting as major transshipment points for such foodstuffs.

An examination of carloading data for the Osaka region shows that rail movement of foodstuffs—including imports and local production originating in this region—remained above the 1944 average until March 1945. A slight dip in that month and in April was followed by record May movements almost 25 percent above the 1944 level. Car shortages and handling delays, as well as a reduction of mainland imports because of B-29 mine laying, brought a slight fall in June, but July carloadings were again slightly above the 1944 average. In the light of available stocks and harvest prospects in the Osaka region, authorities were confident at the time of surrender that sufficient food would have been available for another year even if mainland imports had been cut off.

As unessential inhabitants were forced out into rural areas, food supplies readily accessible to the urban centers were believed more than adequate in volume to maintain those engaged in essential industrial activity. The food crisis which did de-

velop after the urban attacks was the immediate result of the breakdown in urban distribution machinery rather than an absolute or prospective food shortage. Raid damage to food stocks was temporarily serious but these stocks could have been replaced. The physical facilities for bringing available food to urban industrial workers continued to function and were so extensively developed within the region as to defy complete disruption. But especially after June, local machinery for utilizing these facilities failed as did the general level of civic discipline that would have been essential to its operation—even in the absence of such widespread urban destruction.

Thus for Osaka and for the surrounding region it must be concluded that, in volume, food receipts were maintained above the critical level and apparently could have been well into 1946—given effective utilization of the remaining stocks and the readily accessible farm production. Small wooden craft continued to bring in some food from near-by Inland Sea points. Fish and other marine food supplies were maintained relatively well, and the railroads managed to handle remaining food imports as well as a record volume of traffic in domestically produced agricultural products.

In order to maintain priority traffic in the categories already discussed, the railroad administration had to curtail other movements considerably during 1945. In some cases the burden was eased by reducing cross-haulage. This was especially effective with respect to building materials and certain other categories but it could not be expected to compensate in the longer hauls involved in the movement of coal and basic metal products as Inland Sea maritime traffic declined. While much lumber continued to arrive by water during 1945, other building materials movements fell off seriously even before the decline in ship movements. Thus there was a relatively small burden for the railroads to absorb. Rail carloadings of building materials throughout the Osaka region declined more than 20 percent during the last half of 1944 from the peak levels of the spring months. The decline continued into 1945 although there was a sharp increase during May related to the dispersal effort and to emergency defense projects.

Machinery had always moved in considerable part by rail and tonnage loading figures for the region remained steady through the first three

quarters of 1944 and then rose gradually toward the end of the year. Rail traffic in this category—most of which originated in Osaka and other key cities—continued to rise during the early months of 1945 to almost 90 percent above the 1944 level in May. Here priority dispersal efforts were added to war production shipments. June loadings fell slightly below the 1944 level. Again in July the total rose above that average before the final decline in August.

Military shipments, like machinery shipments, were more significant as outgoing movements than as receipts. Although Osaka ceased to serve as an outbound transshipment point by the end of 1945, traffic in military supplies remained high here as well as for the region as a whole until the surrender. The major role of local industry in this field assured continued priority consideration for such movements in and out of Osaka even though military items produced elsewhere now moved by rail directly to Kyushu and west Honshu points. Total traffic in military supplies had reached a record peak at Osaka in December 1944 when a few ships were still clearing from this harbor for Japan's island outposts. By March 1945 total traffic in military goods had declined by 20 percent but was still well above average 1944 levels. April and May traffic again improved and as late as July the total was still maintained above the 1944 average. During the attack period military traffic represented items manufactured or finished at Osaka or those removed from stocks administered by the Osaka Army arsenal and other local military authorities. Carloading data previously presented for the region as a whole clearly emphasizes the general expansion of military rail traffic during the 1945 period.

This summary underlines the priority consideration given to the movement of food, finished machinery and military supplies at the expense of other items. From a tonnage standpoint, the burden of this priority traffic could be absorbed by the railroads without too much strain. The critical problem was that of moving sufficient coal and other bulk industrial materials to maintain essential activity. A serious decline was inevitable when shipping could no longer be maintained through the Inland Sea.

FUEL AND INDUSTRIAL MATERIALS

It is the purpose here to outline Osaka's supply position in fuel and industrial materials before

and during the attack period and to relate overall changes in receipts and inventories to production trends of the city's primary and end-product industries. The impact of these supply factors will be discussed in more detail as a part of the individual industry analyses. The examination of Osaka's fuel position deals with the machinery of distribution upon which priority output in Osaka depended, the sources of supply, and the status of transport facilities. Osaka's importance as a regional administrative center has already been pointed out. This role applied particularly to materials allocations and therefore much of the following discussion will deal with the whole region as well as with Osaka itself. A comparable treatment of basic metal supplies and other industrial materials indicates that available fuel supplies were allocated with considerably more success than were other basic commodities.

Despite curtailed receipts, transport irregularities and difficulties with communications and records, coal inventories and deliveries were effectively adjusted throughout the raid period to minimize any inhibiting effect on current production levels. After the June 1945 attacks, production was so seriously curtailed that fuel inventories actually increased to record levels. Thus to a lesser degree the June attacks turned this critically scarce production factor into a relative surplus position, just as the March attack had created a surplus in electric power supply.

Before any B-29 attacks on Osaka, local fuel requirements had been considerably reduced as part of the program to concentrate iron and steel production at large integrated mills located elsewhere. At the same time, this program permitted a halt in shipments of iron ore and other raw materials as well as a considerable reduction of pig iron and ingot steel receipts in favor of castings, forgings, and semi-finished fabrications. Consequently during late 1944 and 1945 there was substantial decline in total tonnage deliveries of these categories at Osaka, but only part of this decline represented a net reduction of basic metals required in priority end-product output.

The shipbuilding industry was by far the largest consumer of iron and steel products in Osaka. Despite severely reduced steel deliveries in late 1944 and 1945, most shipyards ended the war with large inventories of basic materials. In comparison, the tonnage requirements of other industries

were relatively modest. Supplies of special alloy steels essential to the aircraft and ordnance industries were maintained at record levels well into 1945. Light metals supplies were already heavily curtailed by this time, but basic fabricating could have been continued at substantial volume into the fall of 1945 and sufficient ingot and scrap aluminum were in prospect to meet priority requirements for the aircraft industry through the rest of the year.

Despite the over-all scarcity in basic metals, the full weight of declining supplies had not yet begun to affect end-product activity before plant damage and general urban dislocation caused production delays that, in turn, created idle stocks at various levels of war industry. Except for scheduled cutbacks in shipbuilding and in certain ordnance categories—where Japan's changing strategic position was a determining factor along with the necessity for economy in use of remaining bulk materials—it is difficult to find evidence in Osaka that over-all shortages in basic materials directly forced any reduction in priority end-product activity during 1945.

Beginning in March, production difficulties did prevent effective utilization of available materials in many fields. After the June attacks, output levels were far below the gradually lowering ceiling that might otherwise have been enforced on priority activity by the over-all basic metals stringency. Analysis of conditions during the attack period indicates that fundamental weaknesses in the allocations system had far more to do with basic materials problems than did actual physical shortages. In contrast to the system prevailing in coal distribution, basic metals allocations were influenced by a variety of authorities, none of which was able to prevent hoarding or to assure that available supplies were directed in correct proportion to those producers actually capable of turning out the most urgent military end-products. Competition between Army and Navy procurement agencies was matched by the extra-legal activities of large private war contractors and their brokers.

Thus, what at first sight appeared to be cases of priority output curtailment imposed by the materials ceiling often proved on examination to have resulted from breakdowns in the allocation system. During the attack period, transport and communications difficulties had a far more dis-

ruptive effect than might have been the case if a flexible but ironclad control of materials had been in force. As in the case of food supplies, over-all shortage and uncertainty as to future allocations forced all consumers of basic materials to hoard and to use the black market. The chronic discrepancy between plan and performance was accompanied by a confused distribution pattern that rendered prompt adjustment to post-raid conditions extremely difficult.

The foregoing discussion of Japanese shortcomings in basic materials distribution is not intended to depreciate the increasingly precarious margin of resources on which essential production was being maintained. With overseas imports cut off and domestic activity declining in the extractive industries, there was little prospect for maintaining basic activity in Osaka at a high level throughout 1945. The certain knowledge of impending reductions and shutdowns unquestionably influenced the reactions of many business leaders and some government officials to the problems imposed by the air attacks.

Nevertheless, Japanese ability to "get by" in the absence of adequate production resources could be demonstrated in almost every field of activity. This capacity was evidenced especially with respect to many items deemed essential for preparation of last-ditch defenses in the home islands. At the beginning of 1945, the general supply position at Osaka had been considerably eased by curtailment of shipbuilding and other activities rendered increasingly obsolete by strategic developments and making particularly heavy demands on available stocks of basic materials. Pipeline stocks assured that the effect on end-military output of a further decline in basic industries could be deferred for some time. Thus, despite raw materials stringencies, local authorities were reassured by the continuous rise of ordnance output and other critical items during the first months of 1945—until the March urban attacks.

Japanese success in deferring the effect of basic materials stringencies could have been bettered with a more adequate system of controls. Difficulties in this system were already evident before 1945 but the basic weaknesses might not have been so fully revealed in the absence of urban attacks. Nevertheless, major production units in priority fields were generally taken care of at Osaka. In most cases the influence of military

authorities and managerial enterprise in supplementing official deliveries through informal channels assured adequate reserve supplies for large end-product manufacturers. Except for the dependence of many such units on subcontractors and other outside sources for components, the production breakdown after mid-March might not have been so serious.

The complex structure of production in Osaka and the confused pattern of materials distribution both proved highly vulnerable to the types of dislocation produced by the urban attacks. The flow of metal products was severely affected but difficulties were even more pronounced with respect to other industrial materials. Control of such items was even more chaotic and, in many cases, their production had earlier been sacrificed in favor of more immediate military requirements. Also, these items proved to be highly vulnerable to incendiary damage when the attacks came.

Maintenance items, such as special lubricants, disappeared almost completely from regular channels, as did certain chemicals and insulating materials. Shortages of replacement items for machinery presented serious difficulties even before the attacks and placed severe limits on execution of the dispersal and repair programs. Such items as electrical fixtures, power transmission belting, and other critical production elements were destroyed on so vast a scale in the urban attacks that restoration of even partially damaged shops was impossible except for a few favored concerns.

Normally the incidence of incendiary damage was very heavy and prompt measures were required to protect equipment and inventories from further damage through exposure and corrosion. The over-all shortage of tools and building materials had been intensified by allocation breakdowns even more widespread than in the field of industrial materials. Post-attack efforts to restore production were severely handicapped by the lack of effective machinery for locating and assigning existing supplies on a priority basis. Thus even in this field, as in that of basic metals and industrial materials, the question of over-all availabilities became secondary in 1945 to that of efficient utilization of supplies at hand.

Japanese production had faced supply difficulties from the beginning of the war. The failure to perfect adequate distribution machinery rendered end-product activity in Osaka and other

major centers considerably more vulnerable to air attacks. In the absence of such attacks, there seems little evidence that lack of basic materials necessarily would have constituted a critical limiting factor on top-priority ordnance and aircraft activity before the end of 1945.

The Fuel Position (Exhibits 16, 17, 18)

In general, fuel distribution seemed to be efficiently and intelligently administered in Osaka and in the surrounding region. Electric power and utility gas, rather than coal, were the principal energy sources for several categories of priority industry in Osaka and this was even more true in Kyoto. Consequently, the main concern of fuel authorities during the attack period was to meet minimum utility gas requirements and the relatively small but vital coal needs of end-product producers in Osaka and, at the same time, to maintain coal deliveries to the most urgent basic industry units at as high a level as other production factors would permit. With dangerously low stocks and steadily declining over-all coal allocations, this task was difficult during the period of industry readjustments preceding the attacks.

As compared with other basic materials, the machinery for control of coal supplies was relatively simple and not subject to the administrative weaknesses and abuses which vitiated so many Japanese planning and allocation efforts. Except for coal consumed by the railroads, all supplies were handled by one agency through relatively self-sufficient regional offices. Coal deliveries were consigned directly to utilities and all important industrial consumers. Such deliveries were based on individual allocations determined in advance but modified in terms of week-to-week inventory positions. Smaller industrial consumers obtained their supplies through branch agencies set up in each city. In like manner these branches distributed their quotas in terms of established priorities for various categories of activity as well as actual plant requirements.

After mid-March 1945, most severe transport and communications difficulties confronted the Osaka distributing agency and these were occasionally complicated by irregular deliveries. Thus it became increasingly difficult to readjust deliveries in accordance with constantly changing plant conditions. But with few exceptions, factory inventories in Osaka during the attack period were kept at the minimum which the over-all stringency

called for. Scheduled deliveries were promptly diverted from plants which sustained physical damage or were forced to curtail output for other reasons.

There was no evidence of a black market in coal. This success contrasted sharply with the situation which developed with other basic materials discussed below. Some reallocation of unneeded factory coal stocks was undertaken during 1945, but much more might have been accomplished. The main problem here was inadequate labor and transport facilities although these might have been met had the need been sufficiently urgent. Altogether, less than four thousand tons of unneeded coal at electric power plants in this region were actually moved between mid-March and mid-August although some fifty thousand tons was readily available at only two plants on the Amagasaki waterfront. Much smaller but equally unnecessary inventories were on hand at other power plants. The Osaka Army arsenal had large reserve stocks as did its branch plant east of the city.

In the event of sustained disruption to the reduced flow of coal which was still arriving in mid-August, such unneeded and available stocks could have been drawn upon to maintain priority output. But the decline in local production, especially in June, rendered such steps unnecessary. The fact is that both industry stocks and central inventories of coal began piling up in Osaka after the June attacks. For the first time since early in the war there was thenceforth a steadily growing margin between coal receipts and consumption. As Exhibit 17 indicates, central inventories finally rose to equal monthly deliveries to all industry. Through careful inventory control and flexible delivery scheduling, coal allocation authorities had managed throughout the raid period to minimize coal shortage as a direct limiting factor in practically all categories of war production.

In the Kobe report considerable attention is given to official efforts at balancing declining supplies of coal and basic materials in that city's relatively more important heavy industries. The effect of coal rationing on industrial output in Osaka will be discussed later in connection with each industry but at this point the over-all supply position is examined.

Coal for the Osaka region came from four mining areas. By far the most important source was

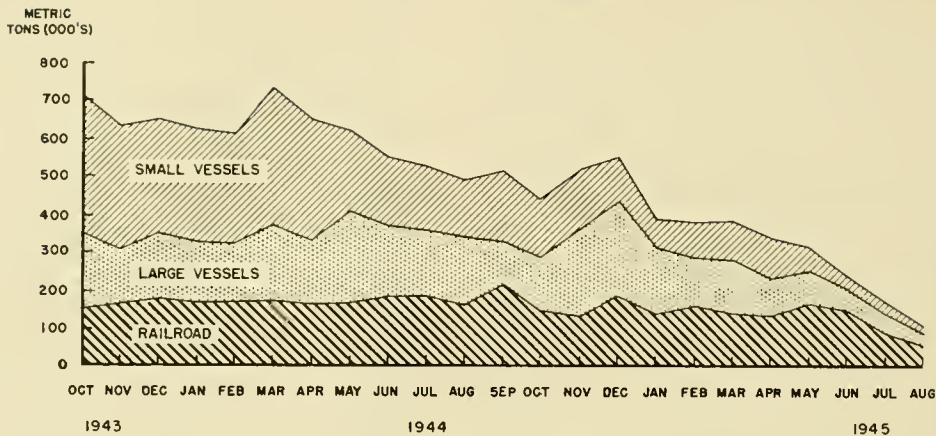
the north Kyushu fields, but coking and gas coal from the mainland and from Hokkaido was highly prized. West Honshu mines, though closest, were relatively unimportant until 1945, when their share in Osaka receipts rose steadily until August but never amounted to more than eight percent of the total. Mainland imports had fallen to about that percentage in the latter half of 1944, as coking coal was no longer needed except at one integrated steel mill in the Osaka region. Hokkaido imports, after declining to a very low level during 1943-1944, improved rapidly during the spring of 1945, when shipping was concentrated in the Japan Sea, but such imports were still relatively minor. Kyushu coal had always accounted for 70-80 percent of the region's coal needs and remained at 85 percent or more of the total after mid-1944.

Exhibit 16 presents the picture of coal receipts and the relative importance of rail freight, large colliers, and small coastal vessels in its transport. All the distribution for this region is included except that coal consumed directly by the railroads which was always controlled and handled separately. It is estimated that railway requirements amounted to 10 percent of other regional fuel receipts during 1943-1944. During 1945, fuel consumption by railroads gradually rose to equal more than 20 percent of all other consumption.

As a result of many factors, Japan's over-all coal position was deteriorating long before the area raids began. As described in USSBS Pacific War Report No. 36, production was falling because of labor difficulties, machinery and equipment failures, and inefficient and short-sighted mining techniques. But as events developed, transport difficulties became even more serious. Attacks on shipping had progressively curtailed the facilities available for mainland imports. Before the middle of 1944, imports from north China, Manchuria, and Korea were being squeezed, although not finally cut off until June 1945. Included in the north China tonnage was the high-quality coking coal so essential to the Japanese steel industry and not produced in sufficient volume domestically.

Intensification of shipping difficulties thus imposed restrictions on coal shipments to Osaka over and above the general coal shortage in Japan. The increasing scarcity of shipping cut down particularly on coal transport to Osaka from the north

**COAL TRANSPORT - OSAKA REGION
TONNAGE RECEIVED BY RAIL, LARGE
AND SMALL VESSELS**



NOTE:
COAL FOR RAILROADS USE IS EXCLUDED

EXHIBIT 16

Kyushu area at the other end of the Inland Sea. The B-29 mining program in the Inland Sea and finally in Osaka harbor further reduced these shipments. Consequently an additional burden was thrown on the railroad system—especially on the Sanyo line leading from Shimonoseki—which was already under greatest strain and unable to sustain increased loadings for very long. The problem of gondola car maintenance was a particular threat.

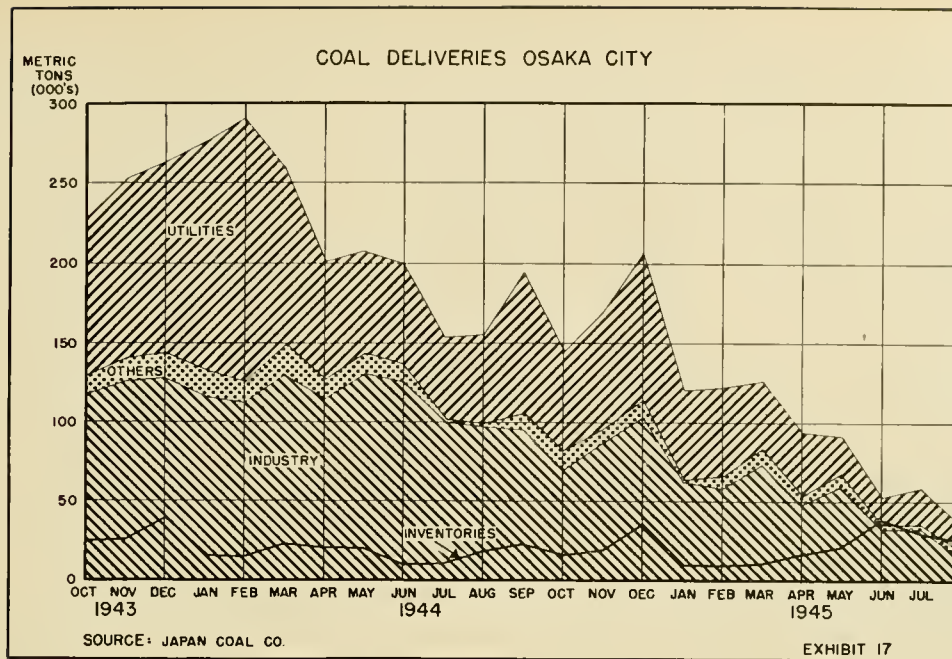
In this connection, the various urban attacks had little immediate effect on coal deliveries except as they slowed down utilization of transportation facilities between Osaka and sources of coal to the west. As was indicated in the shipping and railroad sections of this report, there was some slow-down in freight handling and in the movement of ships and freight cars as a result of the large area raids. Unloading of gondola cars and colliers was never seriously delayed at Osaka. Moreover, these effects were small indeed compared to the impact of B-29 mining on Inland Sea coal traffic and the effects that would have followed from the program of heavy attacks initiated on the last day of the war against the crucial Sanyo rail line.

The area raids did cause temporary disorganization and delays in coal deliveries to Osaka plants not served directly by rail or collier. However, it appears that such delays had very limited effects since the consumers were themselves severely disorganized in the immediate period after such attacks. Only in the case of a few suburban plants

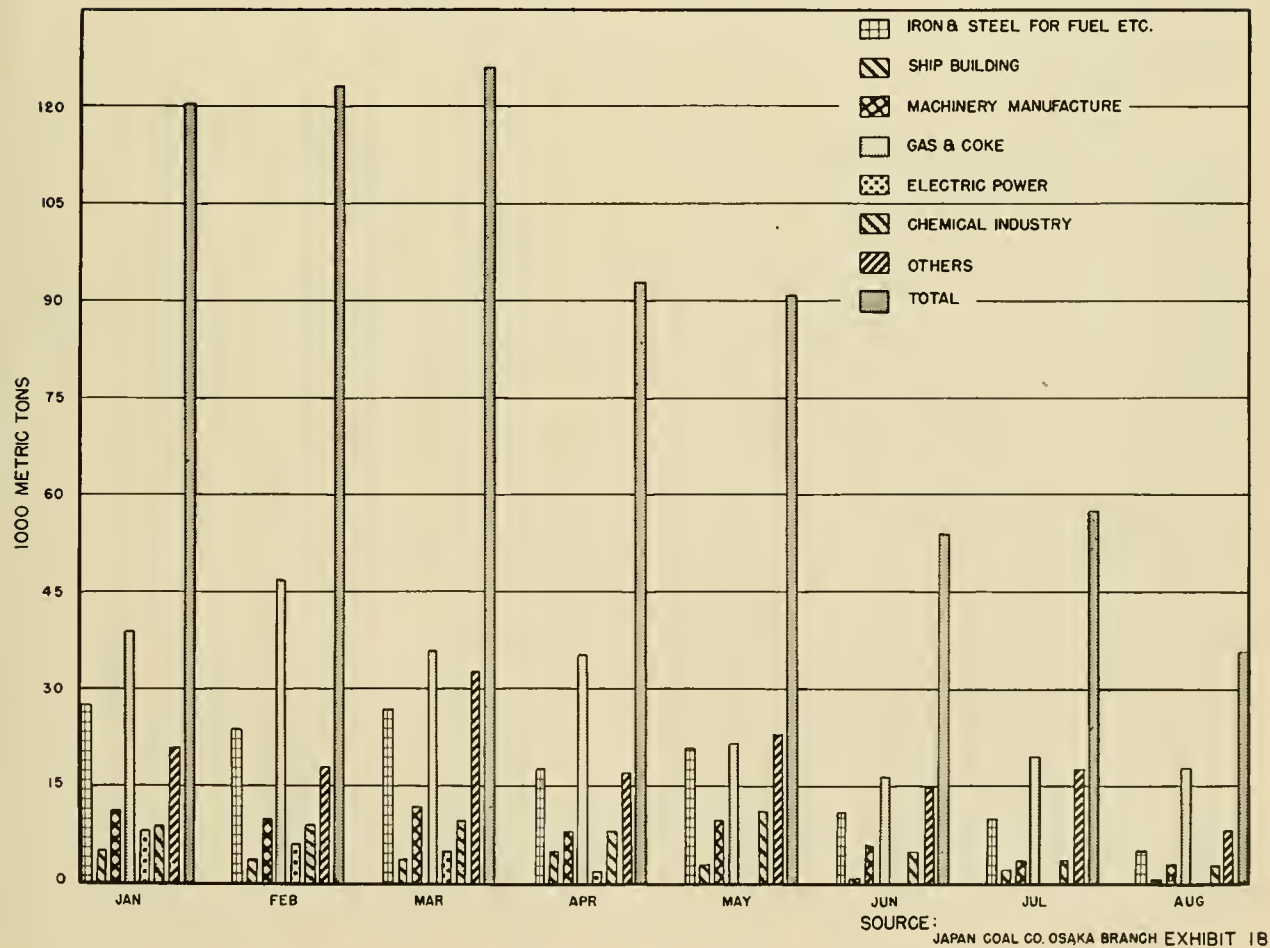
was priority output directly curtailed through delivery delays. Exhibit 17 gives a breakdown of coal deliveries to Osaka consumers for the period of analysis and Exhibit 18 provides a more detailed analysis of deliveries during 1945. All consumer categories are included except the railroads. Their position was never permitted to suffer, although normal stocks of a month's supply at all points were, in certain cases, reduced temporarily to less than a week's supply. The tightest period for railway inventories in the Osaka region was in late March and early April when unloading delays following the initial urban attacks caused car shortage and a decline of rail traffic in coal. After May 1945 railroad inventories were built up to peak levels.

The relative importance of utility coal consumption in Osaka is clearly indicated by the delivery data. Gas consumption, as previously indicated, remained relatively steady but electric power requirements were highly seasonal. The sharp drop in industrial receipts in mid-1944 reflects the reduction in local iron and steel activity already discussed. It will be noted that central inventories remained at a generally low level until June 1945 but piled up rapidly thereafter to record levels.

It is evident that the sharp cut in over-all coal receipts during 1945 was not felt by most end-product producers, even with more drastic reductions in shipments. Their relatively modest fuel requirements could always have been met without forcing a much more serious limit on the activity of the city's few large basic metal producers. In



1945 COAL CONSUMPTION IN OSAKA CITY



(Unit 1,000 metric tons)	January		February		March		April		May		June		July		August	
	Total	Per-cent	Total	Per-cent	Total	Per-cent	Total	Per-cent	Total	Per-cent	Total	Per-cent	Total	Per-cent	Total	Per-cent
Utility gas	38.8	32.1	47.0	38.4	36.3	28.8	35.5	38.2	22.1	24.2	16.6	30.6	20.0	34.1	17.8	48.9
Electric power	7.8	6.5	6.3	5.1	4.5	3.6	1.6	1.7								
Iron and steel fabrication	28.1	23.3	24.1	19.7	26.5	21.0	17.8	19.1	21.0	23.0	11.0	20.3	10.3	17.6	4.8	13.2
Machinery manufacture	10.9	8.4	9.5	6.8	11.8	9.4	8.2	8.8	10.4	11.4	6.1	11.2	4.2	7.2	2.6	7.1
Shipbuilding	4.9	4.1	3.5	2.9	4.3	3.4	5.2	5.6	3.2	3.5	1.0	1.8	1.6	2.7	.5	1.4
Other metal products	.8		1.0		2.3		1.0		1.1		.9		1.5		.7	
Metal refining	.4		.5		.5		.6		.3				.3		.4	
Chemical industry	9.2	7.6	9.0	17.3	11.0	7.9	7.5	8.1	11.2	12.3	4.6	8.5	3.9	6.7	2.5	6.9
Cement and clay products	2.3		4.9		6.2		2.6		6.9		3.7		7.0		1.7	
Fibre and textiles	2.9		1.1		2.7		1.9		2.5		1.8		1.6		.7	
Food processing	1.2		1.0		1.4		.9		1.2		1.0		.5		.7	
Aviation fuel (alcohol)	1.2		1.3		2.5		1.5		1.4		.1		.5		.1	
Briquettes	1.9		2.5		4.0		.7		.7		2.8		1.4		.2	
Ship bunkering	7.0	5.8	7.2	5.8	7.2	5.5	5.4	5.8	5.2	5.8	1.9	3.5	3.5	6.0	2.5	6.9
Public works and government factories	1.2		1.8		3.4		1.4		2.3		1.0		1.1		.2	

¹ Coal for railroad use excluded.

many cases, such firms were able to conserve fuel through increased use of electric power after that energy source became so plentiful. As already mentioned, some firms had gone beyond substitution of electrical furnace operations for other types of heat treatment and had installed electric equipment for steam-raising.

Coke (Exhibit 19)

Up to the fall of 1944 coke was consumed at Osaka for metallurgical purposes in the production of pig iron as well as for fuel purposes. Coking coal became so scarce, however, by August 1944, that the production of this type of coke and the manufacture of pig iron was discontinued in Osaka. After this time coke was used only for fuel purposes, mainly in foundry work and heat treating of metal products. Fuel coke was produced locally as a by-product of utility gas manufacture in Osaka's three gas plants, and relatively little tonnage was ever obtained from outside the city. The general coal shortage, which was most stringent in the grades of coal suitable for the production of good coke, limited local production even below the maximum permitted at the existing level of gas manufacture.

As Exhibit 19 indicates, consumption of coke in Osaka city averaged about 25,000 tons a month until August 1944, only 20 percent of it being used for non-industrial purposes. After this point, both supplies and deliveries declined until the end of the war. Non-industrial use was squeezed down to no more than four percent of total consumption by October 1944. The air at-

tacks on Osaka had no direct effect on local coke production. As indicated earlier, there was extensive damage to gas works but these were already operating below capacity as a result of stringent gas rationing and, after March 1945, by reduced industrial consumption.

Charcoal (Exhibit 20)

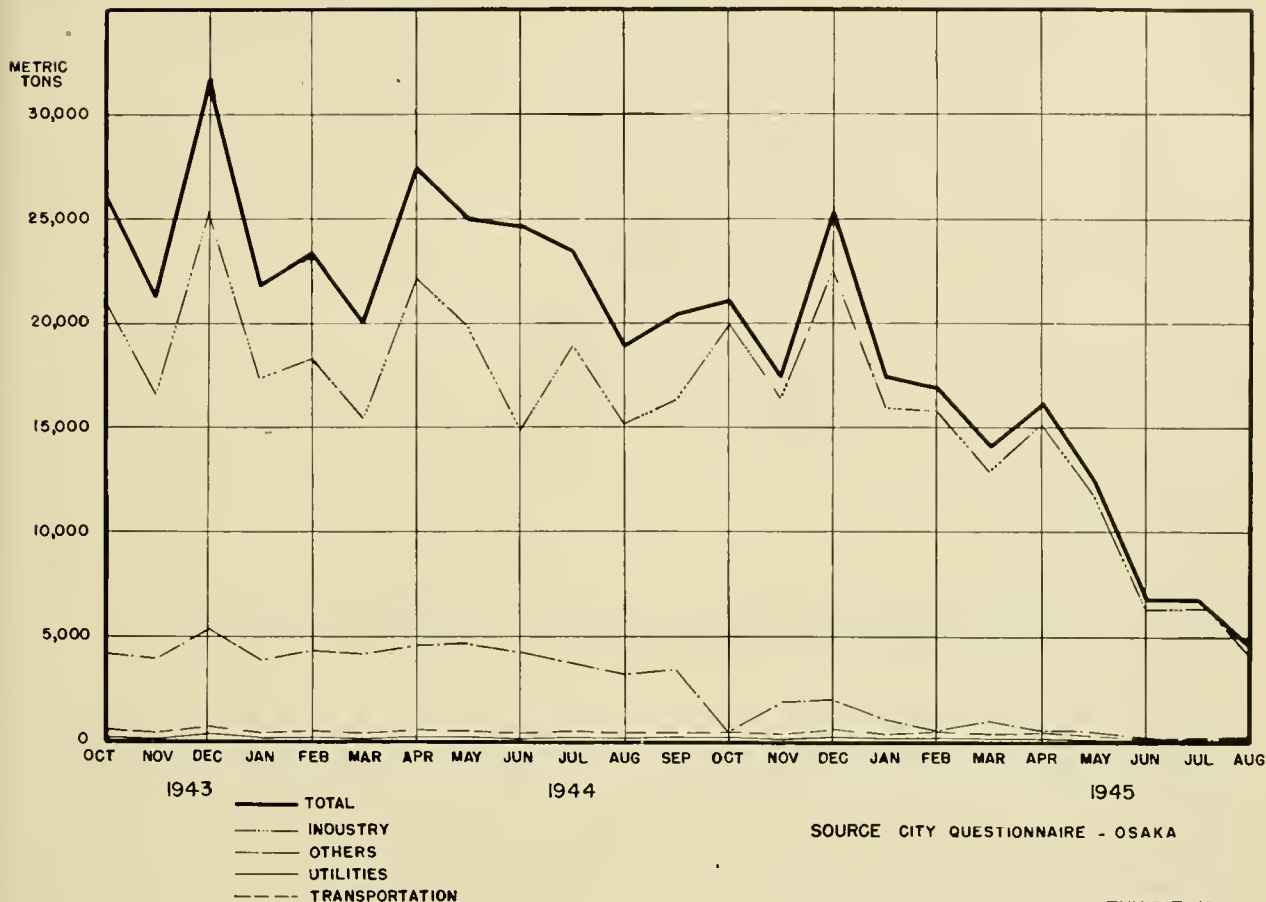
Until the last two or three months of the war, 60 percent of charcoal consumption in Osaka was for home use in heating and cooking. The remainder was divided between use in industry and transportation, with the latter taking a considerably larger share. Practically all motor vehicles in Osaka were operated on charcoal gas. In the last few months of the war, such use was somewhat sustained at the expense of domestic users. Total consumption fell from a peak of 7,500 tons in February 1944 to 2,100 tons in October of the same year as a result of bottlenecks in the production and transportation of charcoal from rural areas. After a recovery to 4,800 tons in January 1945, monthly deliveries fell steadily and sharply to a low of 700 tons in July 1945.

Basic Metals (Exhibit 21)

A full analysis of Japan's declining basic materials position is provided in USSBS Report No. 36 and the discussion here, as was the case with fuel supplies, will be restricted to consideration of delivery trend in Osaka and problems of allocation and distribution control.

Like coal receipts, deliveries of iron ore, ingot steel and basic iron and steel fabrications repre-

CONSUMPTION OF COKE IN OSAKA CITY



SOURCE CITY QUESTIONNAIRE - OSAKA

EXHIBIT 19

sented approximately one-fourth of all incoming tonnage at Osaka during the period of analysis. As previously discussed, the cessation of iron manufacture and of all but electric furnace steel production at Osaka in mid-1944 permitted a significant drop in the transport demands of this industry. Exhibit 21, which summarizes data on incoming and outgoing traffic in this category, reflects these changes just as did the data on coal movements and deliveries. During the latter part of 1944 there was a decided shift in the character of receipts and shipments as ore and coking coal deliveries ceased. Allocations of fuel coal to steel producers were also cut and ingot steel or basic shapes replaced pig iron as the principal input item for Osaka steel fabricators.

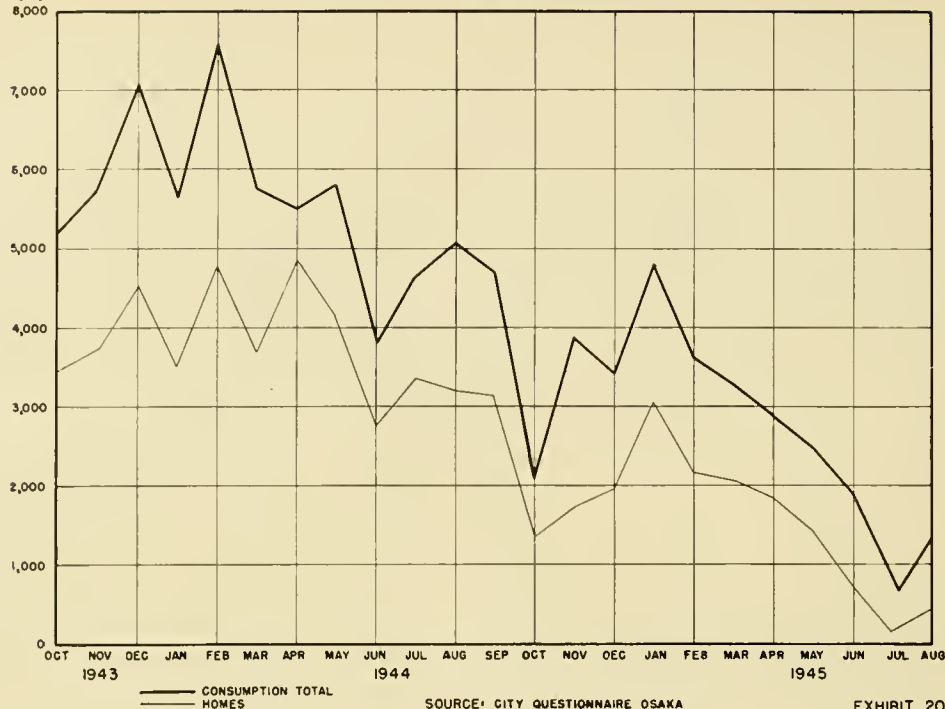
During this period production of special alloy steels was stepped up however. As compared with total ferrous metal output, these were of comparatively modest volume but they were of far greater importance than ordinary iron and steel for end-

product ordnance and aircraft items. Accordingly, electric furnace production of alloy steels resisted the general decline well into 1945. Simultaneously with the concentration of ordinary iron and steel output elsewhere, local fabrication of steel plate for ship building was drastically reduced. Data on activity, receipts, inventories, and product shifts among Osaka basic metal fabricators will be dealt with later in this report. It is sufficient here to emphasize the important overall changes that were taking place prior to the attacks, both in the character and the volume of ferrous metal receipts and deliveries.

By far the largest consumer of steel products in Osaka was the shipbuilding industry. The decision to reduce output of many local shipyards in late 1944 permitted sharp curtailment of local steel products deliveries. Nevertheless, the priority accorded the shipbuilding program remained so high as to claim an increasing share of Japanese steel production until the end of the war. The share

METRIC
TONS
8,000

CONSUMPTION OF CHARCOAL IN OSAKA CITY



of total finished steel obtained by this industry rose steadily to 31 percent in fiscal 1944 and during the second (April-June) quarter of 1945 reached 46 percent. Thus, despite a serious decline in over-all steel production, Japanese shipyards were still receiving finished steel during these last critical months in the same volume as during fiscal 1943—itself a record year for the industry—and only 30 percent less than during the March 1944–March 1945 period.

As a group, the shipyards in Osaka were not as heavily favored during 1945 as were those in Kobe and some other shipbuilding centers. But here as in Kobe, inventories of basic materials began to pile up after the March urban attack and continued to accumulate throughout the raid period. As emphasized in USSBS Report No. 48 on merchant shipbuilding, there had been a considerable reduction of steel inventories during the 1944 shipbuilding spurt, despite record deliveries, but the decline in shipyard activity during the raid period was far greater than the drop in receipts of finished steel.

Fabricating and delivery rates for steel products will be discussed later in this report and in the Kobe report as related to shipbuilding. Steel inventories and requirements of other industries, while relatively less important from a tonnage

standpoint, will also be considered subsequently in relation to their operations during the attack period. It is sufficient here to indicate that priority requirements for end military items seemed to be adequately maintained in Osaka despite the substantial output decline in Japan's steel industry. Generous over-all inventories were the rule at practically all major ordnance and aircraft plants in Osaka.

Exhibit 21 provides a rough indication of general trends during the period of analysis but must be interpreted in light of the foregoing discussion. In January 1945 total tonnage receipts at Osaka in the iron and steel category were approximately 70 percent of the October 1943–September 1944 average—a remarkably high figure considering the drastic change in composition of these receipts. The downward range from 49 to 37 percent during the next three months included a generous volume of finished iron and steel from the tonnage standpoint. The subsequent decline reflected general post-attack production conditions at Osaka as well as growing transport difficulties. With inventories piling up in Osaka, some effort was made to divert remaining steel output to other consuming areas where the tempo of production was being maintained.

The situation was roughly comparable in the

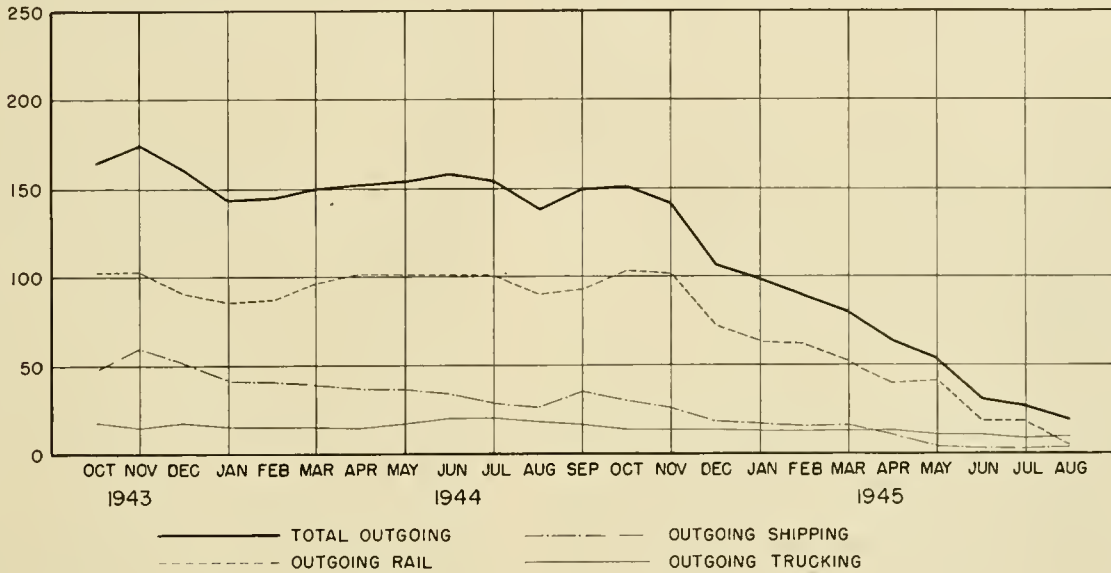
OŠAKA CITY

MOVEMENT OF IRON & STEEL

(RAW MATERIALS PIG-IRON, INGOTS AND FABRICATIONS)

OUTGOING

METRIC
TONS
(000's)



INCOMING

METRIC
TONS
(000's)

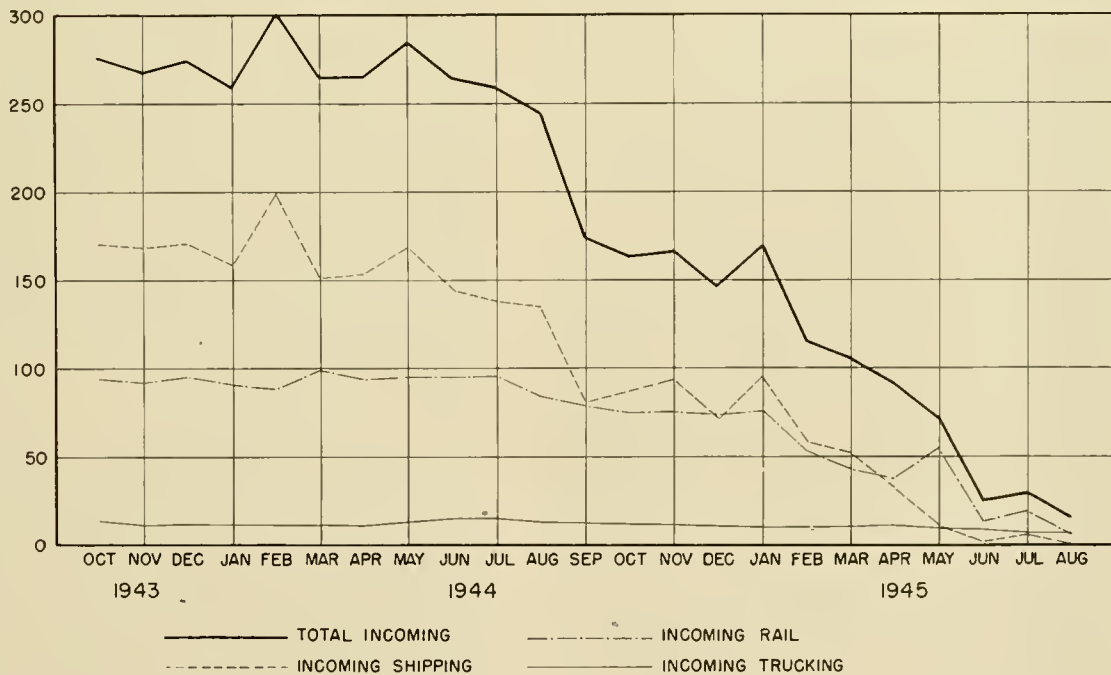


EXHIBIT 21

non-ferrous metals field. Osaka had one copper refinery which was operating at relatively low levels until 1945. Here the ruling consideration was that of transport and power economy—production of electrolytic copper and copper alloys was concentrated in power surplus areas closer to mines and smelters. But in 1945, the threat of transport disruptions led to plans for greater utilization of the Osaka refinery. However, large additional shipments only began to arrive in May 1945 and the plant was severely and permanently disabled in the 7 June urban attack. In general, copper supplies were tight throughout the war but much had been done through substitution and redesign to minimize essential consumption. Except for a few well situated concerns, large inventories of copper items were rare in Osaka and, as discussed below, there were serious imbalances in various types of fabricated items.

Ingot aluminum or magnesium was not produced in Osaka, but was shipped in to the important local fabricators, largely for manufacture of aircraft components. Pressure to maximize output during late 1944 had reduced local ingot stocks to a critical point but the attacks on aircraft plants eased this problem. Basic fabricators had materials in sight to continue operations at planned levels until September 1945. At reduced levels of operation, supplies could have supported the aircraft industry into the first quarter of 1945 but thereafter production pipelines would have been exhausted and only scrap stocks would have been available. Heavy damage to primary fabricators in June and July eliminated prospects for continued utilization of remaining supplies at Osaka.

Rail loadings of light metals were relatively unimportant from the tonnage standpoint in the Osaka region, but remained comparatively steady until June 1945. Peak traffic was attained in August 1944 and there was a gradual decline during late 1944 and early 1945. In April, total tonnage was about 70 percent of the 1943–1944 average but dropped thereafter to 48 percent in June and continued at that level until the surrender. Since primary production of light metals took place outside the Osaka region, these figures primarily indicate trends in return movement of primary and secondary scrap, withdrawals from military reserves of virgin metal, and bulk shipments of basic fabrications.

The Breakdown of the Allocation System

In a sense, it is inaccurate to state that the machinery for allocating basic metals in the Osaka region broke down during the attack period, for grave inadequacies had been evident throughout the war. Despite various efforts dating back to the outbreak of the "China Incident," the Japanese never managed to achieve an integrated pattern of control over industrial materials. Such machinery was urgently required to assure maximum production even before supplies began to decline. After Japan's basic materials position had deteriorated seriously, it was too late to eliminate glaring weaknesses in existing arrangements. There can be no question that these shortcomings contributed in considerable degree to the production problems arising during the attack period. In the absence of central knowledge and control of inventories and deliveries, it was impossible to utilize fully the volume of materials available when key plants were damaged and production dislocations rose to fantastic proportions in congested industrial districts.

The summary section of this chapter has outlined the general nature of allocation difficulties and contrasted the relative success of coal distribution in Osaka with conditions prevailing in the basic metals. The over-all pattern of controls in this field and the struggle between rival military and business elements for control of supplies is described in detail in USSBS Pacific Report No. 36. The present treatment of this subject is limited to a brief inventory of the practices which developed under the existing inadequate arrangements. Prior to the air attacks, these unofficial practices tended to meet the immediate supply difficulties of those elements most favorably situated in local industry. But after the initial urban attack on Osaka, official allocation authorities were unable to cope with problems of production readjustment and unofficial short-cut methods proved wholly ineffective.

In general, allocations of war materials and ingot metals to local steelworks and fabricators were satisfactory until mid-1944, although deliveries were becoming increasingly erratic. There was considerable friction in application of the program to halt local manufacture of pig iron and ingot steel in favor of integrated mills elsewhere. But raw materials for this purpose were reduced gradually and in generally correct pro-

portion. Criticism was directed mainly against the failure to concentrate schedule levels of local metal fabricating in the most efficient units. Pressure to continue the activity of all operators on a pro rata basis was not successfully overcome in Osaka until May 1945 and reforms then were too late to be effective. This policy had the effect of scattering ingot deliveries, preventing continuous operations on similar orders, and tying up large pools of skilled labor and other badly needed production resources. Comparable difficulties in the light metals field were enhanced by variations in the quality and characteristics of ingots received during late 1944, requiring continual production readjustments in alloy rolling and extrusion operations and resulting in more rejects. Here too, deliveries became more erratic but enough alloy materials were on hand, or arrived during the attack period, to assure scheduled operations for the aircraft industry at least through September 1945.

The most serious administrative problems arose not at the level of basic production but in the scheduling of deliveries from primary metal producers through intermediate stages of fabrication to military end-products. Procurement officials were reluctant to forego any immediate advantage that might accrue from independent control of materials entering into end items for which they were responsible. Various private interests also resisted creation of effective central controls over plant inventories and the movement of materials among company affiliates. These pressures, along with the complacency that affected all Japanese war planning until late in the war, prevented creation of an integrated production and allocation authority.

After various compromises, considerable power for determining individual quotas of available supplies was granted to the Munitions Ministry, which had regional branches in Osaka with general jurisdiction—at least in theory—over this aspect of the war production program; but the Munitions Ministry system worked only in a restricted area. The Army and Navy retained considerable independent control over much of their respective munitions programs. The Navy also had a dominant position in both merchant and naval shipbuilding. Only with respect to aircraft production were the military agencies willing to concede relatively complete authority to the Munitions Ministry. To an increasing extent, Muni-

tions Ministry officials in the Osaka region devoted their efforts to the aircraft production program at the expense of other activities equally essential to the war economy. Thus during the attack period factories contributing to the aircraft industry were the principal beneficiaries of regional machinery for expediting the flow of materials and for carrying out the repair and dispersal programs.

The Munitions Ministry superstructure, with its limitations as to jurisdiction and authority, had been imposed upon an earlier system of industry control associations responsible for assignment of allocation orders to individual producing units. Such industry control agencies were primarily private trade associations and, accordingly, influenced to a varying degree by the dominant firms and by military procurement agencies. Regional branches of such control associations had an important role in day-to-day production and delivery scheduling in the Osaka region. After the fall of the Marianas, there were renewed efforts to tighten up the war production control pattern and to achieve the maximum degree of regional autonomy, both in administration and in the physical organization of production. But the basic weaknesses remained. What had been merely annoying bureaucratic causes of delay and frustration before B-29 attacks started constituted almost insuperable barriers to production adjustments during the raid period.

The official pattern of materials allocation and scheduling, as well as the way it operated in practice, is described in detail in USSBS Report No. 36. In general, producers of equipment and major components obtained authority for allocations of basic materials through several agencies. Even end-product producers were often in this position. Procurement of all requirements for the aircraft industry, including aircraft instruments and accessories, was finally channeled centrally through the Munitions Ministry, although even this degree of integration was achieved in practice only toward the end of the war. But shipbuilding and marine equipment and naval ordnance contracts remained under control of the Navy, ground ordnance and accessories under the Army, railway equipment under the Transport Ministry, and other items under various control associations.

Each production order or order modification called for an application for appropriate allocations and then for requisitions on specific sup-

pliers. These negotiations usually involved officials of the contracting agencies and of various Munitions Ministry departments, as well as several of the control associations concerned. Control association and Munitions Ministry difficulties often had to be straightened out at Tokyo, even though procurement agencies were decentralized on a regional basis and the ultimate suppliers were located in the Osaka or other outlying regions. As a last resort, local Army and Navy expeditors frequently arranged to draw upon special reserves and service requisitions if production delays threatened.

In this confused situation and with the chronic overestimation of over-all output and availabilities, it is easy to see why priority scheduling of materials did not work smoothly and why almost every production official resorted to unauthorized means for protecting his supply position. Such "private enterprise" was frequently encouraged by impositions of fines for failure to complete military end-product deliveries on schedule. The large basic materials stocks discovered after the surrender at so many end-product and intermediate fabricating plants—despite the over-all stringency—seems less paradoxical when specific cases are examined.

There were innumerable ways in which unauthorized inventories could be built up under conditions existing even before the disruption caused by urban attacks. In the first place, there was the lack of adequate control, inspection, and enforcement powers on the part of the Munitions Ministry in its theoretical role as ultimate arbiter of priorities. Also, there was no effective control over movements of material between different plant units of a single concern working on different allocations and end-products. In fact, the practice of unauthorized transfers was frequently encouraged by Army and Navy "expeditors" on the spot. Similarly, belated deliveries of materials no longer required for current output could be "buried" as part of the officially-sponsored program for dispersing stocks of materials, or could be parcelled out among subcontractors. In any event, there were no effective sanctions against hoarding.

Another source of leakage from the official allocation system was through inadequate control of scrap and rejects. Shipyards, for example, trimmed and punched their own shapes rather than having them prefabricated and much of the scrap

went into unofficial channels. Although such leakages were relatively far less important on a volume basis in the case of most end-product producers, the practice was widespread. Firms receiving metal products of wrong sizes or specifications could also claim excess losses in adapting it for production. Many firms thus more than covered costs on reworking off-size steel products such as rod, wire, washers, and other shapes, and thus were encouraged to collaborate with suppliers who preferred to turn out items of maximum profit under existing price schedules. Such practices were not universal, nor should they be interpreted as wilful sabotage. They were the inevitable consequence of inadequate control and unrealistic price policies. The critical problems have already been mentioned—lack of centralized allocations machinery and effective inventory control. Many Osaka firms, even shipyards, contributed to several types of war production. Output might be divided between the Navy shipbuilding program, the two service ordnance efforts, the Munitions Ministry's aircraft program, and various other users. Thus, with no direct surveillance of current stocks in relation to requirements, firms tried to balance the benefits and frustrations attendant upon the competitive supply systems which prevailed throughout the war.

In general, the Army cooperated with the Munitions Ministry allocations system on major items but the Navy never fully accepted the concept of integrating materials allocations. Also, each service had special materials quotas, which it was inclined to reassign among favored users, in addition to the regular quotas provided for Army and Navy arsenals. The Navy had further bargaining power through control of shipping and fuel oil stocks, and another important Navy advantage with the sales officials at such government plants as the Yawata Steel Works. During the war, some of these officials who had formerly been naval officers were allegedly under direct Navy control and used their position to divert steel to Navy contractors. Naval control of convoy movements and harbor traffic was repeatedly cited as a means for assuring that rival claims for available materials were settled in favor of preferred contractors. To meet this problem, many firms purchased their own wooden schooners which, until 1945, were not subject to convoy regulations. Likewise, the Army built up its own fleet of ships to handle materials

and emergency deliveries of finished items for its arsenals and vital private war contractors.

It was possible to divert large quantities of steel and other basic materials by such means because there was always far more allocation orders outstanding than there was material available. Actual deliveries were often far behind original schedule, so that changes in production might result in deliveries of material for which orders had already been cancelled. Transport delays often resulted in material piling up at basic fabricators like the Yawata Steel Works at a time when priority consumers were clamoring for supplies. In such a situation, every concern endeavored to build up stocks for which they had no immediate or long-run use, as a basis for informal "trades." Such opportunities were frequently provided through the possibility of padding materials requirements and thus obtaining duplicating allocations from different purchasing agencies. Although actual deliveries might be delayed, such orphaned materials provided a basis for taking on additional emergency contracts or "encouraging" subcontractors, as well as for trades necessary to maintain current output despite delays in scheduled receipts.

Leakage of basic materials out of official channels came to be a most important part of the subcontracting system. As previously described, prime contractors normally handled all responsibility for obtaining materials and executing deliveries to their subcontractors. It was customary to allow an extra margin of loss in material supplied by parent companies to subcontractors in order to make up excess production costs incurred by the latter and not covered by official controlled prices. For their own protection, most concerns attempted to maintain strict control over their many subcontractors in this respect. Some went so far as to undertake, through job analysis and time studies, the direct supervision of costs and operations, and to insist upon systematic collection of all scrap and rejects. Practically all concerns exercised some financial control. But nevertheless, the parent firm had to allow a negotiated "leakage," or else to provide supplementary remuneration, for subcontractors' actual costs during the latter part of the war were often four to five times that for the same operation performed in a well-operated plant under normal conditions. In part this was due to unskilled labor and poor

work layout but even after borrowing skilled workers for staff training and supervision, costs in many such units still remained high because of lower labor productivity and the exorbitant wages that small operators had to pay. Thus the subcontracting system helped to reinforce other pressures on the official system of basic materials allocations. Inventory hoarding and systematic "leakage" were essential elements for the operator who wishes to keep his subcontractors in line and be in position to trade for necessary materials not obtained through official channels. "Swaps" thus became almost essential to operations in late 1944 for most producers. "By 1945 practically everything was changing hands above fixed prices," were the words of one well-informed Mitsubishi Electric official. Theoretically, such transactions—if sanctioned—were supposed to be negotiated at official fixed prices, but transport, handling, and storage charges could easily be padded in view of soaring costs for casual labor. Long-established business connections might help, but after mid-1944 it was impossible to get authorized deliveries for many types of metal fabrications without paying black market prices, in view of the huge number of outstanding requisitions as compared with actual production. The over-all shortage here of a basic metal, such as copper, might not be so important as official pricing inequities which made certain fabricated products, like copper wire of specified gauges, highly unprofitable. In most cases, such transactions did not mean that extra yen changed hands. The official fixed price might be paid plus certain products made by the customer and needed by the supplier. In many cases, some scarce maintenance item, or a machine tool, might be traded. Very frequently, the "loan" of skilled labor might be arranged for a concern not favored under existing manpower allocation procedures.

The summary section of this chapter has pointed up the general consequences of these basic weaknesses in the control of materials for war production. Whatever these weaknesses might have contributed to production difficulties in the absence of air attacks, there can be no question that they substantially increased the impact of urban disruption on output during 1945. The situation was even more vulnerable with respect to other industrial materials than with the fabrication and delivery of basic metals.

Other Industrial Materials

As previously emphasized, the Munitions Ministry organization at the regional level lacked adequate inspection facilities even with respect to bulk commodities and, in any event, was preoccupied with servicing the aircraft industry. Regional control association offices had no real authority except in respect to executing allocation decisions received from Tokyo and this was particularly the case outside the bulk commodity field. Navy officials never sympathized with efforts to extend civilian authority over their procurement programs and the Osaka Army Arsenal officials were openly utilizing black market techniques, as well as their independent allocations, to expedite their various programs.

In such a situation of uncertainty and possible shortage, every operator tried to build up stocks of maintenance items as well as materials, and to hoard even those for which he had no immediate or long-run use, to be used in trading. Earlier in the war, such operations had been frowned upon even between financial affiliates. But as general weaknesses of the Munitions Ministry control scheme became more evident and that agency became preoccupied with the problems of the aircraft industry interchange of materials was officially encouraged. The Navy thus encouraged its contractors in the electrical equipment field to organize a clearing house for interchange of scarce items, similar to the informal arrangement among shipbuilders. These schemes gradually extended from bulk materials to all other industrial requirements. Such interchange was supposed to be geared to the official allocation system but, in fact, transactions were carried on to an increasing extent without any notification to government officials other than the Navy inspectors at the plants concerned. But the practice of unofficial trading became even more widespread, extending far beyond particular units of one concern or trust, or producers of similar end products. Especially this was the case in maintenance items essential to continued output but not required in large bulk and thus difficult to control. These items frequently were produced by small firms not favored by existing priority regulations for labor and materials. Thus such products tended to disappear from the regular market, especially when the prospect of air attacks began to loom and purchasing agents were busy building up reserves. It became

almost impossible to avoid dealing with brokers for many items, despite the official campaign against such operators.

Thus, in late 1944 when air attacks came—when deliveries were interrupted, stocks destroyed, production changes ordered, dispersal efforts suddenly undertaken, and equipment repairs attempted—there was no central data on the actual amount and location of supplies or on current pipeline conditions for many critically important items. During 1945, top officials in Tokyo may have been preoccupied with over-all figures on the country's already serious and prospectively critical position in coking coal, pig aluminum, or other bulk commodities. But such commodities were not the most critical problems to the factory managers and public authorities directly concerned with maintaining current output in the Osaka region. Output of those war items deemed essential to the newly announced strategy of "arming the one hundred million who fear not death" was usually covered by existing stocks of basic materials, but after the March 1945 attack, maintenance and other industrial products provided the critical supply difficulties.

At most levels of production, inventories of basic materials were piling up at an alarming rate after March 1945 but current output was often stalled for need of maintenance supplies, spare parts, special lubricants, construction materials, building hardware and tools, electrical fixtures, belting, and similar items. The official allocations system lacked the integration, the authority, the information or the flexibility to deal effectively even with the bulk commodities, let alone the many other items which provided the real production bottlenecks during 1945. Thus, even without the transport and communications problems, the damage to control association offices and Munitions Ministry records in this region, the situation would have become increasingly serious. The control system which existed on paper and operated during 1943-44 through systematic violation of its spirit and regulations was certain to break down under the impact of air attacks which affected all levels of production and all industries contributing to essential war production. Instead of cushioning the effect of B-29 attacks, this system contributed to the general industrial breakdown. Its peculiar vulnerability to the dislocations resulting from the urban raids helped prevent efficient utilization of available resources.



Photo 23.—The administrative heart of the Osaka region. Looking northeast across the central business district toward Osaka castle. The conspicuous white prefectural center is seen directly in front of the castle, while Army headquarters and factories of the Army arsenal extend widely around this famous landmark. Note that most of the concrete business buildings visible in this picture have been gutted. Steel frames and wooden business structures were completely destroyed and even many brick structures collapsed completely. In this district were located many of the factory headquarters as well as trade associations and public offices responsible for war production in Osaka and the surrounding region.

THE STRUCTURE OF INDUSTRY IN OSAKA

The Place of Osaka in Japan's War Economy

Osaka ranked second among Japan's six principal urban centers in size, population and aggregate contribution to war production. In shipbuilding, where the city produced about a tenth of the nation's wartime total, in electrical equipment, where the proportion was about one-seventh, and in machine tool and general machinery where the ratio reached one-third, Osaka was itself a major factor. Its position was also important in many other supporting industrial fields and in basic metals fabricating, although neighboring Amagasaki and Kobe also made important contribution to local requirements.

Almost 25 percent of Osaka's industrial labor force of over half a million was devoted to the aircraft industry although no final assembly took place within the city, but in ordnance output the Osaka Army arsenal was both a manufacturing and final assembly point for roughly 20 percent of army requirements. Aside from shipbuilding and ordnance, the wartime industrial role of Osaka was primarily an intermediate one—between the primary reduction of basic materials and the final assembly of military end-products.

Osaka's position as a major overseas transshipment point became increasingly important as the war progressed and as traffic was diverted away from exposed routes to Nagoya and Tokyo. Thus Osaka's extensive storage and lighterage facilities

were utilized to organize outbound military shipments of goods processed in the Eastern centers as well as in the Osaka region.

In aggregate industrial capacity and activity, Osaka ranked closely behind Tokyo and far ahead of other Japanese centers. But like Tokyo and Kyoto, Osaka had a considerable amount of lower priority and nonessential industry which had been partly curtailed and partly converted during the war. Nevertheless, the fact that Osaka had five times the aggregate labor force of Kobe at the beginning of 1945 and four times the industrial floorspace of that city, provided a fairly accurate measure of its relative position. Kobe and Nagoya more completely concentrated on priority war production but Osaka had a vital supporting role for end-products elsewhere in addition to its own direct contribution.

The role of Osaka as Japan's second administrative center has already been discussed and will receive further consideration in later sections. Both for the Osaka region and for military and transport functions extending considerably beyond its boundaries, administrative agencies located in Osaka city had come to have a predominant position during the war. Thus in terms of its basic economic contribution and as a vital element in the network of military and civilian administration, Osaka's position in the Japanese war economy was of major importance.

The Pattern of Industry in Osaka

Data obtained from the prefectural police authorities provided relatively complete information on factory size and function in Osaka during the last phase of the war, when practically all available labor had been mobilized and plant reconversion reached its peak. In connection with the program for distribution of food rations to workers at each factory, the police required detailed information on payrolls and attendance. Records for five months during 1945 were relatively complete, thanks to the practice of storing the original data in underground vaults at each district police station. From these records, local authorities compiled tables for the survey specifying the number of plant units and the number of listed employees assigned to each of five general manufacturing categories. Such tables were prepared for each police district of Osaka covering January, March, May, June and July 1945. Despite

certain recognized shortcomings this material provided a relatively clear and accurate picture of the industrial pattern in Osaka.

The factory labor data provides a fairly accurate indication of the functional pattern in Osaka, both in terms of the type of activity and the size of plant units. Of almost 505,000 workers in Osaka plants, according to the registration data for January 1945, roughly 134,000 were in plants contributing primarily to the aircraft industry, 99,000 to armament, 88,000 to shipbuilding and 50,000 to other metal fabricating. Almost 127,000 were in other types of manufacturing, including chemicals, electrical equipment, rubber, leather and woodworking and all consumers goods industries. The distribution according to plant size is clearly suggested by the total figures for all manufacturing. Plant units employing over 500 each had 208,707 of Osaka's total industrial labor force. At the other extreme 140,635 were in plant units employing less than 50 each.

The following tables summarize this data:

Aggregate industrial employment
[OSAKA JANUARY 1945]

Plant size	All plants	Over 500 employees	50 to 500 employees	Under 50 employees
All industry-----	504,563	208,707	155,221	140,635
Aircraft-----	134,295	43,129	52,356	38,810
Ordnance-----	98,825	53,598	22,000	23,227
Shipbuilding-----	88,229	63,342	15,035	9,852
Metal fabrication--	56,363	26,355	14,734	15,274
Other-----	126,851	22,283	51,096	53,472

NUMBER OF PLANT UNITS

All industry-- --	16,061	94	1,415	13,552
Aircraft-----	4,647	20	464	4,163
Ordnance-----	2,400	20	227	2,153
Shipbuilding-----	992	26	138	828
Metal fabrication--	1,807	14	174	1,619
Other-----	6,215	14	412	4,789

The above divisions, as between industries, are necessarily arbitrary in many cases since many units, large and small, contributed to more than one category. Particularly with respect to small plants listed as contributing to the aircraft industry, there was considerable exaggeration, since many black market workshops managed to identify themselves with this industry to assure themselves a priority ration status, although making only a token contribution. Nevertheless, authorities regarded these classifications as generally accurate. The high proportion of employment in small units is of particular interest for it contrasts



PHOTO 24.—Typical subcontracting district in Osaka. Medium sized factories depended heavily upon small workshops, most of them located in two-story wooden structures.



PHOTO 25.—Post-attack view in same district. Except for occasional concrete structures, only burned-out transformers and industrial debris mark the location of former small factories and workshops.

sharply with conditions prevailing in Kobe and most other cities. Even in Kyoto, most of those contributing to war production were in larger units.

Employment in very small workshops deserves particular attention because these units were the most common victims of incendiary attacks and formed the bottom layer of the local subcontracting pattern. The following table indicates the number of registered employees in manufacturing units with ten employees or less as of January 1945.

Industrial category	Number of plant units	Percent of all units	Number of workers	Percent of all workers
Aircraft	2,410	51	14,301	10
Ordnance	1,264	53	7,810	8
Shipbuilding	318	32	6,948	7
Metal fabrication	886	49	3,784	6
Other	3,994	64	19,060	15

It is evident that there is considerable variation between industries as to the role of these small workshops. In the aggregate they represented barely 10 percent of the total labor force and a considerable smaller proportion of total power consumption and output.

While over 9,000 of Osaka's 16,000 production units thus accounted for only a tenth of its industrial labor force, 46 plants with over 1,000 workers each employed a third of the city's industrial workers. These units, starting with the Osaka Army arsenal and its 38,000 workers, were the most critical elements in local war production but all depended to a considerable extent upon components and subcontracting functions provided by smaller units.

INDUSTRIAL DISPERSAL AND REPAIR

The following discussion of dispersal and repair problems deals in some detail with the one major—and futile—attempt to modify the production structure previously described, and to adjust it to the conditions which arose during the attack period. No serious effort to reduce existing war industry vulnerabilities was even considered in the Osaka region until 1945. The program undertaken after the March urban attacks revealed basic flaws in the structure of war production as well as in the administrative machinery which was supposed to provide means for adjusting essential activity to the new and critical conditions.

However, the program of expansion undertaken by key war industries before and after Pearl Harbor had done much to reduce the risk of damage to aircraft and certain other end-product activity in urban attacks. Execution of this program was relatively successful. It had been undertaken not on strategic grounds but as a means for utilizing existing pools of skilled labor and nonessential factory floorspace suitable for conversion. But such dispersed expansion did not basically modify the traditional dependence of Japanese industry on subcontractors crowded into the major cities. By the time serious attention was given to the organization of subcontracting complexes near large outlying end-product war plants, the general shortages of labor, building materials, industrial fixtures and equipment presented overwhelming obstacles. Administrative machinery adequate for the task was woefully lacking.

The last-minute effort to undertake large-scale dispersal from Japan's major cities was handicapped by the prior need for placing major aircraft production facilities beyond reach of precision attack. Japan gambled on its ability to maintain current output until the last minute and still disperse effectively in the event that our strategic bombing program proved successful. That gamble would have been dubious under the most favorable circumstances. The destruction of so high a proportion of Japan's stock of capital equipment in mass incendiary attacks doomed all hopes for prompt execution of the aircraft dispersal program. The disorganization of the labor force and the whole economy prevented effective utilization of the generous time-interval granted urban industries in the Osaka Region between March and June 1945. Except for a few key units, the June attacks caught priority factories disorganized and still "at risk" in congested urban industrial areas. The repair program, like that for dispersal, was doomed because of the high measure of physical destruction and the overwhelming disorganization of urban life and official administration.

Dispersal—The First Phase

Prior to the invasion of the Marianas, there were few advocates of industrial dispersal among military and industrial leaders. Complacency about military prospects, preoccupation with maximizing output, and lack of awareness as to the manifold organizational and economic difficulties



PHOTO 26.—Dispersal par excellence. Prewar view of Sogo department store, on main thoroughfare and subway crossing, central business district. Offices and machining operations of Sumitomo aircraft propeller plant were moved into this virtually bombproof structure after surrounding area had been burned over.

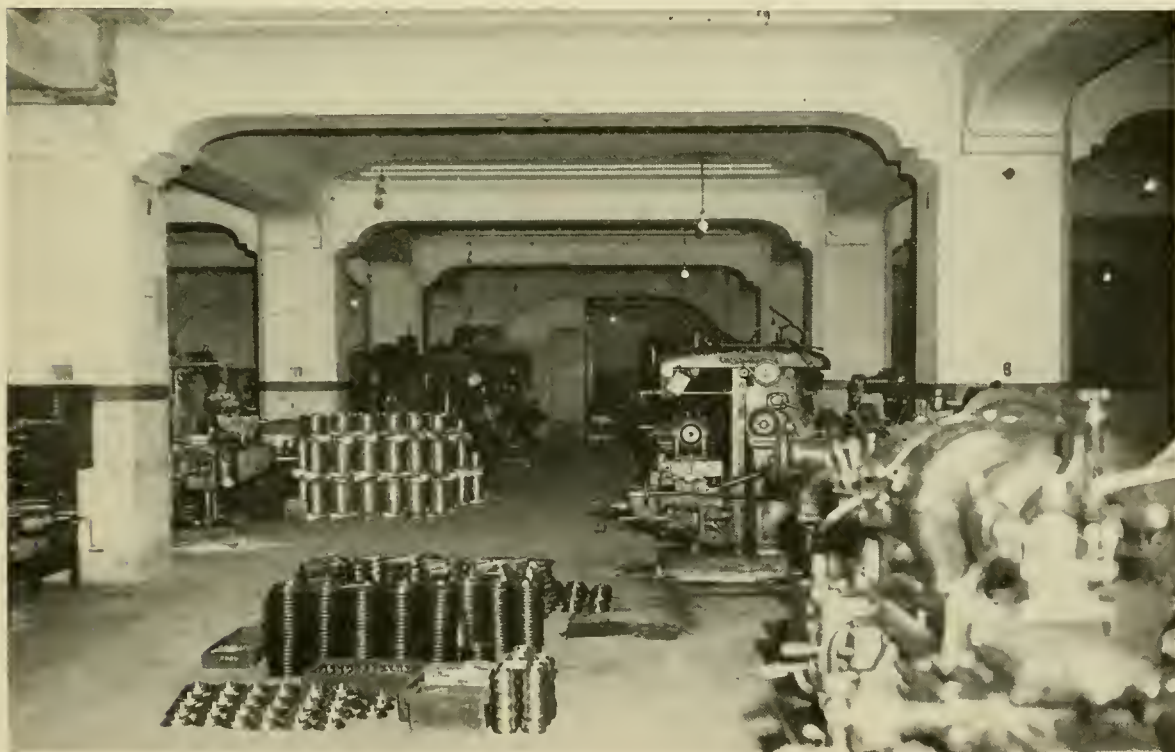


PHOTO 27.—Machine tool operations in one corner of the department store sub-basement.

that priority dispersal would ultimately entail affected the thinking of responsible business men and public officials. Neither group realized the magnitude of the air attacks that were to come or the utter inadequacy of available defenses. The military, especially, were unwilling to make the necessary sacrifices in current production.

Other considerations influencing delay were the existing shortages in construction materials and the claims on labor and transport facilities which a thorough and effective dispersal program would require. The experience of German industry under air attack did not seem to affect official thinking on this subject or to drive home the necessity for advance planning. As a result, from 1942 until late 1944 no official planned dispersal program was developed for priority Japanese industry. Such dispersal as did occur during this period was dictated by technological—not strategic—considerations. It was nearly always initiated and executed by individual firms and was incidental to the rapid expansion of various war industries. Such dispersed expansion was designed to utilize existing plant facilities and pools of skilled labor as a matter of convenience and economy. Air-raid protection was definitely not a primary consideration and the role of government officials was secondary and indirect.

In the Osaka region such priority firms as Kawasaki Aircraft and Sumitomo expanded by securing the plants of less essential enterprises—mainly textile and spinning mills but also warehouses, breweries and pottery works. Many textile and other lower priority firms were encouraged to convert their facilities to the production of essential items. Many of these, among which the Kanegafuchi spinning combine was the most energetic in the Osaka region, produced important military end-products, while others took on subcontracting work from ordnance and aircraft companies. Toward the end of this period, some war industries planned to establish workshops in the schools as part of the program for utilizing student labor. In Osaka City, 22 large schools were converted exclusively as factories and factory training schools early in 1944. As the war progressed and industry became increasingly dependent upon the student labor force, workshops were set up in most schools to save the students' time and maintain better labor discipline. In Osaka City, 221 out of 282 principal primary and

middle schools were being used in this manner by the time of the attacks.

In addition to the conversion of nonessential plants and schools for war production, a few large producers did begin to disperse in the strict sense by initiating final assembly at plants which formerly had functioned only as suppliers of sub-assemblies and parts. Kawasaki Aircraft, which produced about one-sixth of all 1944 combat aircraft, provides one of the best examples of such procedure in this area. This firm originally established engine and airframe production at Kobe, but later moved its final assembly operations a few miles west to Akashi. The original Kobe works concentrated on heavy components for the Akashi engine plant. During the war, sub-assembly plants were also established at Futami, midway between the other two plants, and at Takatsuki on the outskirts of Osaka.

When the firm was ordered to boost output in mid-1944, it decided to convert both the Futami and Takatsuki plants to complete engine assembly by taking over other near-by unessential floor-space and by moving in some of Akashi's machine tools along with additional new equipment. The wisdom of thus establishing three near-by assembly complexes was proved when the Akashi plant was hit in January 1945. Bombing was heavy and accuracy was of a high order in this attack, but due to improper fuzing and lack of incendiaries, 94 percent of the machine tools and other machinery at this important airframe and engine works remained serviceable. The Kawasaki company was able to move much of this equipment to Futami and avoid a critical drop in engine production. The Futami plant, as a result of this foresight, was able to produce over 1,300 aircraft engines between January and August 1945. The Takatsuki works was still in the process of conversion to complete assembly and began to deliver engines only in the last weeks before the surrender. However, parts production there and at another branch plant in Sakai maintained Futami output during the critical months of 1945, despite the heavy attack on the Akashi works and damage to the firm's original plant in Kobe. Even much of Kawasaki's dispersal-expansion program was initiated too late to be fully effective. And few other firms in this region were as far advanced.

It is not possible to offer a complete and accurate analysis of the dispersal activity which did



PHOTO 28.—Typical dispersal site in hills near Kyoto.



PHOTO 29.—Close-up of unfinished dispersal structure showing typical Japanese construction methods for small factories and shop buildings.

take place during this period before the Marianas landings shocked the authorities into action. There was no over-all dispersal policy in effect nor was there any government agency charged with supervising and maintaining records concerning that dispersal which did occur. Nevertheless, the records of individual companies during this period indicate the nature and magnitude of the dispersal, and it is possible to draw certain valid conclusions.

Dispersal in the Osaka region during this 1942-44 period was confined entirely to large producers—principally aircraft, electrical equipment, and machine tool concerns. As indicated above, practically all such activity was incidental to expansion. Inasmuch as dispersal was undertaken on the initiative and responsibility of the individual companies, only the largest companies could command the necessary materials, transportation, capital and labor to undertake these plant developments. The Army and Navy were far more interested in maintaining current production levels to the exclusion of all other considerations, and continued to voice assurances as to their capabilities for defending priority factories from air attack.

Accordingly, plants located within Osaka City were not encouraged to move unless as part of an expansion program that could not otherwise be satisfied. Thus, with few exceptions, firms within Osaka City took over near-by available factory space when necessary, or, more often, made subcontracting arrangements with additional established firms located in the city and thus equally vulnerable to large-scale urban attacks. In the cases of local expansion which called for readjustments of equipment, movements were generally over relatively short distances. Transportation was thus largely confined to trucks, barges, and carts, the latter being the most reliable. In the cases where major conversion was required, it took from two to four months before production was underway at the new sites.

Among the large producers of priority items, most were able to accomplish all the expansion-dispersal that they undertook during this period. Mitsubishi Electric and Shimazu Engineering both reported their programs of plant expansion satisfactorily completed. Kawasaki Aircraft, Kawanishi Aircraft, and Sumitomo Propeller, whose dispersal projects consisted of extending

final assembly activities or more complex sub-assembly operations to existing sub-assembly and parts plants, were able to accomplish their early programs with satisfactory facility. Such new factory developments—and also the rapidly completed neighborhood expansion-dispersals undertaken by many smaller Osaka firms—had little negative effect upon current production. Since the firms involved were already producing at their highest rates, temporary production losses, if any, were in terms of potential rather than actual output—for example, higher plant utilization at the original site through three-shift operation. In most cases, shortages of labor and supervisory personnel ruled against more intensive use of the original plant.

Although all major companies succeeded in carrying out their dispersed expansion plans in this region, they encountered serious difficulties in transporting machinery and materials. Especially in late 1943 and 1944, it became increasingly difficult to obtain a sufficient amount of dependable truck transportation. The armed forces were reluctant to lend their vehicles and black market charter prices were very high even early in the war. Thus such firms were forced to depend mainly upon their own resources. They were equally dependent upon their own employees for much of the necessary labor. Construction workers, like building materials, became progressively scarcer. Even where existing facilities were being converted, there frequently was much difficulty in taking care of housing and transport of workers.

Advanced dispersal was accomplished with difficulty and at the expense of some current production. It laid claim on already scarce labor, transport, and material resources. But it is clear that a more general dispersal program could have been accomplished during this period without creating serious dislocations in the region's economy. At the price of some current production, the most important production facilities could have been rendered less vulnerable before 1945, when shortages were more acute and air raids were in progress. This failure to disperse—or even to organize plans for dispersal—during this period from 1942 to late 1944 represents a serious and basic error and contributed to many of the production difficulties experienced during the attack period.



PHOTO 30.—Unfinished business. One of many country roads near Osaka lined with heavy equipment from Osaka Army Arsenal. Delays involved in tunneling led to extensive use of small factories and farmhouses. Very little of this ambitious program was completed before the surrender. Labor difficulties were less serious than lack of building materials, electrical fixtures, and auxiliary equipment.

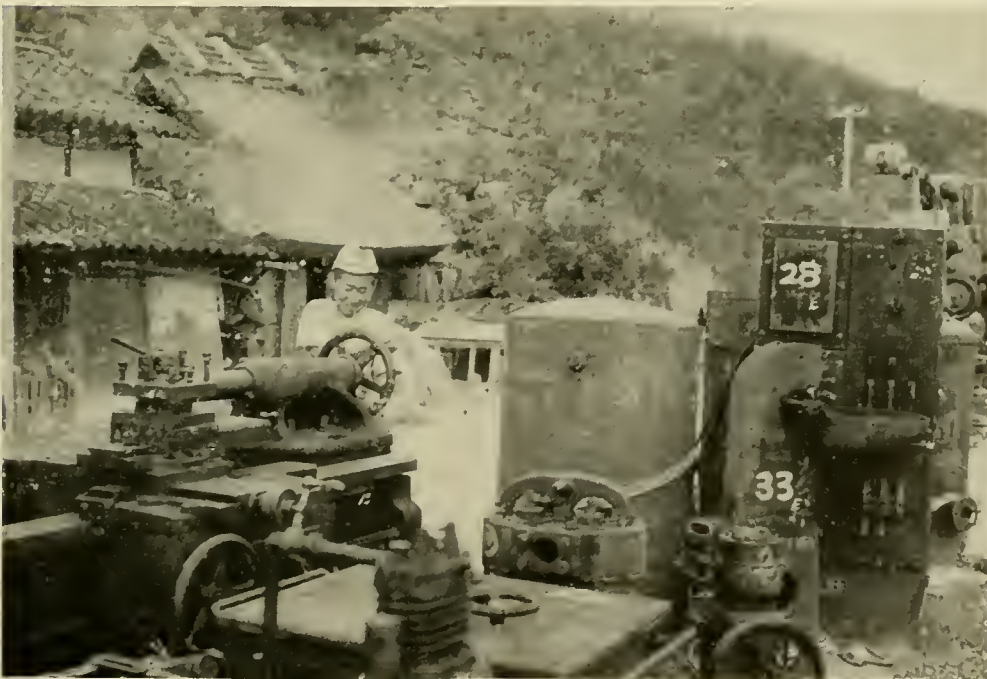


PHOTO 31.—Exposed machine tools, electric equipment, compressors, and punch presses waiting near another dispersal site. Large amounts of dismantled equipment were also to be seen awaiting transportation from urban sites. Only priority factories could obtain facilities capable of moving heavy equipment.

Dispersal in 1945

The second phase of industrial dispersal was carried out to escape precision and urban area attacks and to minimize damage already inflicted on industry from such attacks. In late November and December of 1944 a few large companies in the Tokyo area were directed to disperse—and then only after protracted debate in official and business circles. It was not until 23 February 1945 that a final decision was made by the government in Tokyo to disperse on a planned national basis.

On 12 March 1945—three days after the catastrophic 9 March area attack on Tokyo—a “Central Counter Planning Headquarters of Production and Defense” was organized in the Munitions Ministry to supervise and enforce dispersal of all key war industry in Japan. This agency functioned through the regional headquarters of the Munitions Ministry, one of which was located in Osaka City. For the country as a whole, the organization planned to move key elements in major war industries to 1,575 dispersed sites, 1,191 of these were located above ground, 132 semi-underground, and 252 underground. In addition, it was planned to disperse thousands of small producers, essential for maintaining components deliveries, on the initiative of regional authorities. Top priority was given the aircraft industry, including producers of engines, airframes, propellers, and aircraft ordnance. Second priority was given to producers of communications equipment, anti-aircraft ordnance, “special attack” weapons, special steel, anti-friction bearings, machine tools, critical chemicals, and aviation gasoline.

The Home Islands were to be divided into six autonomous and increasingly self-sufficient regions so that production could continue in the areas not immediately attacked, in the event of Allied landings elsewhere in Japan. The Osaka area was designated as one of the six regions with administration centered in Osaka City. Within each region the local Munitions Ministry officials assigned a district into which each plant was to move, the choice of the exact site being left to the company's discretion. The Industrial Equipment Board of the Munitions Ministry was to purchase or lease the sites and provide subsidies for dispersal expenses. Although a few producers, such as the Osaka Army Arsenal, did receive their actual funds for this purpose, private companies

received only promises of future repayment. This failure to advance funds added to the reluctance of many companies to move.

The dispersed sites were to be located on ground suitable for underground and semi-underground installations where possible, and usually in places where some suitable factory buildings were already in existence. The companies were to move and start production on a temporary basis in the buildings at the new site until permanent underground or other installations were completed. All facilities were ultimately to be moved into the completed dispersal plants and buildings at the original site were to be abandoned. Administrative, research, and other offices, as well as supplementary workers' billets and facilities were to be set up in existing structures at the site or nearby. Thus all operations of the concerns covered were to be removed from the former sites in congested urban areas and a time limit of six months was stipulated for completion of the entire program.

With respect to production, the Government estimated that losses of only 20 percent would be averaged during the six months period while the program was under way. This estimate was highly unrealistic. The private estimates of individual companies were considerably higher and turned out to be far more accurate. For example, Sumitomo Propeller, which produced 66 percent of all aircraft propellers in Japan, estimated dispersal of its four major plants would cut production as follows until the new sites were functioning: Osaka plant 90 percent; Amagasaki plant 30 percent; Shizuoka plant 40 percent; Tsu plant 60 percent.

On 1 April 1945, the national order was issued for the dispersal of first priority factories. This was followed by a second order on 16 May 1945 for the dispersal of second priority factories. In July 1945 a final national order was issued directing the dispersal of all war factories not specifically covered by previous orders. Actually many of the most important aircraft, communications, ordnance, and electrical equipment producers were unofficially informed of specific directives affecting them before they were issued, and some companies were already in the process of moving when the orders were officially announced. In addition to the large companies affected in Osaka, 400 small manufacturers in the city received dispersal orders initiated by the regional Munitions Ministry office. These local orders were issued at

intervals over a period from 10 April 1945 to 9 August 1945 in an attempt to stagger the dispersal activities. It will be recalled that Osaka's first urban attack occurred in mid-March and the others in the first half of June.

It is extremely difficult to estimate how much of the ambitious plan described above was ever realized. The Osaka office of the Munitions Ministry retained few records and the adequacy of even these is open to serious question. The offices were reestablished in March and June after successive raid damage and much of the available data had to be reconstructed by appeals to Tokyo and to plant records—where possible. Companies were reluctant to report their failure to comply with dispersal orders or to resume output as scheduled. When official inquiries were made, they almost uniformly over-estimated how much they really had accomplished. Actually if machinery was moved to a new site but not installed, or was even enroute, it was reported as "dispersed" and was thus regarded by the responsible authorities in their official reports to Tokyo. Similarly, if employees were no longer reporting at the original plant, or simply had left their homes because of the air raids, they also were reported as dispersed—which indeed they were but not quite in the way the Government had intended.

Of the 400 small companies in Osaka City which were ordered to disperse, 183 reported dispersal in progress at the time of surrender with varying degrees of completion ranging from 10 percent to a few who reported 100 percent. These firms claimed to have dispersed a total of 13,043 machines and about 18,000 employees. The remaining 217 companies reported no dispersal accomplished at the war's end. No accurate data is available as to the number of dispersed companies that got into anything more than token production again, but from a sampling of individual cases, an estimate of 15 percent to 20 percent for this region would appear to be generous. Those companies which were able to start production at dispersed sites were wholly unable to regain old rates of output.

In summary, the program for dispersal of small companies from Osaka City was a failure. Fifty-four percent of the companies accomplished no dispersal at all despite orders to do so, and of the 46 percent which did report some activity, only a fraction were able to start production at their new

sites. In every case, rates of production on an over-all or per man-hour basis were substantially lower than at the old sites. The experience of the small companies in Osaka City was typical of the effect of dispersal on all companies in the region. Such activity was not undertaken to any extent in Kobe. The net result of dispersal efforts among small plants was to increase the difficulties of the large priority factories for which they were, in most cases, subcontracting. The program further disorganized transport, decreased the total number of machines in production and, therefore, over-all output at a most critical period. Finally these efforts encouraged a wholesale breakdown in labor discipline.

Dispersal of the larger companies in the Osaka region was less chaotic during this period but had the same net effect upon production. Kawasaki Aircraft earlier had been fairly successful in dispersing by converting two sub-assembly plants and parts producers to final assembly plants. But after the Akashi attack in January 1945, it endeavored to reestablish its airframe assembly facilities on a "bomb-proof" basis and also to put its Fuatami engine plant underground and into the woods, emphasizing tunnels, scattered small buildings, and old mines for its shops. When the war ended, 1,200,000 square feet out of a planned 1,900,000 square feet of new construction had been completed and the company considered its dispersal 60 percent complete. But it had not begun moving on a large scale to the new sites and shortages of auxiliary equipment and construction materials made it clear that production would be seriously hindered.

The effects of air attacks are significant and are illustrated by the dispersal of the Naruo plant of Kawanishi Aircraft—located midway between Osaka and Kobe—which produced over 3 percent of all 1944 combat airframes. In the first months of 1945 the company began to disperse certain operations. In April 1945 it built 72 planes with the prospect of improved output as component and labor problems following the March urban attacks on nearby cities were overcome. But in May 1945, production fell 61 percent and the company attributed the drop almost entirely to dispersal difficulties. On 9 June 1945 the Naruo plant was heavily hit for the first time and the company immediately accelerated its dispersal efforts. The combined effects of dispersal and the

air attacks during the June-August 1945 period were to hold production down to 23 planes against a planned 320. Heavy urban raids almost invariably forced companies to attempt to speed up dispersal in progress at the expense of whatever production was being maintained and had an indirect effect of further dislocating the entire regional economy.

The records of other representative large firms indicate similar results. Mitsubishi Electric at Kobe was able to accomplish 35 percent of its planned dispersal. The Osaka Army Arsenal originally planned to disperse only five percent of its total operating capacity because of the nature of its heavy equipment, but completed only 25 percent of this relatively modest initial effort by the end of the war, despite its priority command on labor, transport, and other facilities. Ten local top priority anti-aircraft ordnance factories under the control of the Osaka Arsenal were able to effect an average of 56 percent of planned dispersal. But with every possible advantage, production rates averaged only 17 percent of that scheduled for mid-August at the new installations. Thirty other companies, engaged in making fuses, shells, and various aircraft and ordnance parts under the direction of the Osaka Arsenal, but not given first claim on all requirements, accomplished an average of 42 percent of planned dispersal and production at the end of the war had reached 30.3 percent of that planned.

Failure of the Dispersal Program

Dispersal undertaken prior to late 1944 was successful in the main because it was on a small scale in terms of the region's whole economy. Little new construction was necessary and the distances involved were relatively short. Shortages of skilled labor and materials were not as great as in the closing year of the war. Every company which attempted to disperse during the attack period encountered many serious difficulties. These difficulties arose from two main sources. First, there were extreme shortages of such essentials as transportation, labor and materials—all of which were greatly intensified by the urban attacks. Secondly, there were basic errors and miscalculations in policy, planning, and administration of the emergency dispersal program.

As noted earlier, practically all companies trying to disperse out of Osaka City during the at-

tack period listed transportation as their single greatest bottleneck. Motor transport was already overtaxed when dispersal began on a large scale. Trucks generally were in disrepair and poorly maintained. No company was able to obtain all that it needed. Fuel was short for industrial truck owners and, while a few favored companies received aid from the Army and Navy, military motor pools were not made fully available because the armed forces were likewise short of fuel and trucks. Direct military needs, as well as the needs of Army Arsenals and their affiliates, were increasing. Private companies could not loan their facilities legitimately to other firms for the same reasons and few companies could afford to hire trucks in the black market. Fees up to 2,000 yen per day precluded their use by all save wealthy individuals who were removing valuable personal goods from the urban areas.

Where they could be obtained, ox and horse carts were more reliable but were not suitable for long hauls, a round trip of as little as ten miles requiring from 12 to 24 hours. Transportation of equipment and materials from factories to railroad terminals, and again from the rural railroad sidings to the new sites, was largely dependent upon these types of transportation. It was in the failure of transportation within Osaka and other centers that most firms had their greatest difficulties. Moreover, roads and facilities at the new sites were frequently unsatisfactory for heavy transportation.

The railroads were similarly overburdened during the attack period. Breakdowns of loading equipment and cars became frequent and repairs were increasingly difficult and time-consuming due to a shortage of skilled labor. But, in general, the railway could move everything that was loaded. Temporary delays after heavy raids were not of great magnitude but car tie-ups in Osaka and at dispersal sites were most serious. Machinery and materials frequently remained out in the weather for many days and even weeks awaiting transportation to and from rail cars and plants. Damage to machinery was often very extensive since adequate protection was lacking. Loading and unloading of trains and trucks was also a serious problem because cranes and labor were even more scarce than the transport facilities themselves—especially at the dispersal sites. This series of related problems was formidable at most dispersal sites but, taken together, they seemed

even worse within Osaka City itself. The seriousness of the local transportation situation is illustrated by the case of Sumitomo Propeller which was given most convenient near-by sites and top claim on transport facilities. This high priority company estimated that if transportation had been fully available it could have completed dispersal of its Osaka plant in half the time actually required. The Amagasaki works of this firm could have completed dispersal by August instead of December 1945 as was estimated at the time of the surrender.

There were also many labor problems in connection with dispersal. Each firm was usually forced to rely upon its own labor force. The armed forces, the Munitions Ministry, and an association of leading contractors were all supposed to aid in the program but their help was very slight before June and most negligible thereafter. In Kobe the system for recruiting transport and construction labor broke down completely after the March attack and the situation was almost as serious in Osaka. In all Japan only 38 million man-days of labor were officially diverted to dispersal during 1945. A few Osaka producers received military aid, as in the case of Kawanishi Aircraft whose Fukuchiyama dispersal plant was built for it by the Navy. Troops and civilians mobilized for building defenses were assigned to aid several other top priority firms. But in the few cases where sufficient bodies were made available other labor problems arose that will be considered below.

Factory workers whose homes were not destroyed in the urban attacks had little desire to move from their homes because billets and food were usually more scarce at the new sites than in Osaka. They preferred to forage for food individually rather than concentrate in large groups in a small rural settlement where local facilities and transport were inadequate. Few concerns could assure their bombed-out workers adequate quarters. Fear of raids and food shortages thus led to increased absenteeism at the very time labor was needed most to help in organizing dispersal and maintaining sagging production levels. For raid victims turned to relatives or established factories outside the urban areas. After the March raid on Osaka, it was impossible to prevent large numbers of employees from leaving the city, and dispersal was further crippled. Many workers who deserted their posts in Osaka

later offered themselves for black market rates as common labor at dispersal sites after fleeing Osaka and getting established in rural areas. But many were loath to remain at their assigned Osaka factories and risk summary transfer to a site where living conditions might be intolerable.

The third great difficulty was in materials shortages—principally construction materials and fixtures. Cement was very scarce. Logging operations were expanded in the region but there was a shortage of personnel to process it into finished lumber. Many Osaka sawmills were destroyed in the March attack along with large lumber stocks. Shortage of electrical equipment, valves, belting and other specialized fixtures was the major problem for those who were able to meet their needs for labor and construction materials. Apparently this class of shortages—enormously increased as a result of damage in the Osaka and Kobe incendiary attacks—proved to be the most critical obstacles to restoration of output at the dispersal sites. Much equipment was damaged in transit and several firms had their chief trouble with moving delicate machinery for which they were unable to procure an adequate supply of packing and crating materials. Repair problems were frequently unsolvable at dispersal sites and constituted another major production obstacle.

In terms of policy and planning on a governmental level, it is indisputable that dispersal was undertaken too late. The reluctance of the armed forces and of some companies to sacrifice production to dispersal continued right up until the time when the air attacks forced some action. Despite these air attacks, there were still many companies which would not support the government's policy. Some, plagued by shortages and rising costs, preferred to use up their existing inventories and take on black market work until damage would enable them to collect on their insurance. When directed to disperse a certain percentage of their production equipment, many would thus move their most nonessential equipment, leaving their vital machinery untouched and still in production. There was no effective machinery to enforce dispersal orders and legitimate excuses were always at hand.

The administration of the program was likewise faulty. Basically, there was no coordinated priorities system for dispersal requirements. Thus, when the key plants contributing to the

aircraft industry in Osaka—and all regarded as essential—attempted to disperse simultaneously. operators found themselves competing disastrously for transportation, materials, extra labor, and government aid. While the aircraft industry was still trying frantically to move, the second national dispersal order was sent out and other priority companies in the region began their dispersal also. Their efforts succeeded only in adding to the confusion.

Quite aside from lack of personnel and from very serious communications troubles, supervision and enforcement of dispersal orders could not be anything but ineffectual. The Munitions Ministry and its regional offices had nominal authority but this meant little to plant managers during the raid period. They were inclined to follow the directions of the military service for which they were producing and through whose “expeditors” they received such practical aid as was available. The military agencies, in turn, embarked on a program of favoring their own most important producers and protecting their own production.

The rivalry in dispersal, like that in the allocation of materials, seriously damaged the authority of the Munitions Ministry and made a shambles of the priority system—encouraging the further growth of “black market” operations by all concerned. Finally, planning and scheduling was unrealistic and few government officials seem to have anticipated the difficulties caused by hasty and wholesale dispersal, particularly in light of the basic dislocations resulting from the heavy urban area raids. Estimates of the production losses due to dispersal and the scheduled completion dates were always highly over-optimistic at all levels of authority and few companies took the government’s figures seriously or expected theirs to be accepted at face value.

Industrial Repair

Industry in Osaka demonstrated little ability to recuperate from the mounting air attacks which began in March 1945. The government-sponsored repair system was poorly organized and wholly inadequate to carry out an efficient, thorough repair program. The program was so badly administered that most companies preferred to avoid obtaining repairs through the Munitions Ministry in Osaka. The shortage of labor was very acute despite the fact that the machine tool companies which did repair work

attempted to use their best labor on repair projects. Only the large producers—the aircraft firms in particular—received any substantial help from either the Ministry or the armed forces. The smaller companies accomplished very little and that only with difficulty and by resorting to various illegal methods.

It should be noted at the outset that an inventory of post-attack repair or replacement of a company’s plant and equipment is not a wholly accurate criterion of productive recuperability. Many companies did not complete feasible repairs on all partially damaged machinery. Absenteeism and other labor difficulties from June through August 1945 were so acute that many plant officials felt that there would have been insufficient personnel to operate the repaired machines even though all damaged equipment had been restored. “Listlessness” thus affected management decisions as well as worker efficiency. Also, dispersal efforts frequently took priority over repair and many firms concentrated on removing undamaged and slightly damaged machinery to dispersal sites and other places of safety rather than trying to repair at the original site. Nevertheless, it is clear that the recuperability of industry was slight in the period from March to August 1945. This was due in large part to shortages of repair parts, skilled labor, and inefficient administration of the few repair facilities.

One of the major factors in the appalling deterioration of available production resources during the attack period was the effect of corrosion on all types of machinery and electrical fixtures during periods of exposure following attacks. Due to the heavy absenteeism and confusion following attacks, minor roof damage often led to severe equipment damage that could have been prevented by prompt measures. The following discussion devotes main attention to the measures for major repair of complex machinery and machine tools. Actually, this represented only a fractional part of the recuperation problem facing any plant which sustained incendiary damage, as plant photographs in this and other USSBS reports indicate. A final section sketches part of this general repair problem in terms of a plant sample undertaken in Osaka.

Even prior to the air attacks on Osaka, industries there were faced with constantly increasing difficulties in repair and replacement of machinery. Breakdown rates of all types of equipment

were increasing rapidly due to natural deterioration and to mishandling by the incompetent and unskilled personnel which all industries were forced to use in increasing numbers as the war progressed. The air attacks on Osaka City and other urban areas, and upon a few large aircraft plants in the region, greatly intensified these problems. Under air attacks, industry was confronted both with severe damage to much of its own equipment and shops and with the loss of important sources of spare parts, skilled labor, and machine replacements. Recoverability varied with the company's own resources in the way of equipment and skilled labor, its priority standing with the Munitions Ministry and the armed forces, and, to a considerable degree, with the ingenuity of management. Labor problems were a paramount consideration at almost every point.

The larger, high priority firms in this region, such as Kawasaki Aircraft, Sumitomo and Mitsubishi, maintained their own repair teams and pools of machines from which parts and replacements were drawn. For example, after the first raid on Kawasaki's Akashi works, the company was able to handle repairs on two-thirds of damaged machines and its losses were further compensated by the timely receipt of 66 new high-capacity machine tools previously ordered.

Companies such as Mitsubishi Electric at Kobe which were part of a large concern received aid from other affiliates and, in turn, were able to provide direct assistance. In this case, Mitsubishi Electric received aid from the Mitsubishi Machine Tool Company and from Mitsubishi's Kobe shipyard. In turn, its engineers and skilled workers aided in planning and executing electrical repair projects elsewhere.

In some cases, replacements were secured by buying out smaller firms which had been damaged and were unable to continue production, or by cannibalizing nonessential plants for fixtures. But most of these installations had already been stripped before 1945. Also, large firms at times were unable to get machine tool producers such as Osaka Kiko, largest concern in the region, to send repair teams and spare parts to their damaged plants and, infrequently, to supply machine replacements. In the absence of official backing plus additional inducements, the smaller, low-priority firms were entirely dependent upon their own labor force and resources for repairs, and equipment replacements and technical assistance

were virtually impossible to obtain unless something more than official orders were offered to the repair companies. Japan International Aircraft, for example, obtained quick repairs only by systematically providing special inducements to various officials and repair companies.

Osaka was particularly fortunate in that 20 percent of the country's machine tool capacity and 34 percent of all capacity for other production machinery was located in the Osaka region, mainly within the city. Hence, priority Osaka companies could hope to obtain skilled repair aid and to draw upon a large stock of equipment. Nevertheless, repair help from Osaka's machine tool industry was confined to a few large firms and was not generally effective. This was initially due to the decision of the government in mid-1944 to convert most of the machine tool industry to direct production of war materials—mainly ordnance items—rather than to continue production of machine tools. By late 1944, well over 20 percent of the industry was in direct production of war materials and no allocations of materials were made for machine tool production in the first half of 1945. Thus preoccupied, the industry was swamped when dispersal and repair demands began to skyrocket at the end of 1944 and early in 1945. When heavy urban damage occurred to the smaller machine tool producers and subcontractors who had been counted on to handle equipment repairs for victims of precision attacks, Osaka's relative advantage from the standpoint of repair potential turned into a serious handicap.

The Official Equipment Repair Program

In May of 1944, at the instigation of the Munitions Ministry, the Precision Machinery Control Association had established the Kosaku Kikai, a machinery repair clearing house which was composed of member firms and designed to cope with damaged machinery for companies in war production. Two branches of the firm were set up in the Osaka region, one in Yodogawa-Ku, a congested area of small machinery concerns, and the other in the suburbs. The Yodogawa establishment was formerly an important private plant which had been engaged in repairing machinery throughout the war.

After June 1944, when it became a branch of the Kosaku Kikai, this Yodogawa plant rebuilt



PHOTO 32.—Repair of incendiary damage was frequently regarded as impossible. Lack of electrical cable and fixtures, belting and auxiliary equipment were regarded as greater obstacles than labor and building materials shortages, but damage from exposure was a major factor in reducing the total stock of capital equipment in Osaka.



PHOTO 33.—Another type of repair problem. Collapsing roof structures in larger buildings not only caused heavy damage to equipment but delayed salvage of equipment.

684 machines and farmed out a large volume of minor repairs to other small shops. The suburban branch itself rebuilt a total of 1,064 machines between September 1944 and August 1945.

Under the official plan, companies which suffered damage or equipment breakdowns reported to the Munitions Ministry headquarters in Osaka which would order its repair affiliate to send repair teams to the damaged plant. These teams made recommendations to the Munitions Ministry, which could authorize some machine tool or repair company to start operations. In practice, the system was inefficient and time consuming, even before the attacks started, and many firms frankly stated that they preferred to obtain repairs from other private sources or to undertake them in their own shops, rather than become involved in negotiations with the Munitions Ministry. It is easy to see why this system broke down after communications were disrupted and many official records destroyed.

The fact was that the aircraft industry alone was accorded a high enough priority to obtain any real aid from the Munitions Ministry. The Munitions Ministry regional headquarters at Osaka furnished the following data on the percentage of machines repaired before the surrender, compared with the number of machines for which repair requests were approved:

	Percent
June-Dec 1944	50
Jan 1945	40
Feb 1945	52
Mar 1945	40
Apr 1945	5
May 1945	11
Jun 1945	20
Jul 1945	1

Altogether, the Munitions Ministry approved requests during 1945 for the repair of 2,776 major machines and was able to complete repair of 879 machines through its facilities before the end of the war. The above figures from Munitions Ministry sources in no sense reflect an accurate estimate after February 1945 of the number of machines in priority plants needing repairs.

General Industrial Reconstruction

An indication of repair accomplished in Osaka City may be obtained from the following table. A sample examination was undertaken in Osaka of repair histories for 5,259 damaged shop units in nine industrial and one miscellaneous categories. The study indicates that 2,579 out of these 5,259 shops were abandoned and no repairs were attempted, while 1,462 shops continued production with equipment remaining undamaged or easily repairable. Of the 1,038 other shop units, the roof coverings were replaced on 320 but equip-

Repair data
5,259 Osaka shop units

	Aircraft 238,940 sq. ft.	Ordnance 183,992	Shipbuilding 16,103	Motor vehicles	Electrical equipment 7,581	Machine tools finished machine precision instru- ments 70,249	Chemicals 17,095	Petroleum machinery 166,600	Miscellaneous 234,354	Utilities 0	Total
Disposition:											
Shops abandoned	803	51	217	33	153	445	340	12	498	27	2,579
Undamaged part continued in production	556	39	131	28	106	219	220	8	320	18	1,642
Roof covering only replaced	122	4	32	1	14	94	8	1	44	0	320
Structural damage repaired; shops restored	85	0	43	0	1	63	43	3	54	1	293
Site cleared. New building erected	94	10	13	4	17	41	64		58	8	309
New site	34	0	18	0	5	7	12		40	0	116
Total shops damaged											5,259
Repair group:											
Firm's own general labor and construc- tion staff	5	3	3	0	7	8	51	3	3	0	83
Firms' own productive labor	88	8	35	1	1	36	103	3	36	7	279
Private construction workers	54	9	10	4	15	51	84		81	0	318
Facilities provided by government departments	128	0	56	0	5	52			67	2	310
Facilities provided by armed forces	8	0	0	0	5	4			3		20
Total shops where repair was attempted											1,010

ment could not be restored. In 309 cases a new building was erected on the cleared site, and 116 shops were dispersed to new sites and new buildings constructed.

In only 83 cases were shop repairs undertaken by construction staffs already in the employ of the operating company. In 279 cases firms used their productive labor for repair purposes. Another 308 shops were repaired by private outside construction workers. In 1,010 cases where repairs were attempted, 670 shops' repair efforts were organized entirely by the owners themselves. Three hundred and ten shop units were aided in repair through government facilities and only 20 received aid from the armed forces. Of the 322 shops repaired with all types of government aid, 136 were in the high-priority aircraft industry. Machine tool makers and shipbuilders were the only other categories receiving significant government aid.

The end of the war found the dispersal program in Osaka City and region still underway. But it had been steadily falling behind schedule and was increasingly hampered as a result of air attacks on the urban areas. The net result of undertaking dispersal in 1945 was to reduce further the productive capacities of industry in this region. As a whole, it represented a net loss to the Japanese war effort despite certain exceptional cases of effective execution. In view of the facility with which urban areas were being attacked and the damage these raids were causing directly and indirectly to the war production program and to the economy as a whole, it is not reasonable to assume that dispersal out of Osaka and Kobe could have been successfully concluded, even if the war had continued.

The basic error was one of timing and, once the program was undertaken, this error was compounded by the maladministration of the region's resources. Even in the absence of urban attacks, the program would have been gravely handicapped, although certain categories of output might have revived after mid-1945. With the enormous losses of equipment vital to the dispersal effort and the general dislocation—especially as it affected labor availability and local transport—the 1945 dispersal program was doomed.

INDUSTRIAL LABOR

While there are certain serious limitations in wartime data on manpower in Osaka, sufficient

information is available to determine the general pattern of developments and to establish the critical role of labor difficulties during the attack period. Basically, this information is of three kinds: general census figures and month-to-month estimates of employment among Osaka residents; payroll and attendance data used by the prefectural police in distributing factory food rations to plants located in Osaka; and adult payroll and man-hour production figures returned in USSBS factory questionnaires. The first category indicates the general availability and trade distribution of labor within the city, but supplies actual figures for only two months, November 1944 and May 1945; the second category of information covers actual factory employment by district and type of activity during January, March, May, June and July 1945; the final category covers the October 1943–August 1945 period for all factory units returning completed questionnaires. The first two categories are principally utilized in this section while the questionnaire data on labor will be presented along with month-by-month trends in production and power consumption.

There are two major aspects of the pre-attack manpower picture to be presented—the general trends in the size and distribution of the labor force and the measures taken for mobilizing and allocating additional manpower to meet the growing requirements of local industry. In general, employment among adult residents of Osaka reached a peak early in 1944 and thereafter declined gradually in response to military conscription and transfer of some workers to war plants elsewhere. In addition, the local labor force may have been somewhat reduced during late 1944 and early 1945 as a result of the firebreak program and voluntary evacuation. Osaka was provided with an extensive network of interurban electric lines so that a large number of local residents normally commuted to factories outside the city limits and likewise many of those employed in local factories and offices were domiciled at a considerable distance from the city. Indications are that roughly the same amount of labor was “imported” and “exported” each day.

As developed earlier in this report, total adult industrial employment within Osaka City reached more than 500,000 in January 1945. The proportion of those in manufacturing had gradually risen during 1944 from 57 percent of total gainful employment to 67 percent by early 1945. The

number of resident adult workers was already declining slightly but the first great drop was occasioned by the March urban attack which alone left a half-million residents of the city homeless. By May 1945 there were only 349,000 adult residents employed in manufacturing as compared with 482,000 the previous November. Many of those left homeless in March found new lodgings in undamaged sections of the city or in the suburbs and returned to their former places of employment, but problems of transportation and living conditions were powerful factors in reducing their subsequent contribution to local economic activity. These dislocations in the local labor force also affected many important war plants located in the suburbs and at considerable distance from the city.

Despite the major readjustments forced upon the local labor force by the initial urban attack in March 1945, there was very little change in the percentage distribution of employed residents among the various industries. By May 1945, despite the sharp decline in total numbers as compared with November 1944, there had been slight relative declines in shipbuilding, in the iron and steel industry, and in less essential industries. Direct employment in the aircraft industry increased only from 19 to 20.6 per cent, but in ordnance the increase was from 17 to 20.3 percent. Osaka's many general machinery and machine tool plants barely raised their 13.5 percent share of the local industrial labor force. Thus as far as Osaka residents were concerned, there was little evidence during this critical period of any proportionate re-allocation of industrial manpower, except among those contributing directly to ordnance output.

The program for recruiting additional labor in Osaka will be described in some detail, along with the machinery for assuring appropriate allocation. As a result of a short-sighted military conscription policy, almost every Osaka industry was seriously handicapped by the shortage of skilled workers. By 1944 the available supply of male adults suitable for forced assignment to war industry had been practically exhausted. Thereafter successive programs for mobilizing women and students were undertaken. The female conscription program was not very successful. A considerable percentage of those assigned failed to remain at work and a high proportion deserted after the first air attack. The student labor pro-

gram was considerably more successful and there was general agreement that work discipline and productivity remained much higher among this group during 1945 than among other employees. By the end of 1944, some 120,000 students had been assigned for war work, although this last source of labor was also practically exhausted by that time.

Despite the impressive number of bodies thus made available for war work, it proved impossible to utilize this labor power efficiently. Basic problems prior to the attacks were the lack of sufficient supervisory personnel and shortcomings in the labor allocation machinery. Few concerns had effective training programs and, in many cases, the newly assigned manpower lacked the physical stamina required for heavy work as well as any experience with machinery or general factory operations. Plant managers were critical of the labor allocation system on such counts as well as with respect to alleged favoritism in meeting manpower requests.

It is clear, however, that much could have been done to insure more effective utilization of available industrial labor, skilled and unskilled. As in the case of other production resources, the lack of integrated control over labor utilization resulted in labor hoarding and pirating, and encouraged the growth of a labor "black market," especially among subcontractors and smaller war plants, as well as among freight handlers and construction workers. Thus, while a sufficient number of bodies were mobilized for war work, the military conscription program had produced critical shortages in skilled categories and supervisory personnel. Under these circumstances, it proved extremely difficult to maintain reasonable standards of productivity as the existing industrial labor force was progressively diluted.

During the attack period, these chronic problems of training and labor efficiency faded into insignificance as compared with raid-induced desertion and absenteeism. There was a 40 percent decline in Osaka factory payrolls between January and July 1945, 15 percent of which followed the March area attack. But attendance rates among those who remained on the payrolls dropped from a January 1945 average of 79 percent to a July average of 59 percent. Thus, according to official figures compiled by the prefectural police on an individual plant basis, daily average adult attendance at Osaka factories de-

clined from almost 400,000 in January 1945 to 304,000, or 78 percent, in May and to 178,000, or 45 percent, in July.⁷ There is good reason to believe that these official figures fail to reflect much of the unauthorized absence which developed after the March attack and especially after May.

These declines in attendance had a much greater impact on some industrial districts and on certain industries than on others, but a concomitant drop in productivity was generally apparent. In the face of increasing shortages of materials and components, these labor problems were generally instrumental in preventing utilization of the resources available. The consequent dislocations were multiplied by a particularly serious drop in the amount of casual labor normally employed in the movement of goods and semi-finished items between production units. Repair efforts were seriously delayed in damaged plants for the same reason. In this connection, a most serious consequence of the urban attacks was the general failure of workers to report after heavy raids. In many cases, the effect of relatively superficial damage to equipment was greatly increased as a result of subsequent corrosion and weathering that might have been prevented by prompt protective measures. Thus, what might have been relatively simple repair tasks came to require major equipment overhauls. Similarly, the dispersal program was not only delayed but involved considerable damage to equipment as a result of labor shortages. Desertion, absenteeism and "listlessness" came to be dominant obstacles at all stages of the war production program. Only a few favored plants located in the suburbs and able to solve their workers' housing and food problems managed to keep labor difficulties from becoming major limiting factors during the last months of the war.

Employment Trends in Osaka

Total employment among Osaka residents reached a peak in early 1944 of 830,000. This figure represented almost 40 percent of the city's population at the time. A downward trend in over-all employment first became evident as early as February 1944, however, and continued throughout the rest of the war. Before the first area attack on Osaka in March 1945, there were still about 750,000 employed inhabitants. Total employment is estimated to have dropped immediately to 650,000 after this first raid, which burned out over half a million residents. There

was a continued decline during April and May, although there were no attacks, followed by another sharp raid-induced decline in June which depressed the total employment figure well below 450,000. There was a steady but less drastic fall in employment thereafter up to the end of the war.

The slight decline in resident employment figures during 1944 had been a result of military conscription and of transfer from non-essential employment to war jobs elsewhere. Some voluntary evacuation also took place during the first two months of 1945. Fluctuations in employment figures after March 1945 are more or less what would be expected in view of the raid pattern—severe drops following the March and June attacks with more gradual declines in the intervals.

As developed later in this section, industrial employment within Osaka, including production workers, supervisory personnel and office help, reached more than 500,000 in January 1945. The steady rise in industrial labor during 1943-44 reflected the net increase in production workers despite military conscription and transfers to plants located outside the city. During the same period, total adult employment was declining among Osaka residents but mobilization of labor from non-essential occupations and from hitherto unemployed groups brought war industries a large supply of additional workers. But problems of mobilizing and utilizing such material created serious production problems, even before the attack period. The marked increment of unskilled workers in most factories partly explains the decline in the quality and efficiency of labor in the last phase of the war.

Before examining problems of recruitment and allocation, it will be well to review the over-all changes in employment among Osaka residents. Two points call for emphasis. As already suggested, industrial employment became increasingly important as war plants built up their staffs at the expense of non-essential activity. While many peacetime manufacturing enterprises closed down, others converted to war production, often as subcontractors. At the same time, non-industrial activity in the city was steadily curtailed, thus freeing additional labor. The following table indicates the percentage relationship between industrial employment and total employment of Osaka residents for periods before and after the attacks.



PHOTO 34.—Industrial chaos in northwest Osaka.



PHOTO 35.—Burned-out area in southwest industrial district.

INDUSTRIAL LABOR FORCE OSAKA RESIDENTS

(THOUSANDS)

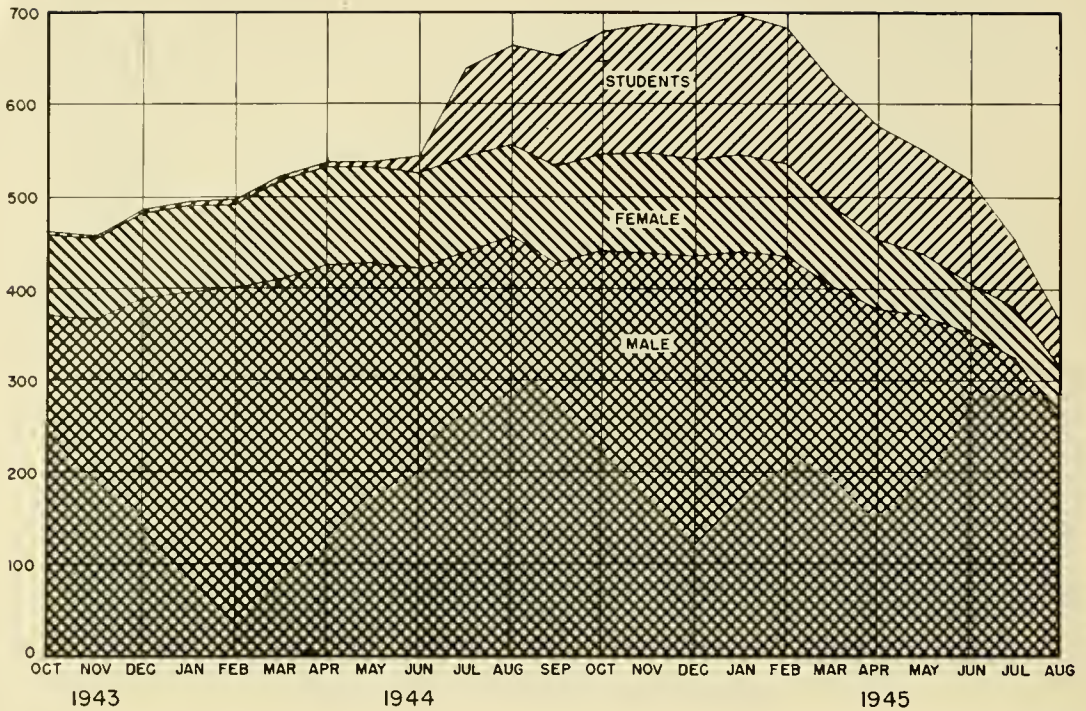


EXHIBIT 22

Osaka City—Ratio of industrial to total employment

Period	Average ratio
Oct. 1943–Jul. 1944	57
Jul. 1944	58
Nov. 1944	62
Jan. 1945	64
Mar. 1945	62
May–Jun. 1945	67
Jul. 1945	65

As labor shifted from non-essential activity, there was also a large amount of new material brought into the industrial labor market. Exhibit 22 summarizes data on the total labor available for industry within Osaka City during the period of analysis. It should be noted that these estimates cover manufacturing, transport, communications, and other public services, and apply only to residents of Osaka. They indicate the total number of regular employees less those withdrawn for military service and including those conscripts, volunteers, and student groups mobilized as replacements and supplements to the regular labor force. The relatively slight increase achieved in mobilizing additional women during 1944 stands out in sharp contrast to the large group of students that became available.

As Exhibit 22 makes clear, the attacks had a decisive effect on all categories of the industrial

labor force available within the city. The following table is based on a special census conducted by the prefectural police and indicates in detail how serious that drop was even after the initial March attack, in which relatively little damage occurred to large factories but general urban damage was severe.

This table also indicates that, although the total number of resident workers declined drastically from November 1944 to May 1945, the ratio of labor employed in the various industrial categories did not change greatly. Only the ordnance category benefited relatively in the scramble to maintain labor after the attack, principally because of the special position of the Osaka Army Arsenal and other manufacturing activities controlled directly by the Army. Employment at the Osaka Army Ordnance Supply Depot and the Equipment Depot actually increased during this period. In the discussion of labor mobilization which follows, it will be seen how the Army managed to maintain its industrial labor force in Osaka, usually at the expense of other equally important war activities. In order to compare these figures with the material presented in Ex-

hibit 22, the number of Osaka adults employed in transport and public services must be included.

The special police census of November 1944 listed 46,872 Osaka inhabitants as working for public utilities, including transport, but only 38,858 were still so listed in May 1945. A relatively sharper drop occurred among employees of other public services. For the industrial categories covered in the table above, a decline of 27.5 percent was registered during this period of peak employment and sudden collapse. Many of those no longer resident found new lodgings in

Osaka City—Resident adults employed in manufacturing
[Police census data]

Industry	No. of workers Nov. 1944	Percent	No. of workers May 1945	Percent
Aircraft industry	95,932	19.8	72,197	20.6
Ordnance industry ¹	82,948	17.2	70,605	20.3
Machinery and machine tools	65,227	13.5	47,575	13.6
Shipbuilding industry	43,953	9.1	31,139	8.9
Other basic equipment	23,152	4.8	15,834	4.3
Non-ferrous metals industry	37,220	7.7	29,082	8.3
Iron and steel industry	24,660	5.1	15,475	4.4
Chemical industries	20,005	4.2	17,058	4.9
Ceramics, printing wood, textile, and food processing	50,509	10.4	31,804	9.1
Other industry	21,687	4.5	11,098	3.2
Governmental manu- facturing plants ²	17,527	3.6	7,373	2.1
Total	482,820	100.0	349,240	100.0

¹ Includes civilian employees at Army Equipment Depot and Ordnance Supply Depot associated with Osaka Army Arsenal.

² This group includes the Osaka Mint, the Tobacco Monopoly, and several small municipal enterprises.

the suburbs and returned to their old employment after the March attack. But related post-attack problems of transport and living conditions prevented many of that group from contributing effectively to further production efforts. Absenteeism and "listlessness" became dominant factors in almost every Osaka war plant.

With this initial presentation of over-all data on the amount of manpower potentially available in Osaka for war industry, attention now turns to the techniques for mobilizing and allocating this labor force to the most urgent production purposes. The very impressive showing with respect to student mobilization indicated in Exhibit 22, and also the success in replacement of conscripted adults, must be assessed in light of the production requirements these programs were designed to meet and the response of those mo-

bilized to the problems of efficiency and discipline and livelihood presented by the urban attacks.

Allocation and Recruitment of Labor

The mobilization of manpower for war industries in the Osaka area followed patterns laid down for the nation as a whole and discussed at some length in USSBS Report No. 47. Industrial conscription legislation had been enacted as early as 1939 with the primary purpose of expediting the conversion of civilian industries to war production and also of forcing skilled workers out of small workshops into the new war plants. In the later years of the war, after civilian industries had been considerably curtailed, a concentrated drive was undertaken in Osaka to conscript young workers and those not already engaged in essential activity.

The total number of workers thus drafted reached a peak in 1943, fell off in 1944 as available categories were exhausted, and dropped to almost nothing in 1945. Workers were allocated only to factories under direct control of the Army, Navy, or Munitions Ministry and, in certain instances, to establishments controlled by the Ministry of Transportation. In the early period of labor conscription, allocations were administered directly from Tokyo. This proved awkward because of the lack of direct contact with local problems and with the factories. In recognition of the increased importance of labor conscription caused by the serious depletion of existing labor forces through military draft, the system was changed in mid-1943. Authority to allocate workers was placed in the hands of prefectural officials. With control thus decentralized, Tokyo authorities were only supposed to monitor the detailed plans drawn up for approved individual factories under prefectural jurisdiction. However, particular allocations were frequently altered from above, usually under pressure of Army and Navy officials concerned with specific procurement problems. Thus, the Prefectural Labor Offices were never able to relate labor draft plans with the final quotas of conscript labor allocated to priority plants. There was always delay or partial failure in meeting requirements.

The same pattern of friction and confusion developed here as with respect to allocations of materials. Over-ambitious unfulfilled paper plans and diffuse authority led to the common practice of "padded" requests, informal pressure

tactics and labor hoarding on the part of zealous plant officials and military "expeditors." The inevitable consequence was a labor "black market" and the lack of central knowledge required for prompt control and reallocation of labor resources after the B-29 attacks commenced.

Prefectural officials also found themselves handicapped in drafting and allocating labor due to ignorance of the diverse labor problems in individual factories under their jurisdiction. Inevitably, in order to judge the merits of competing requests for labor, the prefecture became dependent upon the advice of local Army and Navy authorities, particularly the supervisory personnel attached to priority plants. The self interest of these officials, who were naturally most concerned with labor problems in the particular plants which they supervised, colored their advice to the prefectural authorities and mitigated against judicious appraisal of other legitimate requests.

Belatedly realizing the need for more representative and independent local control, the government in July 1944 established a Committee for Coordination on labor mobilization problems in each region, as part of the general program for regional administration integration. Such a committee, including officials from local offices of all government ministries which controlled or supervised war plants, and advisory representatives from the Railroad Administration and Sea Transport Bureau, was empowered to make final decisions on the allocation and drafting of workers within the Osaka region. However, the reluctance of the central government to forego completely its prerogatives was evident in a proviso which retained the Welfare Ministry as the final arbiter of inter-regional manpower matters, thus providing a means for well-situated companies to override local and regional authorities on labor allocation problems.

Prefectural and regional authorities thus almost inevitably came to consider the largest and most effectively backed request as the most important. Officials were empowered to inspect factories as a check on the merits of individual labor requests and were supposed to combat labor hoarding. This power was seldom used since no personnel were assigned for the purpose. Consequently, most factory managers, aware that they would not receive 100 per cent of their requests in view of existing labor scarcities, consistently

padding their requirements. Believing the size of the request, rather than its urgency, would be determining, they hoped that, if proportionate distribution of the labor available were made as an all-round face-saving solution, at least part of their actual needs would be satisfied.

Thus, in Osaka as in other industrial centers, there was an inflation of the paper demand for labor, especially after military conscription was stepped up in 1944. Controlling officials spent their efforts trying to collect more and more bodies without regard to the fundamental problem—the effective utilization of industrial labor. Solution of this problem would have required careful assignment in terms of job requirements and equally careful plant-by-plant inspection of labor use. Such a program, although frequently considered by certain Osaka officials, never was seriously attempted. Available labor material within the age limits stipulated became increasingly difficult to provide. Well before area attacks started in 1945, the supply of male conscript labor in the Osaka region had almost disappeared. Therefore, the conscription of women and students had been intensified to fill required quotas.

Conscription of Women

In November 1943, the Welfare Ministry advised the prefectural governments to mobilize local women for factory work through a Women's Volunteer Corps. After a trial period, during which the plan was judged to be feasible, the Corps was fully instituted in August 1944. Females from 14 to 40 years of age were drafted according to the type of work in which they already were employed or according to residential area for those not previously employed. Civilian and non-essential factories employing 50 or more women workers were required, in August 1944, to supply 20 per cent of such employees to the Corps for allotment to war industries. This draft, netting about 6,000 workers in Osaka, was the only one made on women employees from civilian and non-essential industry. All other women drafted into the so-called Volunteer Corps were drawn by residential areas from those not currently employed.

Local branches were established by the Prefectural Labor Office to conscript all unmarried women between 14 and 40 years of age who were not already employed in business, industry, or

agriculture, or regarded as necessary at home. Certain other groups were not mobilized in practice. Thus, registered prostitutes were exempted in Osaka as essential for morale. Geishas were included but proved completely unsatisfactory as industrial workers because of their previous high earning power and because they were not temperamentally suitable for war work. Only about two percent of the total female population was actually affected by this program. Altogether approximately 30,000 women were actually ordered to report for factory work in Osaka Prefecture, of which some 19,500 were drawn from within the Osaka city limits. A summary of the results achieved from various assignment orders is presented below :

Period of conscription	Number ordered to report	Source of conscriptees
Nov. 1943-Aug. 1944	10,000	Residential area.
Aug. 1944-Jan. 1945	9,000	do
Aug. 1944-Jan. 1945	6,000	Civilian and nonessential activities.
Jan. 1945-Mar. 1945	6,500	Residential area.

Prefectural officials estimated that 70 to 80 percent of the women ordered to report in Osaka actually complied. After the March area attack they estimated that not more than half of these returned to their assigned factories. Due to the destruction of branch labor offices, evacuation, and subsequent administrative breakdown, no further conscription of women was attempted in Osaka after March.

Student Labor Conscription

Students had been used for temporary work, mostly in agriculture, but also to a certain extent in factories, since the beginning of the war. They were recruited for such temporary jobs through the prefectural education officials upon request from the Prefectural Labor Office. During this early phase, not more than 1,000 students were so employed at one time in Osaka.

Although a Student Labor Mobilization Decree was not promulgated until August 1944, actual conscriptions of students for permanent war work was initiated at Osaka in April 1944. In that month, all students in the three top grades of Osaka middle schools and in the higher classes of technical and trade schools were drafted. Students were usually conscripted and assigned to jobs as class groups, in some cases actually work-

ing at machines set up in school buildings. Working time was considered as school time insofar as academic credits were concerned. In August 1944 an extension of the law provided for the draft of students from the two lower grades of middle schools and even from primary schools, as well as from the lower grades of special trade and technical schools.

Student workers put in eight hours a day at nominal wages, with night shifts permitted where periodic health checks at the factories resulted in official approval. Students were trained for their jobs while on the factory payroll, often in special training centers established in the schools. Aircraft, heavy industry, shipbuilding and the machine industries were the chief recipients of student labor in Osaka. By November 1944, the great majority of students who were subject to mobilization had been drafted.

Student conscription was generally considered the most successful of all labor mobilization measures, due primarily to the fact that students were drafted and allotted by class groups under direct control of teachers. Consequently, they were easier to control and their morale during the raid period was much better than that of other conscript groups. In the few cases where food and housing were properly handled, their discipline and productivity usually remained high. Elsewhere, during the March-May period when labor standards so generally deteriorated, student groups almost universally had attendance records considerably better than other production or management groups.

In July 1945, the factory students corps was established in Osaka in a belated attempt to revive student attendance, which had fallen off drastically in most establishments as a result of the June raids and the attendant transport and living problems. The Factory Students Corps scheme attempted to meet these problems by placing all student workers in dormitories and providing all food and other essentials, so that attendance and production quotas could be rigidly enforced. By the end of the war, however, not more than 10 percent of those students remaining in the city actually lived in such dormitories, with much of this figure representing students who, as a result of the June bombings, had been dehousing and had found no alternative place to live. In other words, the original program for maintaining group discipline and distinct student work

groups collapsed, except in a few isolated cases.

Apart from the three-part program of labor conscription discussed above, the government also sought to recruit potential workers who were not subject to conscription. These included a certain number of exempt floating workers who might be unemployed: longshoremen, construction workers, and other "free labor" categories; certain student categories who were not in the conscript class, and married women. Recruits from this group were classified as "persons volunteering for work" by city officials. They provided a sizable number of war workers in 1944, numbering almost 40,000 at the peak in October. Subsequent enlistment campaigns in January 1945 and again in July resulted in only slight additions to this category, however.

To further increase the supply of labor, the government had appealed also for temporary workers through the "National Service for Labor Mobilization" program. This organization attempted to enroll everyone not regularly engaged in essential industry for at least 60 days' emergency work a year. Women were asked to volunteer for a three months' shift through 1943 and 1944. In 1945, when more critical shortages developed, women were enrolled on a daily basis and students were enrolled for one-week shifts. However, the regular conscription of women and students effectively removed the supply of such labor for temporary service during the attack period. Although the organization theoretically continued to function throughout the war, it accomplished little from January 1945 on. The final blow was delivered by the March area raid which disrupted so many of the neighborhood organizations upon which recruiting for this service depended.

Wage Controls and Wage Supplements

A complete system of wage ceilings for all types of industrial workers had been set up before the war started. Minimum and maximum wages were established for all industries and both overtime and pay increases were controlled. The enforcement of these measures was wholly inadequate. Military-controlled factories and small shops all paid wages considerably above legal limits. Large factories not under direct military control usually kept wages within legal limits but used other means to supplement the real income of their employees. Most factories in the

Osaka area paid their labor by daily wage. About 40 percent had various forms of piece wage system for some employees. The standard shift was 10 hours with overtime possible, and the law allowed annual bonuses which by 1945 frequently reached very high figures.

Wages paid to day laborers and dock workers were much higher than legal levels, having increased during the war from 300 to 1,000 percent. Temporary labor for high priority construction, such as military installations, was paid considerably more even than going "regular" wages. The military frequently pirated workers from local factories by offers of top black-market pay. This practice was blamed for much of the discontent and production upsets in many Osaka plants. The "gang-boss" system which had always prevailed for many types of casual labor rapidly spread throughout small industry.

For major plants, wages generally did not rise along with living costs during the closing period of the war. Largely this was because money no longer constituted an incentive to keep people working, rather than because wage statutes were respected. After the March attack, and especially after June 1945, the population was much more concerned with personal safety and the bare essentials of living than with wage scales. Factories were obliged to increase food and clothing issues during this period to keep workers on the job. The official provisions for distributing rice and other food rations through factories as an incentive to regular attendance have already been discussed. It operated successfully until the first urban attack but, thereafter, proved to be almost a liability even though absolutely essential. With rice deliveries becoming increasingly irregular, there were frequent cases of dissension and of alleged favoritism as between plants or shops. During 1945, practically all plants had to resort to large-scale black-market food purchases for their employees if they expected to maintain a reasonable level of attendance. Those without transport facilities and "connections" were often at great disadvantage in the face of preemptive buying by brokers operating for the larger concerns.

The following factors militated constantly against a solution of the labor problem before the urban attacks commenced:

(a) Military conscription depleted the supply of skilled labor and of experienced supervisory personnel.

(b) Official allocations of labor were made by count rather than by skills and the system developed the same ills as did the machinery for allocating materials. Military and "big business" pressure resulted in unbalanced assignments and encouraged all employers to hoard labor and to "pad" official manpower requests.

(c) No serious effort was made to control the labor black market or to cope with the desertions of assigned workers which began to develop even before the urban attacks.

PRODUCTION TRENDS

Production data for Osaka was obtained through individual factory questionnaires in accordance with the general procedures followed in all cities of this and other regions studied by the Urban Areas Division of the Survey. Because of the magnitude of the task, it was impossible to obtain complete coverage, especially among the city's smaller factories which were most subject to complete destruction in incendiary attacks. But, as discussed below, it was possible to account for plants employing almost four-fifths of the pre-attack labor force by this means. And the picture presented by this group reflected conditions throughout the categories not reached directly.

In the nature of the case, no adequate sampling was possible of production trends in plant units where all records were destroyed or where all responsible management personnel had dispersed subsequent to the attacks or after the surrender. The very complete police records on factory payrolls and attendance rates during the raid period provided general information on the vast number of small units. Supplementary interviews with public authorities and with factory representatives served to round out the picture for the more important categories of war production. The complexity of Osaka's industrial pattern ruled out a systematic interview program of the sort conducted among all major war industries in Kobe.

Where on-the-spot discussions could be arranged with Osaka plant managers, it was possible to clear up discrepancies in questionnaire data previously submitted and to obtain considerable information on the precise effect of labor, damage and supply difficulties. The findings of

many such interviews have been incorporated in earlier discussions and are used in the analysis of individual industries that follow. A widespread interview problem such as that undertaken in Kobe was not feasible in Osaka.

Previous sections have emphasized the magnitude of damage to residences and small factories in the urban attacks on Osaka. The initial March attack caused such great dislocation of the city's industrial labor force and the elaborate pattern for subcontracting war production among small factory units that little success was achieved during the subsequent 75-day lull in efforts to restore essential activity to the previous level. Complicating these efforts were the attempts by some priority units to disperse part or all of their operations, but some key end-product plants had sustained direct damage in this first attack, even though it was directed primarily against the central commercial-residential district rather than the surrounding heavy-industry sections. The shipbuilding industry was particularly affected as were key plants in the machine tool, electrical equipment and industrial belting fields—all vital for the repair and dispersal program.

For the city's basic fabricating industries this first attack was felt primarily in terms of labor difficulties—desertions, absenteeism and lowered efficiency—and in supply interruptions due to administrative breakdowns and local transport delays. The collapse of communications and the destruction of business records and public offices paralyzed efforts to improvise prompt and effective solutions for the regions mounting production problems.

Those producing machinery, semi-finished products and military end-items faced these same difficulties but their direct limiting factors were more apt to be interruptions in the supply of components. These difficulties could often be traced to transport delays or to damage of warehouse stocks, but plant damage was also a major problem, especially among the smaller factory units located in congested areas. Under existing conditions it proved highly difficult even for top priority plants to reorganize subcontracting networks or to find new local suppliers for items formerly received from other major centers which also were attacked.

In general, basic metal shortages had not yet begun to place serious limitations on production of priority items in Osaka. Most categories of

war production had reached peak levels in December 1944 and the contraction in Japan's basic materials position had affected shipbuilding more than other major industries. Even here metal inventories were usually generous and deliveries were being maintained at reduced levels. Local iron and steel production had been reduced as part of the regional integration plan but special steel and light metal fabricating was still continuing at a level adequate for scheduled aircraft and ordnance requirements.

Thus while some major units and many of the smaller and lower priority concerns would have faced increasing production difficulties in the absence of the March urban attack, factors other than basic materials shortages were dominant during the ensuing lull. When the air offensive against Osaka was resumed in June, widespread plant damage and further urban dislocations caused inventories to pile up at all stages of production. Osaka's resources—like all of Japan's resources—were fast dwindling, but the city was no longer able to utilize those which were available.

Three successive incendiary attacks during the first half of June greatly extended the area of damage into peripheral concentrations of heavy industry. While the relative damage to industrial floorspace in Osaka never reached the levels achieved in Kobe or Nagoya, the aggregate destruction was appalling to those trying to maintain end-product and supporting activities most essential to the war program. At this point direct plant damage to machinery and inventories were the dominant limiting factors. But subsequent manpower difficulties severely reduced prospects for recovery in most factories that escaped in part or altogether.

The subsequent discussion outlines production trends in each major industrial category and indicates the relative impact of various forces limiting activity during the period of analysis. But first, brief comment is required on the scope and validity of the data obtained on Osaka production trends.

The Industry Survey in Osaka

The summary report of the Urban Areas Division describes in detail the procedure developed for codifying data on production trends in the cities studied. In Osaka, standard factory questionnaires were distributed through the prefec-

tural authorities to all factory units which employed more than 50 adult production workers prior to the attacks and were in position to supply month-by-month data on production, power and fuel consumption, labor force and man-hours, receipts and inventories of materials and components, physical damage repair and dispersal, etc. for the period October 1943–August 1945. Under conditions existing in Osaka after the surrender it was obvious that most plant units listed on official pre-attack records as contributing to war production would be unable to meet these requirements. But most of those units that were destroyed or had ceased operations before the war ended were very small and a large number of these had contributed indirectly or directly to factories where records were intact. The detailed factory labor data previously cited provides considerable information on the history of smaller units during the attack period as well as a check on the adequacy of our questionnaire sample.

The following table provides a rough indication of the adequacy of the sample. As previously indicated police figures place registered factory employment in Osaka—including supervisory and clerical help but excluding students and casual labor—at 504,000 for January 1945. Almost 140,000 were listed as employed in the 14,500 workshops with less than 50 workers each and since a minimum of 50 shop workers was stipulated for the selected plants it is estimated that another 30,000 were thereby limited from possible consideration. Questionnaires were also distributed to plants in suburban Osaka with more than 150 adult production workers but plants not related to war production were eliminated. Out of 198,350 registered factory workers in suburban Osaka, a maximum of 105,000 might have been recognized in completed questionnaires.

More than 1,400 questionnaires were distributed and more than 1,200 were returned, including about 1,000 from within Osaka City. A number of these were from under-size plants or were otherwise unusable, and 926 questionnaires from the city and the suburbs finally remained for analysis. Month by month data was complete on 439 of those returned from plants within Osaka and accordingly these were used in the calculation of production trends summarized in the exhibits presented later in analysis of each industry. Questionnaires from selected suburban

plants and some from major plants located within the city but not adequate for statistical use are analyzed separately in the subsequent discussion. Many of Osaka's most important plants, including the Osaka Army Arsenal and the Sumitomo Aircraft Propeller Works are thus handled separately. The following table indicates the degree of coverage by labor force data for each industrial category as determined by the Survey procedures.

Category	Number of plants included in statistical series	Total adult shop force in series plants	Approx. shop force in other Osaka plants analyzed	Total usable questionnaires (Osaka and suburbs)	
				Total	Hit plants
Aircraft			7,300	4	2
Ordnance	33	15,518	46,000	57	24
Shipbuilding	30	45,138	7,200	58	46
Electrical equipment	42	25,800	4,000	81	39
Machinery	79	39,913	10,250	171	101
Components	75	29,574	5,400	201	107
Metal fabrication	54	45,864	16,000	101	67
Chemicals	36	16,700	4,000	72	44
Miscellaneous	50	29,353	4,600	151	89
Total	439	245,997	104,750	926	545

Within Osaka City there were 647 manufacturing establishments in January 1945 with total employment of more than 100 each and another 862 employing between 50 and 100 each. Together these groups accounted for 364,000 workers.

Certain discrepancies will be pointed out in regard to the data presented in following sections, which is based upon these factory questionnaires. Payroll and attendance figures, during the attack period, must be regarded with particular caution, since many firms made a practice of carrying deserters on their books through most of 1945. Man-hour figures likewise involve considerable error, especially after May, for a large amount of unofficial absence was tolerated in connection with the food transport and housing difficulties faced by most workmen. Production and power consumption figures are not subject to major discrepancies.

Assignment of plants to various industrial categories was necessarily arbitrary, for in many cases two or more types of activity were carried on in one unit. This was especially true in the machinery group, where considerable conversion to ordnance production and to components work

took place toward the end of the war. Some plants assigned to the metal fabrication group might more properly have been included with the components group also. Among those plants utilized in the production series, the relative aggregate importance of employment, production and power consumption for various groups was as follows over the whole period of analysis (October 1943–August 1945).

Industrial category	Employment (adult shop workers)	Electric power consumption	Value of production
	Percent	Percent	Percent
Ordnance	4	3.8	5.5
Shipbuilding	15.5	12.8	11
Electrical equipment	22.5	10.3	16
Machinery	11.8	8	9
Metal components and metal fabrication	36	34	33
Chemicals	4	9.4	10
Miscellaneous	8.3	21.7	15.5

These percentage figures indicate the inadequacy of the statistical sample, especially in ordnance. Thus in the following discussion on each industry, attention will be given to other major plant units where production data was obtained, although inadequate for use in the statistical series. The most important units thus included for discussion are Osaka's two top priority precision targets, the Osaka arsenal and the Sumitomo Propeller Works.

Over-all Trends

In view of inadequacies in the production data on Osaka suitable for inclusion in the statistical series, it is not feasible to offer a definitive composite percentage graph of aggregate production in Osaka for the period of analysis. Certain over-all measurements of activity have been presented in earlier sections of this report and the main emphasis here will be directed to analyzing the conditions prevailing in each major segment of local industry. This discussion will first deal with the range of local activities directly supporting the aircraft industry, touching on production processes at various levels from basic light metals fabrication through components production to final assembly. Subsequent sections will deal with ordnance, shipbuilding, electrical equipment, machinery, metal components and metal fabricating, chemicals, and miscellaneous industry.

Nevertheless, a few preliminary comments are in order respecting over-all industrial trends during the period of analysis. Power consumption in Osaka was affected by seasonal shortages which forced power "holidays" and other severe restrictions especially during part of the December-March dry season and this was important during January and February 1945. There was also a relative surplus of electric power available during the April-June period, but otherwise power consumption provides a faithful index of industrial activity before and during the attack period. The only factor requiring particular attention in 1945 is the relatively large use of power for production of special steel and in other basic metal activity. Maintenance of this activity at record levels during most of June in a few large plants served to compensate for the sharp drop in other power consumption that month.

Bearing these considerations in mind, one may use electric power data as a generally valid measure of industrial activity in Osaka. Power consumption by industry in Osaka City fluctuated only a few percentage points from the October 1943-September 1944 average until March 1944. That month's index was only 92 but was followed by a sharp jump to a 106-109 range for the ensuing 3 months of maximum power availability and of peak consumption by local basic metals consumers. During the summer and fall of 1944, the industrial power index again remained in the 92-97 range until December, when the effort to achieve maximum deliveries of critical war items again brought industrial consumption of electricity up to record levels.

The January 1945 index dropped to 87, almost five points below the average during the previous August-November period. Average daily consumption was slightly higher in February 1945, and the rate continued a modest increase until the first area attack of 13 March. For March as a whole, industrial consumption was reduced to 64 as compared with the base period average, or 25 percent less than in January, and the index continued to slip slightly during the ensuing months when Osaka experienced no attacks. The June consumption index dropped to 51 and in July it stood at 17. The August figure was 15, indicating that industrial consumption had almost reached a "rock bottom" level in the month previous to the surrender.

This data on industrial power consumption can

be supplemented by information on coal and utility gas use to provide a rough index of total energy consumption during the period of analysis. Measuring gas consumption and coal deliveries (reliable coal consumption figures are not available) in kilowatt hour equivalents, it appears that total industrial energy consumption in Osaka during the peak period of October 1943-June 1944 was approximately 16 percent above the average for the last half of 1944. Much of this difference is represented by the decision to concentrate basic iron and steel production elsewhere and thus reduce coal, ore and other bulk commodity movements to Osaka. Local fabrication of basic metals was also reduced during the latter part of 1944. But as is developed below, activity in the later stages of fabrication, machining and assembly for many end-product items increased sharply in Osaka during this period. Since energy requirements for such operations are considerably less than for basic metal work and other activities, the energy consumption index requires appropriate interpretation, especially during 1945. Aggregate industrial energy use in Osaka during January and February 1945 appears to be about 20 percent below the average for the last half of 1944. The use level was almost 33 percent below this base average for the March-May period during and after the first area attack. Estimates of actual coal use cannot be equated with coal deliveries thereafter, for the widespread damage to factories in June caused a pile-up of fuel stocks at individual plants that continued to mount during the rest of the war. Estimated energy use for June was thus more than 60 percent below the average for the latter part of 1944. Similarly, July use was more than the indicated 80 percent below this average.

Assessed from the standpoint of local military end-product output, the drop in energy consumption during 1944 was less significant than the figures indicate. Reductions in local basic processing did not have a proportionate effect on local war production. During this period cutbacks were also instituted in deliveries of basic materials for heavy ordnance, shipbuilding and other items requiring large volumes of iron and steel but no longer of comparable strategic value to the Japanese. The energy drop in January 1945 reflected real declines in scheduled industrial activity, but in large part these did not affect top priority war items, whereas the declines between

March and July were more completely at the expense of such production.

Two other partial measures of over-all industrial trends can be offered. Wholesale trade figures are of particular interest because, aside from an estimated 25 percent relating to consumers goods, they reflect the severe decline in availabilities of many industrial materials not required in great volume but nevertheless essential to continued operations. There are obvious pricing problems involved in assessing this data but it does indicate the general trend, including the enormous inventory losses sustained by suppliers and brokers in the March and June urban attacks. Official figures on wholesale trade in Osaka place the monthly average for the October 1943–September 1944 period at approximately 130 million yen. Using this average as 100, the indicated trade index for the 1945 period is as follows:

Month	Index of wholesale trade
January 1945	86
February	83
March	¹ 45
April	42
May	46
June	² 36
July	30
August	29

¹ First urban attack. ² Three urban attacks.

Price inflation during the latter months of this undoubtedly masks a considerably greater decline in volume.

Finally, an index is offered of deliveries by factories included in the statistical series used below. As already indicated this covers only part of the city activity in each category. Altogether it accounts for production to which about 246,000 adult shop workers contributed. To this total the output data for the Osaka Army Arsenal has been added. Aggregate production by these plants rose steadily from October 1943 to about 20 percent above the base period average of 184 million yen during the second quarter of 1944. Reduction of basic metal fabrication and a sharp fall in shipbuilding and ordnance primarily due to changes in types of production kept production at from 88 to 98 during the third quarter of 1944 with a last quarter spurt reaching 108 in November and 112 in December 1944. The 1945 index figures are as follows:

Month	Index
January 1945	89
February	90
March	¹ 74
April	80

May	71
June	² 38
July	28
August	18

¹ First urban attack. ² Three urban attacks.

Aside from propeller assembly, no final aircraft production took place within Osaka, but 27 percent of the city's industrial labor force was registered as contributing to the aircraft industry. In general, key units of this industry in Osaka and its suburbs had ample stocks of basic materials at the time of surrender and the prospective sharp decline in earlier stages of fabrication need not have affected Osaka's contribution to the aircraft program scheduled for 1945 until the very end of the year. Fuel and electric power difficulties never arose except for a few suburban plants where temporary reduction in gas supplies occurred after area attacks.

Plants outside the area of damage had relatively little labor trouble during the raid period, thanks to priorities and special advantages in procurement of supplementary rations. Plants that did suffer damage or attempted wholesale dispersal out of the city experienced major obstacles in the way of manpower transportation and shortage of industrial fixtures and repair materials. Absenteeism became the dominant limitation on output even for large units which escaped major damage in the area attacks and did not attempt dispersal. For units engaged in production of subassemblies and major components, subcontracting problems frequently became dominant considerations after the March attack, although some difficulties were experienced earlier as a result of precision attacks on Nagoya and Tokyo. Some firms were able to reorganize their subcontracting activities during the March–May lull in B–29 operations against Osaka but thereafter the problems of improvising new production arrangements became almost insuperable for all but a few firms.

The ordnance industry in Osaka was dominated by the local army arsenal but many moderate-sized private firms also existed, supported by a host of smaller components suppliers. The arsenal was particularly favored with respect to all production requirements and also was able to take care of its main private contractors. Production at the arsenal reached peak levels just before the March attack, which caused slight plant damage and would not have involved insuperable labor or subcontracting difficulties, except for the failure in deliveries of fire-control

apparatus after damage to suppliers of those critical items in the initial urban attack on Tokyo. Production of anti-aircraft guns was accordingly brought to a standstill and temporary dislocations affecting other priority items were not fully overcome before the June attacks, which resulted in general disruption of activity. Because of its heavy dependence on private suppliers of components this major arsenal was thus virtually paralyzed before precision attacks destroyed all but a fraction of its facilities. Ample stocks of fuel and basic materials were available but under conditions prevailing after March these could not be utilized.

Output for private ordnance plants likewise was climbing above all past levels when the city was first hit in March 1945. A sharp drop then was followed by a slight revival in May, but heavy declines occurred in June and July. Here, too, large reserves of basic materials were available but damage to inventories and to suppliers of components proved disastrous.

Shipbuilding in Osaka was heavily affected by direct damage and labor difficulties from which the industry was wholly unable to recover. While cutbacks in basic materials allocations had taken place, major units still had large stocks and were unable to utilize current deliveries after March in most cases.

Electrical equipment output fell somewhat below the previous average after a December 1944 peak. Heavy physical damage to plant and to inventories occurred in March and June along with severe disruption of subcontractors, which were particularly important in this industry. The machinery industry likewise dropped back from peak deliveries at the end of 1944, in part related to widespread conversion to ordnance production. March damage was not serious and expanded ordnance output in a few plants tended to compensate for components difficulties by others. June damage was very heavy and the combination of labor and components problems prevented subsequent recuperation. Conditions in the field of metal components and general metal fabricating are much the same, although special considerations apply to basic steel fabricators, who were sharply curtailed in 1944.

March damage to the chemical and rubber products category proved relatively heavier than for most groups and June damage brought operations to a standstill for most units. Certain

categories of miscellaneous industry were also hard hit in March, especially the industrial belt-ing group. But in general these industries were not as severely affected by components and subcontracting problems as was the case with those discussed earlier. Labor problems and materials shortages proved more acute in many cases.

Aircraft

Aside from a few gliders and trainers, no aircraft were produced in Osaka City during the war. Nevertheless, over a fourth of Osaka's half-million industrial workers were employed prior to the attacks in factories and workshops contributing to Japanese aircraft production. In January 1945, 134,000, or 27 percent, of the 505,000 working at plants within the city limits were at plants credited by police records to the aircraft industry. An additional 64,000, or 32 percent, were so listed among the 200,000 industrially employed in the suburbs. Osaka had always been outstanding for its metal fabricating and machinery production. A large share of this city's pre-war facilities was therefore mobilized to supply components and sub-assemblies for aeroengine and aircraft assembly works located elsewhere. In addition, many new parts plants were established in the former textile mills and other peacetime factories that dotted suburban Osaka.

Seven near-by engine and airframe assembly plants operated by Kawasaki and Kawanishi, Japan's third and fourth largest producers of combat types, depended upon Osaka subcontractors for the great bulk of their requirements, but an important part of this component and sub-assembly output moved to Mitsubishi airframe and engine plants in the Nagoya region and in Kyoto. Certain items, including propellers, were also shipped in considerable volume to Nakajima assembly plants in the Tokyo region and to assembly and modification centers in western Honshu and Kyushu. Some Osaka and Amagasaki plants were also tied into the relatively minor aircraft assembly operations of Japan International, near Kyoto. Detailed corporation reports have been prepared by the USSBS Aircraft Division on each of the concerns mentioned. The discussion here will be focused on operations within the Osaka region as these were affected by dislocation of supporting units located in Osaka City.

In Osaka's contribution to Japanese aircraft production, small units played a considerable role.

Altogether, there were almost 200 parts plants within the Osaka City limits and 100 in the outskirts which each employed more than 100 persons just prior to bombing. There were also in this industry, however, nearly 4,500 shops employing less than 100 people each within the city and almost 1,000 such units in the suburbs. In the aggregate, such small factories and workshops accounted for almost half of the labor force assigned to aircraft, although few of these supplied items directly to final aircraft assembly plants. Just as in several other war industries, these 5,500 small units formed the lower and intermediate layers of a complex subcontracting system which had grown out of Osaka's prewar industrial pattern.

The completed components and sub-assemblies which Osaka contributed to Japan's aero-engine and final assembly works were shipped in large measure from 20 major plant units employing a quarter of the 134,000 aircraft workers within Osaka City and an additional 25 which accounted for almost half the suburban aircraft labor force. With few exceptions, these 45 largest factories depended directly or indirectly upon an elaborate network of plants and workshops for small parts and for intermediate processing operations.

As the foregoing discussion indicates, analysis of the decline of Osaka's part in the Japanese aircraft industry during the attack period involves all phases of the city's economy. Within the city limits almost half of the 4,600 odd factories and workshops contributing to aircraft prior to the first urban attack were destroyed or completely abandoned before the end of July. Likewise, by July only half the pre-attack labor force of this industry was still employed by the plants still in existence. But, as suggested earlier, a considerable part of this group had actually left the city and would have been dropped from company records during August.

Relatively few of the suburban plant units were located in the target areas so it is not surprising that less than a quarter of this group were destroyed or completely abandoned before August. And, since certain key suburban plants were continuing to expand operations right up to the surrender, the total labor force employed outside the city limits in aircraft production remained constant at the pre-attack figure.

The aircraft industry was the first target in strategic air operations against Japan. By early

January 1945, Mitsubishi operations in the Nagoya region and Kawasaki activity at Akashi, west of Kobe, had been drastically reduced as a result of precision attacks and hurried initiation of dispersal efforts. Nevertheless, the demand for components and sub-assemblies continued to be urgent, for stocks of such items at the damaged plants had to be replaced if operations were to be continued there, and the new dispersal sites also had to be supplied. Because of transportation difficulties and the large number of new stock piles called for, "pipeline" requirements thus became far greater than had been the case under previous conditions, where aircraft materials moved out of Osaka to a few very large assembly plants. Accordingly, there was no relaxation in official efforts to maintain the output of aircraft components, even though final assembly production had temporarily slumped.

From January to August 1945, the aircraft industry always received first consideration from those responsible for industrial mobilization in the Osaka region. As problems of labor, machinery repair and dispersal became increasingly critical, a deliberate policy of discrimination against the claims of other war industries was pursued consistently by allocation and control officials. Against the background of general decline in the supply of basic materials, every effort was made to assure regular minimum deliveries to fabricators contributing to aircraft. Such concerns, wherever possible, tried to build up large reserve stocks.

To assess the extent to which this program was achieved and to survey the precise impact of air attacks on production, a few of the most important Osaka factories contributing to aircraft will be examined in some detail. In each case an effort will be made to determine what were the factors limiting output during the crucial months of 1945 and what level of output might have been achieved if air attacks had not contributed to production difficulties. Representative plants have been selected from among the most important units in each type of activity represented in Osaka's aircraft industry. Included are plants producing aircraft engines, propellers, castings, forgings and rolled products, components and stampings, and airframe sub-assemblies. In addition to these typical key plants for Japanese combat aircraft output, two examples of glider and trainer production will be surveyed. Subse-

quent sections will present questionnaire data on production trends in the field of components and general metal fabricating.

The Kawasaki Aircraft Company's engine plant in suburban Osaka, with a total payroll of more than 4,000 employees, was shifting from parts production to complete engine assembly during the last crucial months of the war. The two largest plant units of Sumitomo Metals Industry, Japan's main producer of combat propellers and an important alloy steel and light metals fabricator, were both located in Osaka's waterfront heavy industrial district. Including the high percentage of students employed by 1945, the total number of employees in these factories came to more than 22,000. In addition, Sumitomo operated Japan's largest propeller assembly plant in neighboring Amagasaki. After Sumitomo, the most extensive aircraft facilities in Osaka were operated by Mitsubishi in the production of components and airframe sub-assemblies. Among the numerous Kawanishi subcontractors located in Osaka, Tokan Aircraft, which supplied airframe sub-assemblies, has been selected for examination. Finally, attention is also given to the Matsushita Aircraft Company's ill-fated effort to initiate production of light bombers suitable for training and Kamikaze attacks and the glider program of Nissan Aircraft. Altogether, the employees of these Osaka plants account for about one-sixth of the total labor force devoted to the aircraft industry in Osaka City and its suburbs.

Kawasaki Aircraft. Japan's third largest producer of combat airframes and engines (credited with roughly one-eighth of total production) had its assembly operations centered at Akashi, 40 miles west of Osaka, with a secondary airframe complex near Nagoya. The Akashi operations were heavily damaged—and subsequently dispersed—in January 1945. Osaka factories supplied a wide range of materials and components to this firm. In addition, the company itself operated two large units in Kobe and Sakai and another in Osaka's outskirts for the production of engine parts. During 1945, the Osaka Works undertook the complete assembly of engines as part of an expansion and dispersal program first planned in mid-1944. Total employment (including students) at this Osaka engine plant rose to 4,300 by July 1945. A steady increase in the output of parts had been climaxed with the first

delivery of complete engines in that month, but the over-all level of activity was somewhat less in July than in June due to delays incident to reorganizing subcontractors after some of these were damaged in the Osaka area attacks during June.

In general, this Kawasaki engine plant's prospects were good. Ample coal deliveries were maintained with at least two months' supply on hand. Sufficient steel, special steel, and light alloys were at the plant for three to five months' operations at planned levels and full deliveries of basic materials arrived in July and early August. A large stock of major components—fuel pumps, magnetos, superchargers, starters, etc.—were also on hand and, although deliveries of certain items had fallen off in June, a system of new local subcontractors was being organized. There was little concern about air attacks—the plant was established in a scattered group of former textile mills, with some operations underground—and there were no serious labor problems. Ready access was provided to related units in Osaka, Kobe and Kyoto by steam railroad, electric interurban lines, and highways. The other Kawasaki unit in the Osaka district continued producing engine forgings at a high rate until damaged in the urban attack on Sakai in July.

Sumitomo Propeller Works. The parent plant of Japan's main producer of combat aircraft propellers—Sumitomo Metal Industry—was located in Osaka City. Aside from the Osaka Army Arsenal, this, along with the same concern's alloy fabricating works directly adjoining, was the only plant in metropolitan Osaka selected for precision attack by the Twentieth AF. Shortly before the Pearl Harbor attack the firm started propeller production at an even larger factory in neighboring Amagasaki and, by late 1943, almost a third of the Osaka staff had been transferred there and to other new units. Together these two units—depending primarily on forgings and components produced in Osaka—accounted for almost 40 percent of the Army combat propeller requirements and practically all Navy propellers. During 1943–44 Sumitomo started two other propeller plants in the Nagoya region but together these did not represent more than 15 percent of the firm's capacity. The effect of damage and dispersal in 1945 prevented these units from ever reaching scheduled production.

The June area attacks caused a moderate degree of damage to the Osaka plant and destroyed the newer plant across the river in Amagasaki. A precision attack on 24 July 1945 completed the destruction of the Osaka factory as well as the important affiliated steel and light metals fabricating works which supplied shapes and rough forgings, not only for propeller assembly but also for many other ordnance and aircraft component producers in the region. By that date, however, a dispersal program initiated before March had reached the stage where production up to the limit of available component receipts was under way at three dispersal sites. Machining was carried on in two Osaka department store basements and final assembly in a large converted brewery in near-by Nishinomiya. The machine shop dispersal sites were admirably selected and well organized. However, large stocks of materials and some tools remaining at the original site were destroyed. Production of the Osaka complex came to a complete halt when the final assembly unit of the new dispersal system was destroyed, along with all propellers thus far completed there, in the 6 August area attack on Nishinomiya.

The area and precision bombing of Sumitomo's propeller plants was decisively damaging to Japanese plans to maintain aircraft output through 1945. Production delays, however, had begun to trouble this top-priority firm months before its Osaka plant suffered damage. The following discussion is intended to elaborate the effects of dispersal and component problems during the attack period. Output at the Osaka Works per month remained close to the rated capacity of approximately 1200 units through November 1944, but dropped 10 percent in December. After partial recovery in January there was a further decline of 33 percent in February, primarily as a result of component shortages growing out of the initial B-29 attacks on Tokyo and Nagoya areas and decisions to initiate emergency dispersal of stocks and facilities.

Measures taken to deal with these initial production dislocations were expected to assure a return to normal activity by the end of March 1945, and plans for expanding output through partial dispersal were continued. Instead, a drastic fall in March component receipts as well as serious absenteeism following the heavy 14 March area attack reduced output to 50 percent for that

month and to 25 percent in April. May deliveries were back to 80 percent of capacity as previously delayed units were completed—indicating a considerable degree of recuperation. But in June, output fell below 10 percent. Beginning with the loss of some finished propellers and components and a moderate degree of plant damage on 1 June, the successive attacks of that month on Osaka created further indirect obstacles. Again, as after the area attack in March, there was a drastic decline in June component receipts. This obstacle, along with delays incident to completion of an emergency dispersal program involving all plant functions rather than the few originally planned, permitted July deliveries to recover only to 12 percent.

The firm received unparalleled advantages in its dispersal efforts, but these proved to be futile. Quite aside from the July and August damage to Sumitomo installations, the planned revival in output through dispersal was doomed by the destruction of materials at the original plant and by insuperable difficulties in lining up new component suppliers to replace those damaged in the June area attacks. As a consequence, the firm regarded its position as hopeless after 24 July, despite the fact that materials were available, that its department store dispersal sites were virtually bomb-proof, and that every official agency was pledged to assist in meeting requirements for recovery.

Because of its importance to the aircraft program, the reasons for Sumitomo's collapse should be fully considered. Sumitomo officials had the usual complaints to make regarding the materials allocation system and the timing of deliveries, but the firm enjoyed a preferred position with respect to most of its semifinished materials since company affiliates supplied blade forgings and many other alloy and steel items required. It is true that the possibility of shortages in light alloys was anticipated before the end of 1945. In fact, prototype wooden blades were already in production during June. But sufficient basic materials were in sight to meet requirements for the planned post-dispersal rate of all-metal propeller production through late 1945.

The basic materials position was satisfactory then, and dispersal out of the Osaka plant had been achieved with considerably less difficulty than was typical in the case of lower priority plants and among those going into a larger num-

ber of more widely separated sites. But there were other difficulties. Labor turnover and the shortage of skilled and supervisory employees were problems for the company as was the alarming growth of absenteeism after the March and June area attacks. But labor problems were also limiting factors on output in delaying the completion of planned dispersal, and thus contributing to the destruction of machine tools not yet removed from the original plant. Prior to June, and especially after February 1945, a considerable amount of lost production was ascribed to breakdowns in machine tools and delays in getting repairs and replacement parts. Here cumulative under-maintenance plus worker fatigue and "listlessness" were the factors emphasized. After June, this maintenance problem would have been increasingly serious had not other factors limited output.

From the standpoint of materials and labor, Sumitomo had relatively good prospects for continuing to meet the quotas assigned to its Osaka operations after dispersal. But the combination of heavy July damage to stocks located at its original plant and inability to replace sources for critical components nullified the firm's effort to achieve relative immunity from air attack. The components problem proved to be the primary limiting factor. For a typical illustration, we can examine one of Sumitomo's most urgent component problems—that of propeller governors.

Deliveries of governors from two Tokyo suppliers had been sporadic and were seriously reduced after the March area attack on that city, in which both were damaged. The main plant of Sumitomo's principal local supplier, Osaka Kinzoku, was severely damaged in March along with two of the latter's major subcontractors. However, a branch plant just at that time getting into production, was able to maintain output up to the limit of its component receipts—the net effect being to set back the firm's deliveries to Sumitomo approximately six weeks. By the end of May, what was now Sumitomo's sole supplier of propeller governors had its subcontracting system satisfactorily reorganized and had made up a considerable amount of the previous production loss. In the midst of the generally tight basic materials position it had managed to maintain deliveries and to build up a seven months' supply of steel stock items, as well as two to five months' supply of all other materials required by

itself and by its own subcontractors to meet Sumitomo requirements. In the area attack of 7 June, however, this plant (with 1200 full-time adult shop workers—almost a third of the number then employed in Sumitomo's own Osaka operations) was destroyed, and with it some 1300 finished governors as well as a large backlog of components. Three of the firm's major subcontractors also suffered damage in the June attacks. Operations were completely abandoned, leaving Sumitomo with the problem of organizing a new supply of these critical items.

With its original facilities heavily damaged and its program of dispersal output thus disrupted, the Sumitomo propeller plant was incapable of utilizing its resources of labor and materials, dependent as it was on a system of subcontracting which now required basic reorganization. Regional authorities mobilized what facilities were available for organizing a program of repair but no definite operations had been agreed upon up to the time of the surrender. Even if assembly facilities could have been replaced, there is no evidence that component sources could have been improvized within a reasonable time.

To summarize, propeller production at the Osaka Sumitomo plant had suffered some disruption prior to attacks. Efforts to remedy these problems did not begin to show results before the combined effects of temporary absenteeism, dispersal delays and damage to subcontractors in the March area attack caused far more serious dislocations. The measure of recovery achieved by May was again undermined in the June attacks, which caused some damage to the plant itself as well as extensive damage to many critical subcontractors. The dispersal program carried through before the original plant was severely damaged in the July precision attack held promise of renewed operations at a lower level, but components which Sumitomo was unable to produce itself continued to be the limiting factor until the August area attack on Nishinomiya, which brought even the dispersal operations to a standstill.

Throughout this period Sumitomo was assured of adequate deliveries of blade forgings, gear blanks and other basic materials requirements from its alloy fabricating affiliate, although new forging facilities to replace those so severely damaged on 26 July would have been required had



PHOTO 36.—The Sumitomo complex.

the war continued. In the growing stringency of basic materials, adequate amounts to meet propeller requirements would have been available well into late 1945. For a more detailed examination of Sumitomo's basic materials position, attention now must be focused on this firm's Osaka fabricating works.

Sumitomo Fabricating Works. By all odds the most important light metals fabricating unit in the Osaka region was operated by Sumitomo in conjunction with its Osaka Propeller Plant. In addition to supplying castings and forgings for its own propeller affiliates, this factory was a major source of forged, rolled and extruded products for Kawanishi, Kawasaki and Mitsubishi aircraft assembly plants, for many of their component producers and for other war industries. With more than 8,100 full-time adult shop workers in January 1945 and almost a third as many students, this plant deserves particular attention in connection with Osaka's contribution to aircraft and ordnance. Production here reached a peak in December 1944, with the level of operations dropping back about 10 percent—slightly below the previous quarter's average—in January and February 1945.

Because of post-raid absenteeism, the March 1945 output dropped to 70 percent of the previous level, with cumulative effects causing a further decline in April deliveries to 55 percent. No damage occurred to the plant in the March attack, but an unusually high percentage of employees were left homeless. Restoration of practically normal working conditions during late April and May resulted in a May production rate of 90 percent. Slight plant damage (including a temporary interruption of power) in June was secondary to absenteeism in bringing the month's output down to a new low of 15 percent, with a very slow recovery indicated prior to the precision attack of 24 July. This attack placed practically all of the essential equipment beyond feasible repair, as well as destroying more than 1,000 tons of copper and aluminum stocks and semi-finished items. There was no substantial effort to salvage, to repair, or to replace materials or equipment up to the time of the surrender.

It is clear that activity at this critically important plant could not have been maintained at December 1944–February 1945 levels even in the absence of bombing. Deliveries of aluminum and copper, which had reached a record high in

November, subsequently dropped below the previous quarter's average. Receipts continued steadily downward to a 50 percent level by May, and were cut back subsequently even from that rate in view of other production difficulties. But at each point other factors—primarily labor difficulties until the July attack—were controlling. And reserves were sizable. Available materials were sufficient to have permitted achievement of a month's additional production in the period from February through June 1945.

Sumitomo had sufficient light metal stocks on hand or in sight to continue operations at 50 percent of the previous normal level through September 1945. But after that point, only scrap, of which a great deal was available, and small military reserves of virgin metal could be depended upon. In view of the heavy cutback in aircraft production due to bombing and dispersal, production and stocks would have been ample for priority requirements until late in the year. But further drastic production setbacks after the June urban attacks and the heavy plant damage in July eliminated all concern over the raw material problem. Sumitomo did not normally carry large ingot stocks at the fabricating plant, but well over a month's supply of all items at the full rate of operations was maintained throughout the 1945 period. Coal stocks were ample through April, though deliveries were reduced by 25 percent after February, in line with declining consumption. No coal was delivered in June and, with the collapse of operations, there was no further need to meet the concern's quota.

Except for the physical damage incurred in July, there was no technical reason why the Sumitomo fabricating plant could not have continued to meet the requirements of its propeller affiliate and also maintain a considerable flow of forgings, castings and rolled products to other priority consumers. In the absence of bombing, output would probably have been reduced to a 50 percent level by midsummer and would have dropped to very low levels in the last quarter of the year. How promptly this decline would have been reflected in activity at the various stages of priority fabrication and assembly would be determined by the inventories maintained at each point. In fact, the lag in output occurring prior to the July destruction of the plant, and ascribed in large part to indirect repercussions from the March and June area attacks, did not

limit Sumitomo propeller output and was not apparently a direct limiting factor on other customers contributing directly to aircraft assembly activities. In view of the heavy July damage to fabricating equipment, there was little prospect of the Osaka plant participating in the revival of aircraft production planned for the late summer and fall.

To gauge the relative importance of basic materials stringencies and the disruption of components supply growing out of area attacks, it will be helpful to examine the position of typical installations located midway between such basic fabrication as the Sumitomo plant just discussed and final aircraft assembly plants.

Mitsubishi Light Metals. After Sumitomo, Osaka's largest light metals and aircraft components facilities were operated by Mitsubishi, primarily in connection with airframe and engine production at Nagoya and Kyoto. Four key units of this complex will be discussed. The firm's Osaka copper refinery—an old, relatively inefficient plant—operated well below capacity after May 1944. Deliveries of copper suddenly spurted to high levels in April and May 1945, but failed to get processed because of very severe incendiary damage in June. Other company units had operated at a high level, however, until affected by urban attacks. One of the three Mitsubishi fabricating plants continued expanding operations until heavily damaged in June while the others had reached peak output in October 1944. One of these latter, making airframe stampings and tubing, also maintained operations at a better than 95 percent of the base period level until heavily damaged in June, except for temporary delivery difficulties for coal and materials affecting January and March output. While large stocks of copper, magnesium and manganese were maintained, deliveries of aluminum were back only to 50 percent during the first quarter of 1945 and were maintained thereafter at that level. Except for June damage this decline in aluminum receipts would have begun to limit output late in July.

Mitsubishi's largest Osaka unit (with 3,300 full-time adult production workers in January) built engine and propeller components and landing gear. After the October peak, activity fell off by March to 80 percent of the previous level, as production was cut back in connection with Mitsubishi's dispersal and model-change pro-

gram, and as a result of temporary delays in certain copper deliveries. Failure in component deliveries was the limiting factor after the March attack with output falling to 60 percent in April and May. Successive damage in the June attacks destroyed some equipment and large stocks of components, bringing output down to 40 percent that month and to 10 percent in July. Aside from shortages of copper items in January and February the company always had large stocks of all basic materials. Despite a lower level of deliveries—especially after March—at least three months' supply was maintained until the surrender.

As previously stated, activity at Mitsubishi's other Osaka unit—producing simple engine and airframe components—continued to increase through 1945 until heavy damage was sustained on 15 June. Production dropped almost 50 percent that month with only very slight subsequent recovery. This plant's operations were not seriously dependent on subcontracting and June destruction of half the plant's stock of aluminum materials still left one month's supply on hand—as well as four months' supply of copper—with deliveries being maintained through July. Direct incendiary damage was the controlling factor here.

In summary, then, Mitsubishi's Osaka activities held up remarkably well until the plants were damaged in June. Production of the more intricate engine components suffered from March damage to subcontractors but over-all activity was not hindered through lack of basic materials. Large inventories and continued deliveries would have permitted output well into the autumn at reduced levels sufficient to meet scheduled requirements.

Matsushita Aircraft. Brief reference should be also made to the aircraft assembly enterprise of the Matsushita concern, an important producer of radio equipment and aircraft components in the Osaka district which established an assembly plant late in the war. This unit had 2,350 full-time adult shop workers in January 1945, and approximately 1,000 student workers. This plant was designed to assemble composite (wood and metal) light bombers for training and Kamikaze service. The unit started "productive" work in April 1944 but in view of delays in machine tool and other equipment deliveries—especially after B-29 attacks on aircraft plants commenced—and

production obstacles, it did not complete its first plane until April 1945 and managed to complete only three more before the surrender. In view of these delays, receipts of components and materials were curtailed after February 1945, except for special steel and steel wire—items, interestingly enough, which were in extremely short supply among priority plants throughout the Osaka region. Only token deliveries of engines, propellers and landing gear assemblies had been made during 1944 but the concern ended the war with large stocks of special alloy castings and forgings and many other items. No effort was made to reallocate these inventories of scarce materials. Located in the suburbs, the plant itself sustained no physical damage but considerable supplies of components and equipment in Osaka warehouses were lost in the March and June attacks.

The history of Matsushita Aircraft Company provides an example of administrative shortcomings, failures in scheduled equipment deliveries, ineffective control of materials, and labor hoarding. On top of these weaknesses, needed jigs and other equipment were diverted to combat aircraft plants as a result of dispersal and repair requirements resulting from precision attacks. In its labor difficulties and damage to equipment producers, Matsushita's production troubles reflect the impact of urban area attacks. In contrast to this abortive effort to organize mass production of suicide craft is the case of another suburban plant—typical of many outlying middle-sized plants supplying airframe sub-assemblies to Kawanishi Aircraft Company and other major aircraft concerns. Such units were spared many of the indirect dislocating effects of urban attacks as well as direct plant damage.

Tokai Aircraft, a Kawanishi subcontractor. In general, Kawanishi Aircraft, Japan's number four producer of combat types, with all its operations located in the Osaka region, was little disturbed by the area attacks on Osaka City itself, except as they caused noticeable increases in absenteeism. Three of Kawanishi's large assembly and sub-assembly plants were located midway between Osaka and Kobe and depended upon the two cities for labor and components. Though many hundreds of firms in those two cities contributed directly or indirectly to Kawanishi output, only the March area attack on Kobe happened to have a direct limiting effect

on Kawanishi output through interdiction of required components. Although Osaka's component contribution was relatively larger, the March attack on that city affected only a few of the firm's primary subcontractors. During June and July direct precision attacks on the Kawanishi plants forced output far below the level that might have been achieved because of the Osaka urban attacks. This was due to many of Kawanishi's prime subcontractors being located in suburban Osaka rather than in the congested areas most subject to damage. Producers of components were in general more sensitive to area attack than those engaged in fuselage stampings and sub-assemblies since to a greater degree they depended in turn on subcontractors within the damaged districts.

An example of this latter and less vulnerable group of airframe subcontractors, is Tokai Aircraft which was located in Osaka's outskirts and produced fuselage sub-assemblies exclusively for Kawanishi. With 550 adult productive workers and over 200 students, output reached a peak in December 1944 but returned to the 1944 normal rate through April 1945 and continued at 80 percent through July. Though losing its offices and warehouses in the 7 June incendiary attack, only nominal inventories were carried. Operations varied with the receipts of materials from Kawanishi and were geared closely to conditions at the assembly plants. Accordingly, the warehouse damage was not a serious factor. As long as alloy sheet and extrusions continued to arrive, the concern was prepared to maintain its past output record. Most workers lived outside the area of urban damage and the company was fairly successful at controlling absenteeism through supplementary black market food purchases for its employees.

Nissan Aircraft. Approximately the same size as Tokai Aircraft, this concern was engaged in the manufacture of gliders and occasionally produced emergency orders of simple wooden components for other companies. From the time production got under way in January 1944, activity remained at a steady level until the plant was 100 percent destroyed in the incendiary attack of 15 June 1945.

Japan International Engine Works. Japan International had established an engine assembly plant in a textile mill just beyond the Osaka city limits in Amagasaki. These light engines for

trainers assembled near Kyoto were put together mainly out of parts and sub-assemblies produced in Osaka. A modest production rate had been achieved prior to the heavy air attacks and large stocks of components assured continued output until this plant, like the Nissan Works just discussed and the far more important Sumitomo Propeller Plant, was virtually destroyed in the 15 June incendiary attack on northwest Osaka and neighboring fringe areas of Amagasaki.

Conclusion. From this discussion of Osaka firms at all levels of the aircraft industry, it is clear that a favorable supply situation was generally maintained. To the extent that the system for allocating basic materials and other production requirements was effective, it worked on behalf of the aircraft industry. The supply of basic metals would have been adequate to sustain scheduled aircraft production through 1945 in the absence of precision attacks. Components difficulties resulting from the urban attacks delayed production at various levels during 1945 and constituted a serious barrier to recuperation and most end-product plants, or to reorganization of production at new and less vulnerable sites. In the absence of urban attacks on Osaka and other major centers, prospects for revival of substantial aircraft output at dispersal sites would appear to have been favorable—both in terms of components availabilities and the other human and material resources needed for prompt reorganization of dispersed production. Direct plant damage to the aircraft industry in the Osaka region was achieved by precision attacks on one propeller works and five airframe and engine plants, and this was supplemented in urban area attacks by virtually complete destruction of Japan's other major aircraft propeller plant and many larger components plants and fabricating works essential for sustained revival of the industry. Prospects for recuperation were further reduced by repeated dislocation of subcontracting networks through widespread elimination of smaller contributing plants located in burned-out areas of urban industrial concentration.

Ordnance

After aircraft, the second largest segment of Osaka industry was that contributing to the production of ordnance. More than 105,000, or 21 percent, of the city's January 1945 industrial workers were employed in 2,400 factory units and workshops in this category. Concentration

in large factory units was more pronounced here than in the case of industry contributing to aircraft production. The Osaka Army Arsenal with 38,000 workers was by far the largest of the city's industrial enterprises. Twenty other ordnance plants within the city limits had employee payrolls of more than 500 and accounted for 22,000 workers or, with the Arsenal, almost 60 percent of the whole labor force in this group. The ten suburban plants in this size group, including the Hirakata branch of the Osaka Arsenal, employed even more than 60 percent of the 40,000 devoted there to ordnance work. Workshops in this group employing less than 50 people each numbered more than 2,100 within the city but accounted for only 20 percent of total labor, and they were even less important in the suburban districts.

Well over half the 2,400 pre-attack producing units inside the city boundaries were completely out of existence by July 1945 but almost 78,000, three-fourths of the pre-attack labor force, were still carried on the roster of remaining firms. The smaller units were most severely affected by the urban attacks, although practically every sizeable ordnance unit within the city had sustained some damage. The number of suburban factory units in ordnance continued to increase during 1945 as a result of conversion and dispersal. The labor force also increased by approximately 10 percent.

Osaka Army Arsenal (Exhibit 23).—The Osaka Arsenal, which covered a large area to the north and east of the city's famous castle, was by far the largest manufacturing unit in the Osaka region. There was a January 1945 labor force of more than 38,200 adults and over 6,000 students. Almost 30,000 additional workers were employed directly by the Arsenal at other sites in Osaka City and elsewhere in the region, including more than 13,000 at the Hirakata branch, 10 miles east of the main factory. Five hundred and seventy-one private plants, employing more than 200,000 shop workers, were under direct contract to the Arsenal, with an additional 750 private factories and workshops listed as supervised subcontractors.

Altogether, the Osaka Arsenal was responsible for about 20 percent of all ordnance production for the Japanese Army. Plant officials estimate that only 15 percent of the total value of this production was contributed through manufacturing and assembly activities conducted within the main



PHOTO 37.—Osaka Army Arsenal.

Osaka plant, but these operations were essential to completion of practically all major ordnance items. Half of the Arsenal's 30 key civilian subcontractors were located in or near Osaka, 10 in the Tokyo region, three in Nagoya and six elsewhere in Japan. Practically all the smaller civilian plants affiliated with the Arsenal were located in Osaka or other near-by cities of this region. While many of the civilian factories assembled or fabricated complete ordnance items under Arsenal supervision, practically all the more important types were brought to the Arsenal for final assembly, modification and testing. All major ordnance items, however, depended upon final assembly activities performed at the main Osaka Arsenal, although many of the components and sub-assemblies—gun barrels and carriages, fire-control apparatus, fuses, cases, etc.—might be completed by civilian subcontractors.

Accordingly, the Osaka Arsenal was peculiarly vulnerable to the effect of area attacks in respect to its own manufacturing activities as well as to those carried out by civilian plants under its supervision. Not only did the Arsenal depend upon

a complex local subcontracting pattern but it was the primary and direct source of basic materials for most of these civilian affiliates. This arrangement was of considerable advantage in enabling the Arsenal to overcome shortcomings in the official allocations system but it proved highly embarrassing when normal channels of transport and communications broke down following the area attacks of March and June 1945.

The Osaka Arsenal had gradually shifted its production emphasis from field artillery and other ground ordnance to anti-aircraft and anti-tank guns, bombs and aircraft armament. This reorganization caused an abrupt break in output during mid-1944, but recovery was steady thereafter. By the end of 1944 production was focussed almost entirely on anti-aircraft and aircraft ordnance along with such items as were planned for use in defense of homeland beaches. Despite these shifts in production, the monthly value of Arsenal output continued to rise through late 1944 and early 1945, passing the 15 million Yen mark in December and reaching 17 million in March. The level of activity as measured by power consump-

OSAKA ARMY ARSENAL

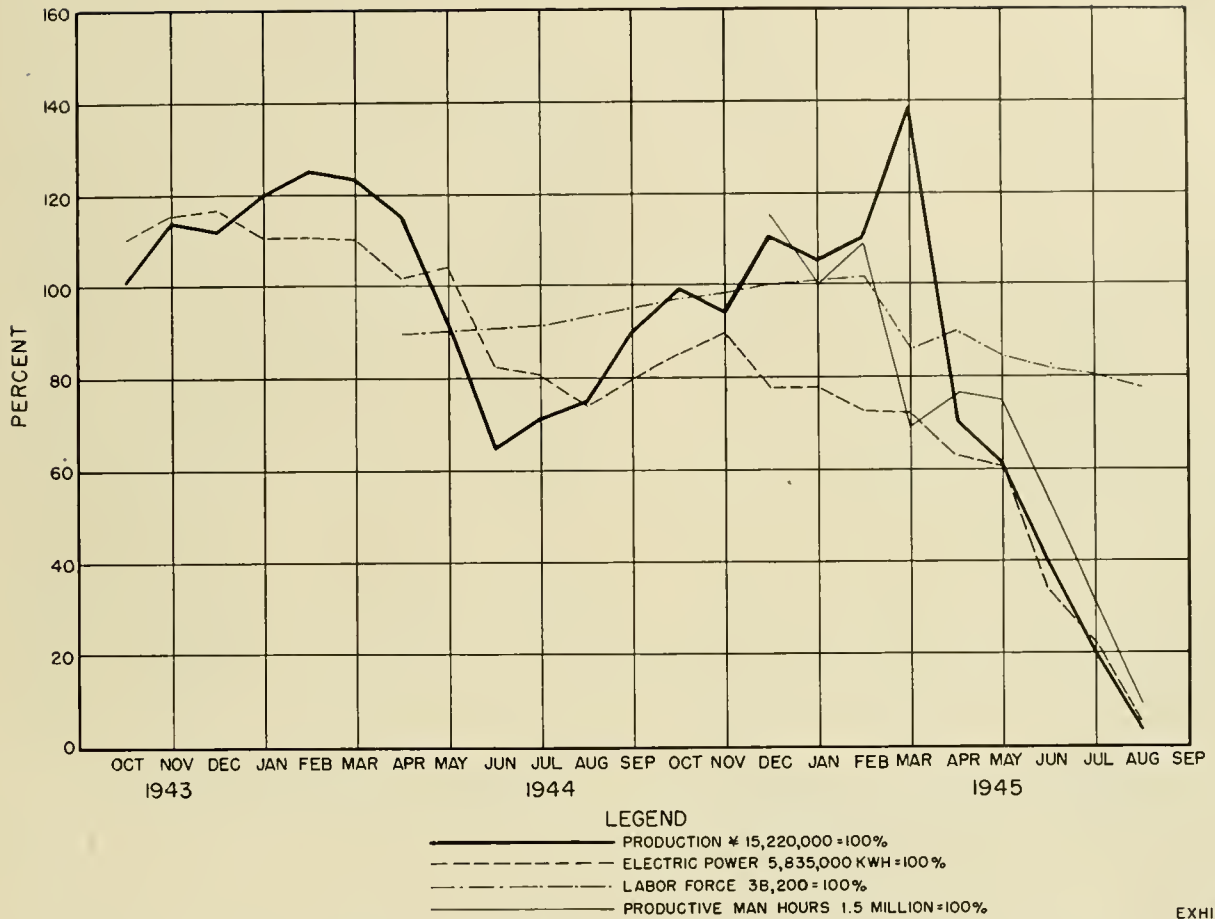


EXHIBIT 23

tion was at its crest from December through February although the number of hours worked fell in the latter month.

Exhibit 23 summarizes activity data on the Osaka Army Arsenal. Power consumption declined after May 1944 as a result of lowered electric furnace activity but machining operations continued to increase. Deliveries of anti-aircraft guns were beginning to reach planned levels in March and accounted for a considerable part of total production value that month. Payroll levels declined after the March attack but official records after the June attacks do not reflect the reductions that actually occurred in June.

The 13 March area attack was centered on the congested industrial commercial area west and southwest of the Arsenal but one large machine shop and a fuse components unit were burned out. After this relatively slight damage, the Arsenal was not again hit until the last area attack

on Osaka more than 90 days later. But instead of continuing upward as planned, April output was only 50 percent of that achieved in March and continued to decline steadily thereafter. Electric power consumption was about 65 percent of the earlier level in April and May, 50 percent in June, and below 30 percent in July. Productive labor hours followed approximately the same course with a relatively greater drop after the June attacks.

The decline in finished production from 17 to 8.5 million Yen in April 1945 was the direct result of failure in component deliveries—especially fire-control apparatus required for the completion of anti-aircraft guns. The shortage of fire-control apparatus made itself felt during the last days of March and was traced by plant officials to the destruction of Tokyo optical instrument facilities in the 10 March area attack on that city. Because production of anti-aircraft artillery was be-

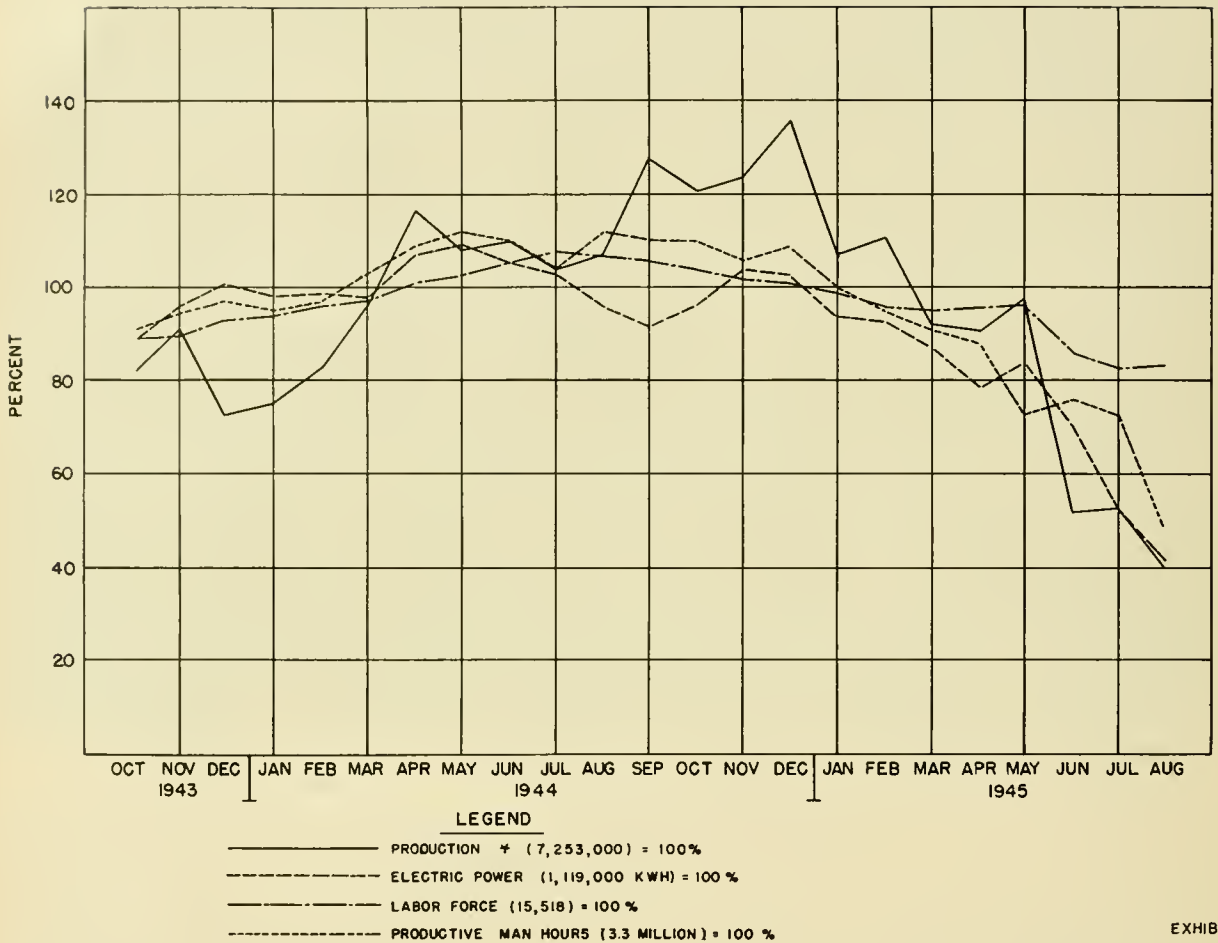


EXHIBIT 24

ing increased at the Osaka Arsenal, inventories of such items were low at the time and efforts to develop supplementary sources of supply within the Osaka region had not yet been completed. After the March attacks on Kobe and Osaka, other component problems arose and, by early April, the Arsenal was clearly faced with the necessity of basically reorganizing its system of subcontracting for practically every vital end-product.

Private Ordnance Plants in Osaka (Exhibit 24).—Exhibit 24 summarizes production data from factory questionnaire returns covering an estimated 30 percent of the Osaka labor force contributing to ordnance production in private plants. From the standpoint of actual output, this sample represents an even higher proportion. And as described below, production trends in these sample plants often reflect developments among a large group of subsidiary contributing firms.

From the end of 1943, output of this sample group rose sharply until May 1944. After new production adjustments during the spring and early summer, output again moved up to peak levels in December 1944. The January reaction to this year-end spurt reflected cutbacks in certain items and selected shortages, however, February output levels moved up again. For the first time since early 1944, March production dropped below the base period average. There was a slight rise in May but a June drop to 52 percent of the average and a further slump toward the end of July. Power consumption remained relatively more steady throughout the period of analysis, registering principal declines in June and July. Payrolls were well maintained until June, but productive hours dropped off after December 1944, registering a drop in May due to dispersal efforts in key units. Plants undamaged in the June at-

tacks returned heavy overtime records for the June and July but, as in other cases, these figures undoubtedly cover a considerable amount of unauthorized absence and diversion of effort to repairs and dispersal activities.

In view of the high priority placed upon maintenance of output in crucial ordnance items, detailed attention should be given to a few of these smaller ordnance plants in and around Osaka. As mentioned above, many of the more important ordnance plants were located in the Osaka suburbs rather than within the city limits and, accordingly, escaped damage. But the declines in ordnance output both for March and June among hit and unhit plants suggest that attacks on the city influenced output indirectly as well as directly. Discussed below are six key plants operated by four of the major civilian producers of ordnance items in Osaka.

Matsushita Metal Works.—One of the largest Matsushita enterprises was engaged in the production of ordnance components and machine tools. This plant, with 2,400 full-time adult shop workers and many students, was also among the more important components suppliers for the Osaka Arsenal. The plant was located outside the urban target area and suffered no direct damage. Production of machine tools at this plant reached its peak in December 1944 and was then brought to a halt as full attention was focussed on the output of gears and various precision parts for priority ordnance—primarily for anti-aircraft and other rapid-fire guns completed at Osaka Arsenal. Output of ordnance components continued to rise through May 1945 but declined over 50 percent in June and continued downward thereafter. The level of activity as measured by electric power consumption remained slightly below its all-time November 1944 peak until March, when only 80 percent of the previous average was used. Consumption moved back almost to normal in May and then declined to 85 percent in June and 75 percent in July.

This priority plant received favored treatment with respect to labor and had no basic materials problems. Operating conditions at the plant remained generally favorable until the surrender. But actual output suffered after the 13 March attack on Osaka due to a temporary failure in the supply of gas required for heat treating. The supply of gas

was subsequently inadequate on various other occasions, placing a limit on what otherwise would have been capacity output levels during April and May. There were further setbacks in June due to erratic post-attack component deliveries and to production modifications. These difficulties were never overcome to the point where deliveries could be resumed at the normal rate—let alone the increased rate which had been projected. Inventories of basic materials were built up during early 1945, in anticipation of increasing rates of output, to twice the former level. Six to 20 months' stock of all materials were on hand in June—except for special steel, where only two months' supply was available—and deliveries of all these items continued steadily until the cessation of hostilities. Supplies in many cases originated with special stocks controlled by the Osaka Arsenal. After May, components problems were the limiting factor on an otherwise expanding enterprise.

Osaka Machinery Company.—The Osaka Machinery Company was one of Japan's principal producers of machine tools and precision machinery and the most important in the Osaka region. While some of the firm's plants continued to concentrate on machine tool building and repair, ordnance manufacture became increasingly important, especially during 1945. One plant, with 2,550 adult shop workers in January 1945, was located within the city but escaped damage in all air attacks. This unit produced machine tools and heavy ordnance components and operated at a high level through March 1945. Disruption of the firm's subcontracting system for machine tool components resulted in the decision to divert all available components to its largest machine tool plant at Itami, on the northwest outskirts of Osaka.

As measured by electric power consumption, activity in the Osaka plant remained at a maximum during April, although all machine tool work had ceased and ordnance output was barely increasing. While deliveries were maintained in May, power consumption fell to 60 percent, in June to 30 percent, in July below 15 percent. Fuel and basic material deliveries and inventories always remained ample, with six months' supply at capacity level of output in all categories except special steel and with assurance that the normal stocks in this item would be maintained by deliveries from the Osaka Arsenal. Despite these favorable conditions, the lack of a few critical components and

the decision to order dispersal brought the delivery of completed items to a standstill in June. With the production loss due to lack of components rising to unheard of levels, absenteeism for the first time became a serious problem and contributed to the failure in the plant's dispersal program.

The firm's two other ordnance plants were located on the northern outskirts of Osaka and both suffered damage during the 15 June area attack. One of these, with over 1,100 adult shop workers, produced bombs, mine components and mortars and operated at a high level through January 1945. Production began to decline in February because of component shortages and dropped again to 25 percent of normal in March, when damage to subcontractors accentuated this problem and a zinc shipment arrived three weeks late. With this one exception basic materials and fuel remained more than adequate but output continued to be held below 50 percent of normal by component shortages until the plant was damaged in June. With a five months' supply of steel and more than 12 months' supply of special steel, receipts of basic materials were cut off in June. Damage was such that only partly finished items could be completed during July, and there was no output in August. Damage to equipment was severe and it was not possible to obtain repairs. No effort was made to reallocate unused scarce materials, however.

The 2,700 adult shop workers in Osaka Machinery Company's other ordnance plant were engaged almost exclusively in the production of mines, along with a few light marine engines. Depending in part on components produced by the plant just discussed, this unit maintained output at a high level until December 1944. Although plant activity, as measured by power consumption, remained at a maximum until March, deliveries of finished mines declined to 60 percent of normal in February and to 30 percent in March. The limiting factor throughout this period was the shortage of a few critical components. Output recovered to 50 percent in April and May as deliveries improved but came to a final halt in mid-June, with complete destruction of the plant's large warehouse stock of components and semi-finished goods, as well as simultaneous damage to several suppliers including the affiliate discussed above. Fuel and materials inventories and deliveries at this high-priority plant were generous, with six

months' supply of carbon steel on hand at the end of the war and 10 months' supply of special steel. There were also ample stocks of such scarce materials as copper and special tubing, as well as three to six months' supply of materials used in the firm's marine engine work.

Osaka Metal Industry.—Another major Osaka firm engaged in ordnance work, along with the production of gas engines and special machinery, was Osaka Metal Industry. Their largest ordnance unit had a January 1945 full-time adult shop force of more than 3,000, making heavy gun parts and anti-aircraft machine guns as well as some chemical machinery. Output as a whole remained at a high level here through March with growing concentration on anti-aircraft items. Heavy dependence on subcontractors (two of whom were severely damaged in the March attack) reduced April activity sharply. Inability to obtain sufficient copper and aluminum alloys to supply new subcontractors limited output to 30 percent of capacity by June. The measure of recovery which appeared feasible in July was prevented by direct plant damage during the area attack that month on Sakai City, directly south of Osaka.

Nobuhara Engineering Company.—The Nobuhara Company had several plants in and around Osaka contributing to the ordnance industry, of which the most critical was the Yodogawa unit with a January 1945 adult shop force of 1,600. The aircraft machine guns produced at this plant depended upon a flow of components from several affiliates and other subcontractors in Osaka. Output here was expanding steadily until the last week of March 1945 when interruption of component deliveries brought assembly to a standstill. April activity, as measured by power consumption, was only 30 percent but came back to 90 percent in May, then dropped back to the April rate before the surrender. Instead of increasing as planned, actual output of finished items was 70 percent of the previous level in March and April, 55 percent in May and less than 10 percent in June and July. Labor problems were not serious and June damage to plant equipment and warehouses, although extensive, did not cut output below the level enforced by the shortage of components. As an assembly plant, this unit was not a large recipient of basic materials but its priority was such as to assure generous supplies of re-

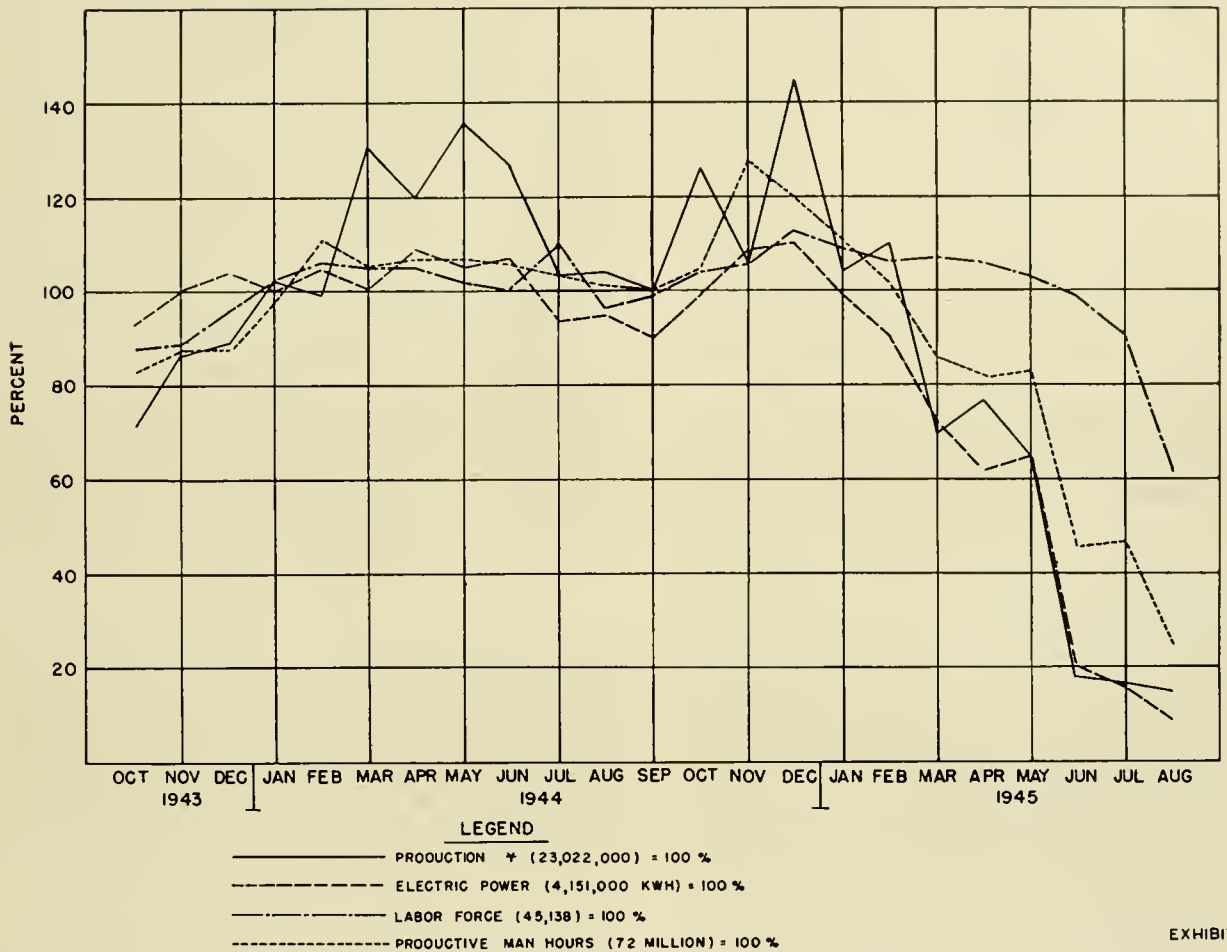


EXHIBIT 25

quired maintenance items, due to special assistance from military authorities.

Shipbuilding

In January 1945, 88,500, or about 17 percent, of Osaka's industrial workers were in the 1,080 yards and workshops contributing to the shipbuilding industry. Over 900 of these producing units were workshops employing less than 50 workers each—most of them producing components and fittings for the large building and repair yards. Total employment in 26 units with more than 500 workers—shipyards and marine engine works—came to more than 63,000 workers ranging down from the 20,000 employed in the two principal Hitachi yards. Together, Osaka's 15 major shipbuilding and repair yards accounted for 11 percent of the total value of the work done by the Japanese shipbuilding industry during the war, including construction of almost 10 percent

of all naval tonnage. All but three of the major units sustained heavy damage in the March and June area attacks and over half the smaller workshops were totally destroyed or abandoned. By July 1945, only half of the industry's January labor force was still carried on company rosters, which represents a marked contrast to the industries contributing to aircraft and armament production. From March onward, previously bad attendance rates in the shipyards became progressively worse and productivity plummeted. Exhibit 25 provides an accurate reflection of trends in this industry.

During the last year of the war, the shipbuilding industry was progressively discriminated against in favor of priority aircraft and ordnance items. Here the changing strategic situation was as decisive as the deteriorating basic metals position. This discrimination made itself felt with

respect to allocations of scarce basic materials, skilled labor and machinery. They still constituted the largest consumers of steel products and the shipbuilding program was pushed with great official energy—especially after the mid-1944 lull associated with design revisions—until the final collapse. An apparent decline in launchings and activity during late 1944 and just prior to the March air attack was the product of minor assembly delays and changes in the types of ships produced, along with diversion of effort to emergency repair work. However, there had been some scheduled cutbacks in January 1945. In general, the shipbuilding industry in Osaka would not have been limited by shortages of basic materials or components until late in 1945 in the absence of air attacks. Since deliveries were maintained for basic metals, inventories piled up after urban attacks started.

A review of the fifteen largest shipbuilding, ship repair, and marine engine plants in Osaka which together employed almost 45,000 full-time adult shop workers in January 1945, reveals that their peak month for deliveries was June 1944 although December of that year was almost as high. Only three units reached their highest rate of production after June 1944. The decline in mid-1944 and just prior to attack is attributable primarily to labor difficulties following a wave of conscription and to changes in production. After March 1945 there was a steady increase in productive hours lost because of bomb damage—both to the yards themselves and to component subcontractors.

Altogether 12 of these 15 key plants were seriously damaged and little success was achieved on repair, a large percentage of damaged shops being abandoned. In June nine plants stopped production completely because of damage to plant, to stocks of components, or to work in progress. Only one of these was able to get back into any rate of production before the end of the war. Physical damage, therefore, was the critical factor in bringing ship production to an actual halt, but components difficulties—rather than shortages of basic materials—also limited activity. One major producer of heavy marine engines received severe damage in March—as did many lesser producers of small engines, with serious repercussions on the wooden ship program then being pushed so vigorously. Direct damage to yards in March af-

fected repair work and smaller craft primarily. June damage was greater in magnitude and forced abandonment of most shipbuilding activity in Osaka. Of the three undamaged plants among these 15 units, one was increasing production steadily until August, one had production steadily trimmed by labor and component shortages during 1945, and the third began to suffer in June from labor problems and a lack of steel deliveries.

Only in three plants was lack of basic materials a direct production problem at any period. Of the remaining ten, five had no interruption of scheduled deliveries and the other five experienced some delivery interruptions but were holding large enough inventories to carry them over even if planned production levels had been maintained during the attack period. Plants which had large raw material inventories usually had large component stocks too, but incendiary attack usually was most effective against warehouses holding such items. Delivery delays and stoppages, both in materials and components, became noticeable only after January 1945. In some cases these became decisive after March. Fuel deliveries were always adequate to meet needs and many units carried generous inventories in relation to requirements. It is of particular significance that there was no evidence during 1945 of successful efforts to reallocate the large stocks of vital basic materials on hand at damaged shipyards.

The two principal yards operated by the Hitachi combine in Osaka employed over 20,000 adult production workers. Though physically separated, these units were functionally integrated and concentrated mainly on tankers and standard coast defense vessels. Together, they accounted for about 5.5 percent of total wartime shipyard activity in Japan, ranking third in the region after the two big yards in Kobe. Record deliveries in May 1944 were never again equalled though new construction at a considerable level was planned through 1945, along with a considerable volume of repair work. Activity remained at high levels until the March urban attack. One section of the yard concentrated largely on repair work after mid-1944 but the other continued on new construction until May 1945 when failure to solve components difficulties following the March urban attack forced virtual suspension of productive work on vessels nearing completion.

Forty-eight percent of total floor space in the repair unit was destroyed in the 1 June attack, along with severe damage to inventories and ships being repaired. Further minor damage also occurred to the other section, which was now virtually limited to ordnance and machinery work in its marine engine shops. Efforts to repair this damage were frustrated by labor and material difficulties and the July precision attack on the near-by Sumitomo complex increased shop floor space destruction above 50 percent and virtually halted all operations. Both units maintained a large labor force until the surrender although little was being accomplished after May. Absenteeism was very high after the March attack and became extremely serious after 1 June 1945. Thus, despite a relatively favorable position among the Osaka yards, Hitachi operations were frustrated—first by absenteeism and components difficulties following the March attack and then by severe damage to the yards themselves as well as to other suppliers.

Fujinagata Dockyard had pre-attack adult employment of more than 13,000 and was principally engaged in naval shipbuilding—destroyers and coast defense ships. Production here rose steadily until January 1945. Cutbacks in new construction then were related to conversion of some facilities for repair work but activity remained high until March and dropped to 50 percent of the peak level by May. Labor difficulties after the March attack and attempted dispersal of certain machinery facilities were the immediate limiting problems, although the firms subcontracting network was also severely upset. Thanks to its priority position, inventories of all basic materials and most components were extremely high, so that delivery interruptions did not carry much threat. The 1 June urban attack caused heavy damage to the yard and to its stocks. With labor problems multiplied, the concern completed no more work before the surrender.

Two marine engine plants operated by the Kubota firm illustrate the problems in that field. One unit, building heavy oil engines, attained peak deliveries in September 1944. Activity as measured by power and fuel consumption continued to increase until the plant was virtually wiped out in the March urban attack. Some delays had been experienced in materials and components receipts after 1944 but, in general, the position was favor-

able. Efforts to salvage the facilities were fruitless in view of the severity of damage and most of the remaining labor force was transferred to other plants operated by the firm. Among these affiliates was a machine tool plant outside the urban target area which had undertaken the assembly of heavy diesel engines during 1944. With very large component stocks and ample basic materials, steel and other metal deliveries were continued until the surrender and production likewise continued to increase steadily. The regular plant force was increased by about 20 percent during 1945 through transfers from other plants.

In general, marine engine production in Osaka was heavily hit by the urban attacks, especially the smaller types scheduled for wooden coastal vessels which were usually constructed in small urban factories. Only a few units were fortunate enough to maintain components requirements after March because stocks were normally low among small producers. The large shipyards suffered both from manpower problems and direct plant damage so that components difficulties seldom had a chance to become primary obstacles.

Electrical Equipment

Almost one-fourth of Japan's electrical equipment, including electrical aircraft accessories and instruments, was produced in the Osaka region—roughly 14 percent in Osaka itself, seven percent in Kobe, and two percent in Kyoto. In the factory census data supplied by the prefectural police, electrical equipment plants were placed in the "aircraft" and "miscellaneous" categories, so it is impossible to present accurate data on the size of producing units in Osaka.

Control Association officials estimated January 1945 employment of adult shop workers in the Osaka electrical equipment field at 50,000, of which more than 20,000 were in small workshops. In addition, many thousands were employed in small metal working shops that supplied components to electrical equipment manufacturers on a subcontracting basis. Destruction of both these subcontracting and component groups was very heavy but the main assembly plants in this field also proved to be highly vulnerable.

Factory questionnaire data on 42 units, including most of the major plants within Osaka, are summarized in Exhibit 26. Production increased at an impressive rate until December 1944, but thereafter fell off steadily through March. Some

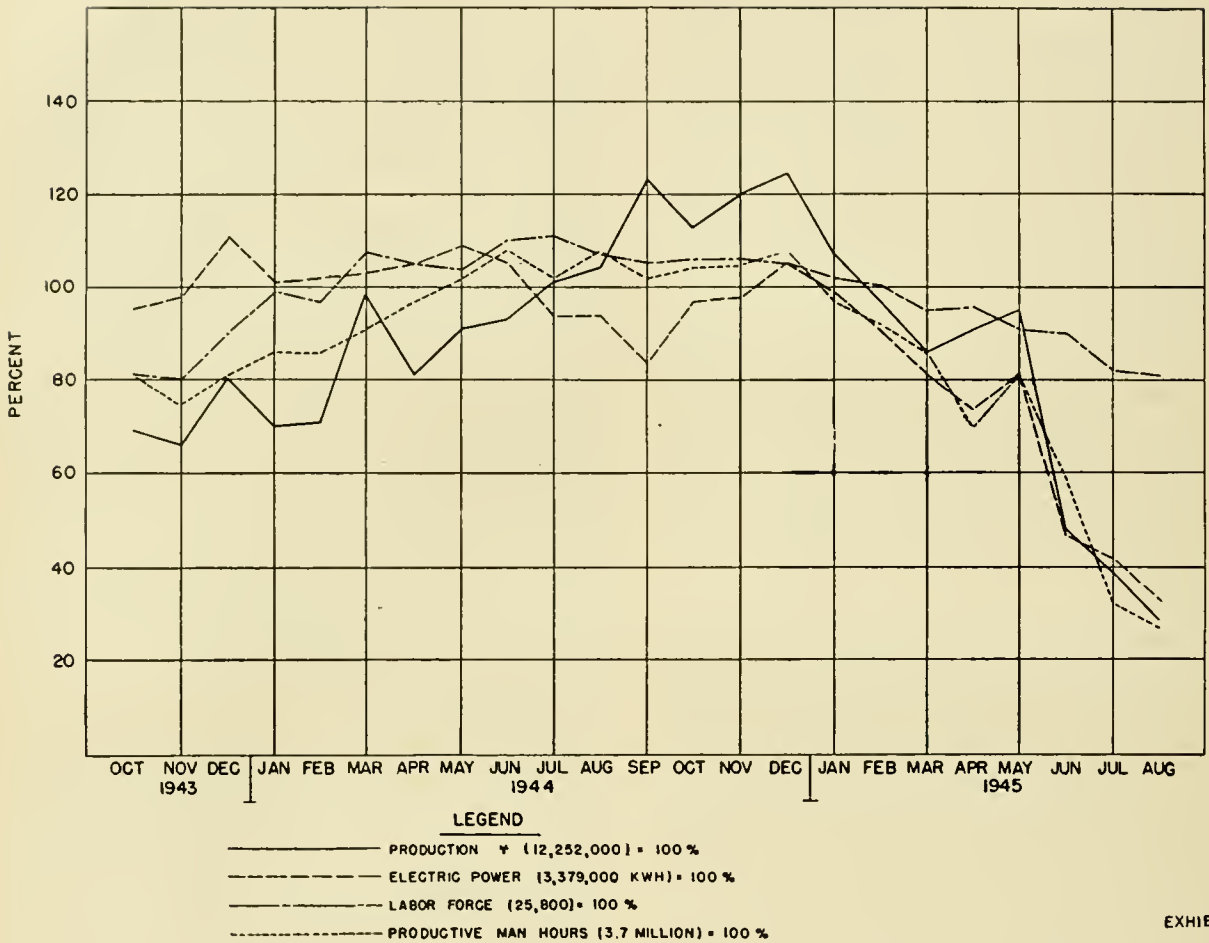


EXHIBIT 26

revival was experienced through May but June damage eliminated a large share of local activity. During 1944, there was a considerable shift in the direction of communications equipment and light electrical accessories for aircraft and ordnance. As production of electric motors and other heavy equipment was reduced, electric power consumption by this industry fell relative to output. Production data presented in Exhibit 26 tends to obscure considerable reduction of activity in the March-May period of 1945, due to complete destruction of plants in March from which returns were unobtainable.

In general, priority companies in this field had managed to build up large stock piles of materials and only two cases were found where supply difficulties became a serious direct obstacle to output. Thus although deliveries became spotty in late 1944 and 1945, most firms found other diffi-

culties more immediate during the attack period. Direct damage to assembly plants and to subcontractors was so severe as to outweigh all other factors after March 1945.

For example, Sumitomo Electric, one of the six largest plants in the Japanese electrical equipment industry, and responsible for about 25 percent of all wire and cable production, reached peak output in March 1944 but there was no significant decline until 1 June 1945, when 40 percent of total floor space was burned out and very heavy inventory losses were sustained. Stocks had been high at this plant although rubber and aluminum deliveries had been severely cut during the first quarter of 1945. This plant had been immune from subcontracting problems after the March attack by the nature of its products but direct plant damage was decisive. Further damage in the July precision attack on the neighboring Sumitomo

Propeller Works ruled out all hope of restoring production. The Nishinomiya urban attack in August destroyed 80 percent of a branch plant where some workers and salvaged machinery had been dispatched.

Three important battery manufacturers in the Osaka suburbs were similarly immune from serious subcontracting difficulties and also escaped damage. Output was cut back late in 1944 but revived again in April and was still being maintained at considerable, though uneven, levels until August. Inventories were large except in zinc and deliveries were generally maintained until the surrender.

The companies most seriously affected by the March and June urban attacks were those making radio equipment and electrical fixtures. Those located in the suburbs succeeded in reinforcing their labor supplies after March but were drastically affected by difficulties in reorganizing subcontracting networks. In some cases, it was possible to undertake such work in the main assembly plants but losses of semi-finished items and simple machinery, along with organizational problems, prevented quick results. For major surviving units, June damage again enforced major output declines.

Machinery

The machinery group includes producers of machine tools, precision instruments, and general industrial machinery. Local production of motive equipment will also be discussed in connection with this group. This industry includes a wide range of products and plant units of all sizes, but even many large or complex items were produced in small factories. For Japan as a whole, almost two-thirds of this type of production took place in congested urban areas and almost 20 percent of it in very small workshops, employing 20 men or less. While a few large concerns dominated some branches of this industry their factories almost uniformly depended upon complex subcontracting networks for components, machining operations and related functions.

About one-third of the nation's capacity for production and rebuilding of machine tools was in the Osaka region—20 percent in Osaka City and the balance in Kobe, Kyoto and Amagasaki. The region's share in total capacity for general industrial machinery was about the same, but an even higher proportion of this share was concentrated in

Osaka City. Both for new production and repair, small workshops played a vital role. As already suggested, many of the principal units in this industry shifted during 1944 to production of ordnance items.

Exhibit 27 presents activity data on the machinery industry in Osaka. Value of production jumped in May 1944 and increased steadily until January 1945 when cutbacks associated with further conversion of facilities for ordnance production forced reduction to the base period average. Power consumption remained consistently below output after mid-1944, for this widespread shift to lighter work of higher value and precision generally involved relatively less use of electric power than had the production of general industrial machinery. Associated with this shift in output was a gradual expansion of the labor force, which continued up to the first incendiary attack in mid-March 1945.

Activity, as measured by electric power, dropped sharply in April, due primarily to components and labor difficulties in many plants. Aggregate value of production did not decline as far through April because of increased ordnance deliveries by a few units. June damage was very extensive, both to plant facilities and inventories and to subcontractors. Component difficulties and inability to restore equipment brought this group to very low levels of activity before the surrender.

Representative machinery and machine tool plants that shifted to ordnance production were previously discussed, so attention on individual plants here will concern only typical units that remained in their normal activity and accordingly might be presumed to enjoy lower priorities for labor and materials. First mentioned are three plants of major importance to local production of anti-friction bearings. The Koyo Bearing Works at Kokubu, a suburb southeast of Osaka had 2,530 adult production workers at the beginning of 1945 making ball and roller bearings. Production there reached a record peak in December 1944, slumped in January and February 1945, but was back to its previous average in March. Component troubles in April curtailed production 50 percent and there was a steady decline thereafter. With large stocks of basic materials and fuel, this plant would have appeared to be reasonably secure. Despite a favorable suburban location, some labor difficulties developed and an attempted dispersal effort proved fruitless. Though production facilities were not

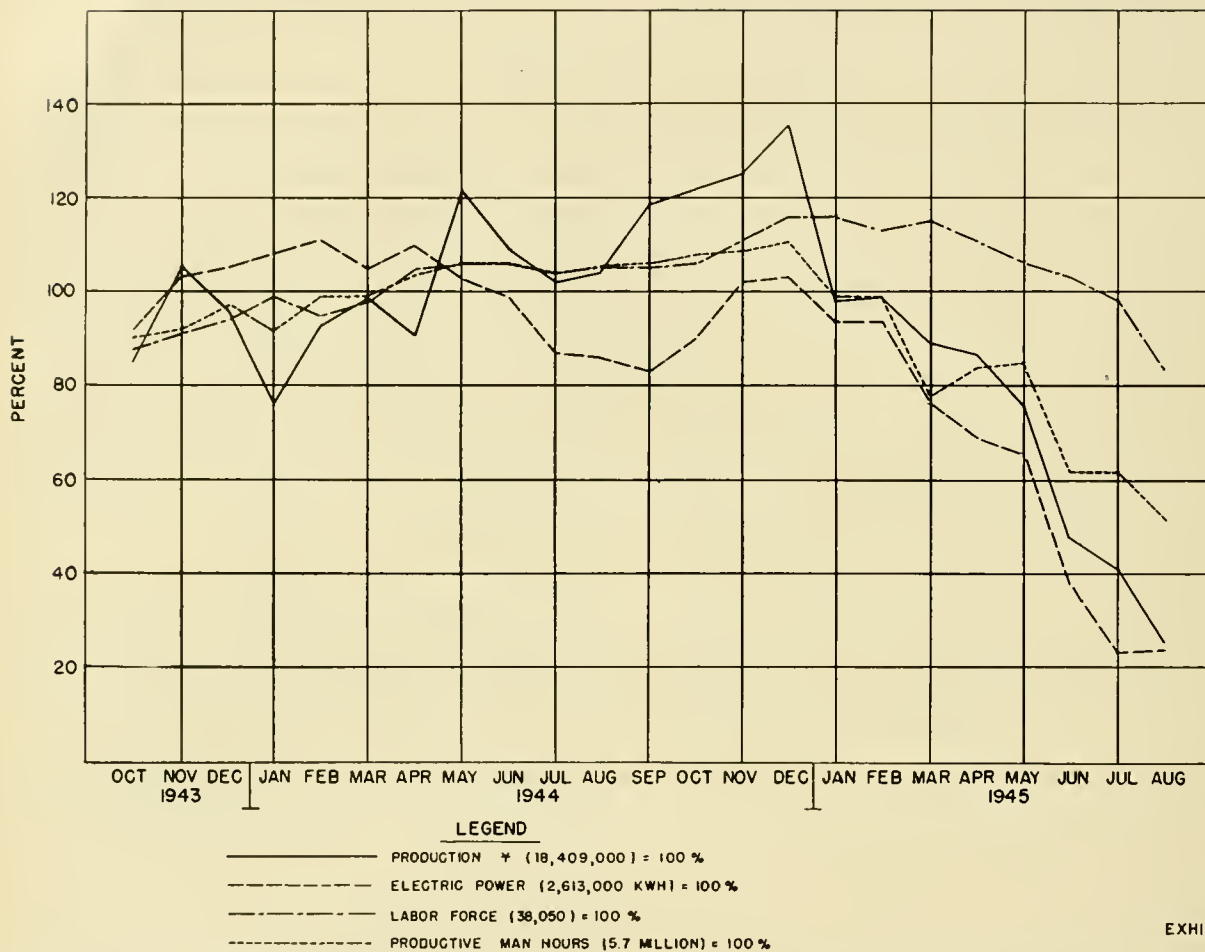


EXHIBIT 27

damaged, the firm lost a warehouse of components in the 1 June urban attack on Osaka.

Much the same pattern prevailed for the ball bearing works, another suburban plant with 1,470 production workers. Gas supply difficulties complicated components problems in April 1945 but May output stood again at 100 percent. In June the index figure was 60 and in July, 30, as the indirect effects of urban attacks were felt. Stocks of special steel and other basic materials at this plant were sufficient for 10 months operation and deliveries were maintained until the surrender. One important supplier of both these firms was Nakanishi Bearing Retainer Company with 800 adult shop workers located in northern Osaka City. Production reached the usual peak in December 1944 but remained at a fairly high level through June. Absenteeism and reduced productivity enforced the drop at that point. Inventories were built up early in 1945 to six months'

supply and this level was maintained. This plant escaped direct damage and depended only on a handful of subcontractors, all located nearby and likewise escaping damage.

Three plants in the machinery group may be mentioned which were severely damaged in area attacks. Osaka Heavy Industry with 530 adult shop workers continued to make heavy machine tools along with some heavy forgings for ordnance producers. Output dropped slightly after October 1944 but power consumption reached a peak in December, however both indices remained at 85-90 through March. Despite very large stocks of basic metals and most components, subcontracting difficulties forced a decline to 40 percent of the base average output during April and May, 25 percent of shop facilities were burned out on 7 June along with warehouses, and production virtually ceased by 1 July in the face of labor, repair and components problems.

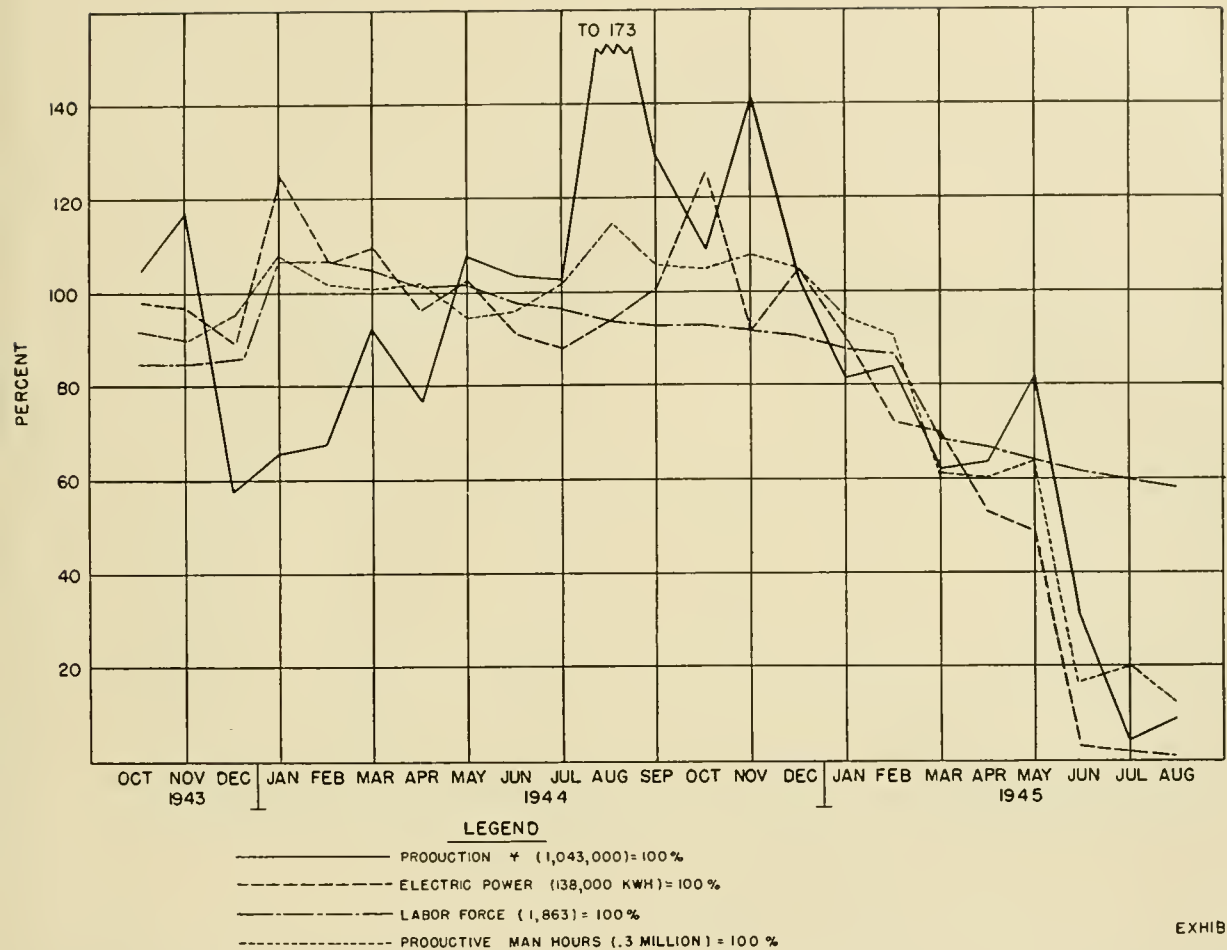


EXHIBIT 28

Deliveries of basic materials were likewise maintained at Uryu Manufacturing Company with 550 shop workers producing pneumatic tools, primarily for the aircraft and shipbuilding industries. Output remained slightly below the July 1944 peak through May 1945, although labor and component problems cut activity to 70 percent of the base average during March 1945 and to 80 percent in April. This plant also suffered an eight day power interruption after the March attack. On 15 June, 80 percent of the plant was destroyed, along with its inventories and almost a full month's finished production which had not yet been delivered.

One final example is the Ebisuya Manufacturing Company with 876 workers making precision gears, small tools and components for end-product plants. Inventories were ample here also, with various types of tool steel stock being built up to

a six-months position by February 1945. Output remained above 85 percent of the base average through March, after a December 1944 peak. Components problems brought a dip to 40 percent in April but there was a steady revival until June, when incendiary damage on 7 and 15 June and high-explosive damage on 26 June virtually obliterated the plant.

Of particular interest in connection with the machinery group are two plants making locomotives—the Osaka Engine Company, whose activity record is presented in Exhibit 28 and the Rolling Stock Manufacturing Company, with over 4,200 adult production workers. The Osaka Engine Company specialized in diesel engines and industrial and mining locomotives. With large stocks of basic materials and continued deliveries, activity had been reduced by materials problems of certain suppliers early in 1945 but components

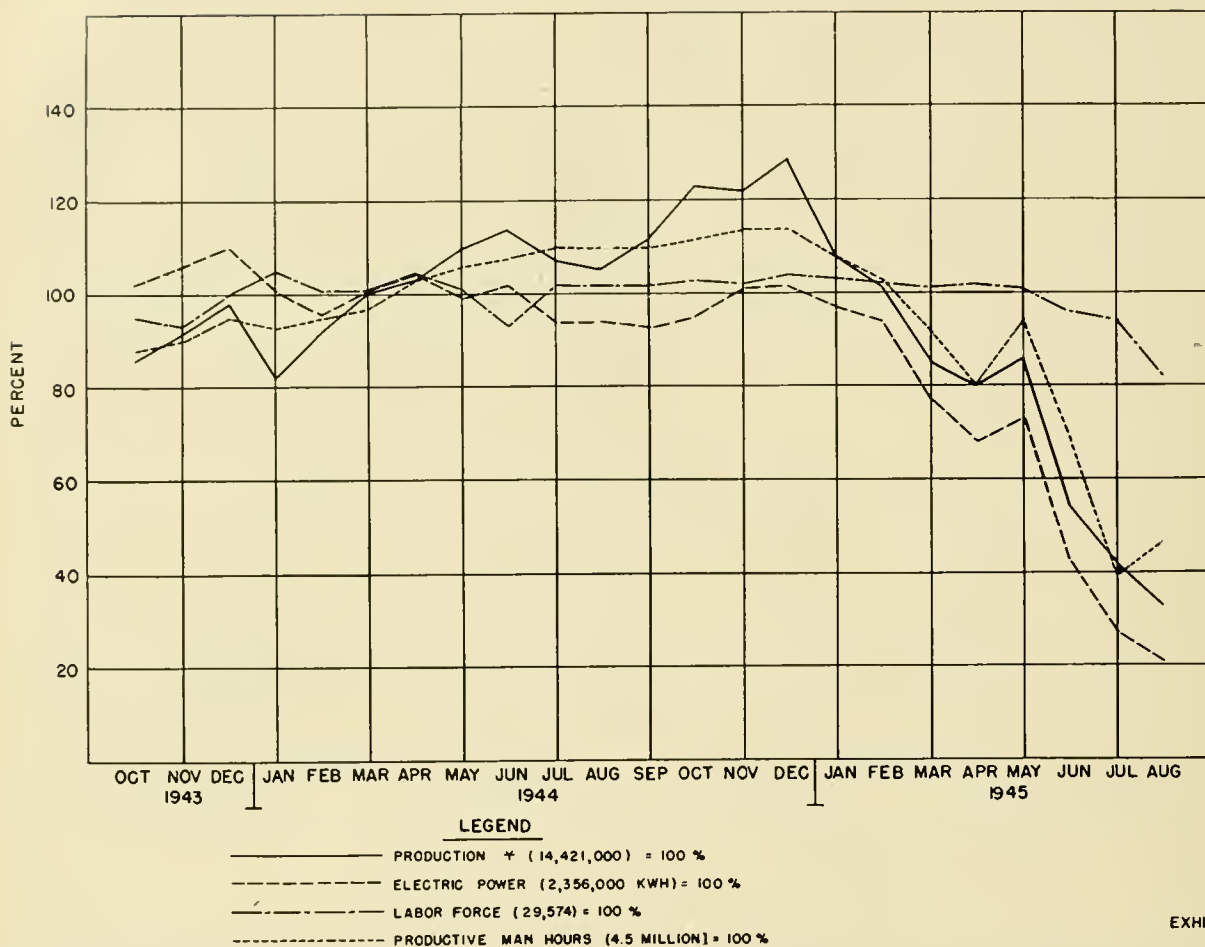


EXHIBIT 29

problems only became critical in March 1945. This plant also had serious labor difficulties, especially after the March attack. Some operations had been dispersed to a suburban branch plant in late 1944 but the effort to complete scheduled dispersal during 1945 proved abortive. Considerable deferred production was completed in May, but light damage on 1 June and heavy damage on 15 June brought operations to a virtual standstill.

The Rolling Stock Manufacturing Company provides a typical example of a firm which was discriminated against, both on critical materials and labor. December 1944 showed peak levels in all indices, and activity as measured by man-hours and power consumption was back to the base average in February after a January slump. But absenteeism registered 40 percent in March and even with 1,000 deserters dropped from the records in April, remaining absenteeism stood at 30 per-

cent. Conditions improved in May, but June absenteeism was 70 percent, encouraged, of course, by plant damage in two urban attacks that month. The plant was hit again in the July high-explosive attack on the neighboring Sumitomo component. Thus prospects for undertaking extensive railway repair activities at this major plant were foiled.

Components and Metal Fabricating

Over-all estimates of metal fabricating by Osaka authorities suggest that peak output was reached in mid-1944. Deliveries related directly to war items reached a peak in November, but deliveries to supporting industries declined gradually from a fourth of the total in May 1944, to a sixth by the end of the year. Thereafter output of direct war item components fell by 20 percent prior to the March attack and by another 35 percent during the month following this initial effort. There was an estimated 10 percent revival in May as part of

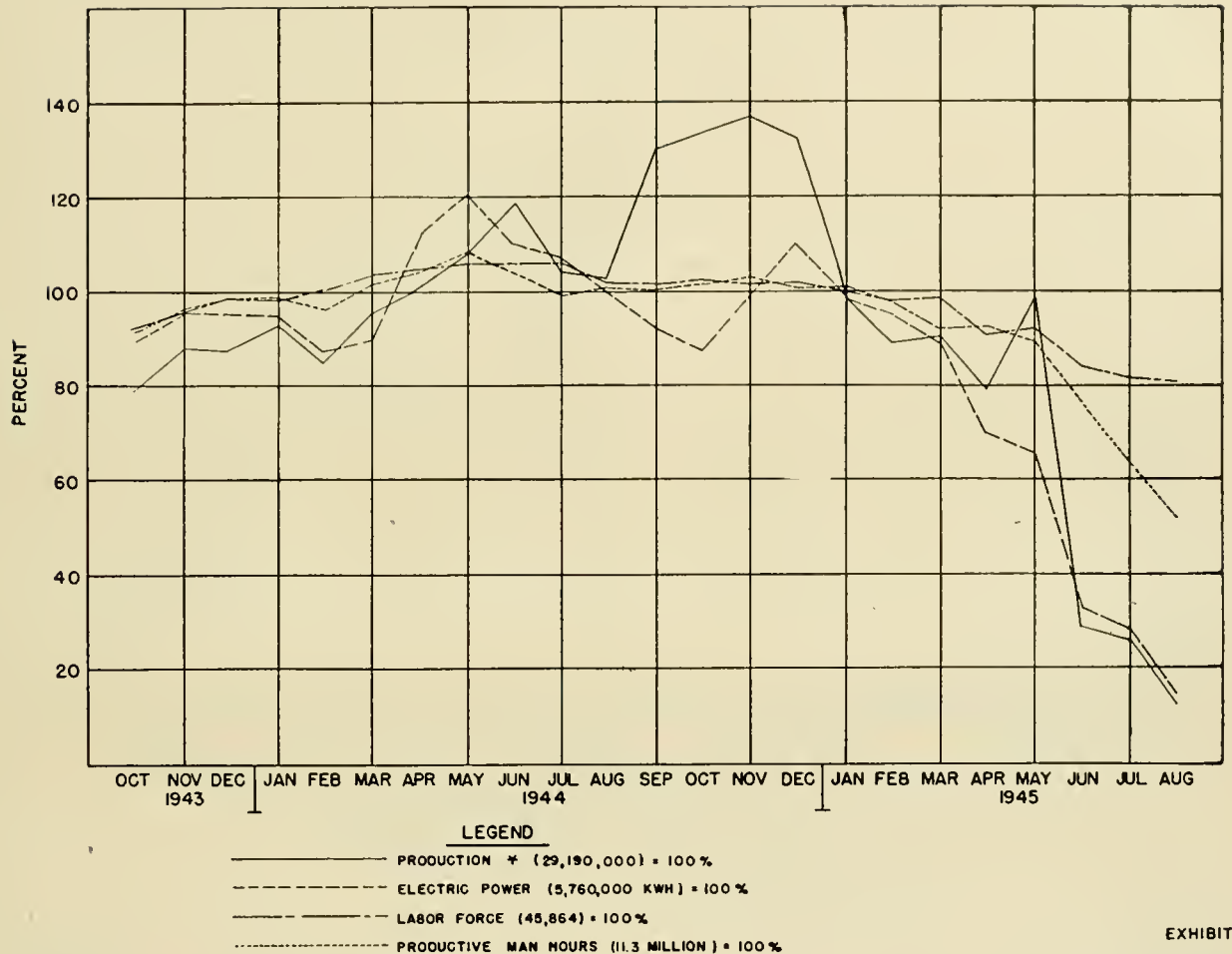


EXHIBIT 30

the city's complicated subcontracting system was reorganized, but June production was estimated at only 25 percent of the base period average and July output at 12 percent.

Factory questionnaire data are particularly inadequate for this industrial group because records in so many units were completely destroyed. Accordingly, the statistical data presented in Exhibits 29 and 30 do not reflect the experience of those firms most adversely affected by the March and June attacks. Furthermore, only one of the six major steel fabricating concerns are included in the statistical series for metal fabricating. Exhibit 30 thus deals with smaller fabricators and firms engaged primarily in forging, stamping, and related activities, while Exhibit 29 deals with firms primarily engaged in machining and precision work. Supplementary data on basic iron and steel fabricating is presented in Exhibits 31 and 32.

Along with their rolling and other fabricating facilities, six Osaka firms had some open-hearth steel capacity and two had blast furnaces. Exhibits 31 and 32 present activity data on these units. In addition, there were two steel works of some importance in neighboring Amagasaki, one with blast furnace capacity and the other specializing in specialty steel tubing and alloy fabrication. The Osaka Arsenal had both electric furnace and open-hearth capacity at its main works and operated additional facilities at its heavy ordnance branch located on the coast west of Kobe. Aside from two large units discussed in the Kobe report, the region's only other basic iron and steel facilities were at Hirohata west of Himeji. As already discussed in previous sections, the Hirohata works was by all odds the most important in the region and during 1944 basic iron and steel production was brought to a halt elsewhere and

ACTIVITY DATA SELECTED STEEL PLANTS-OSAKA

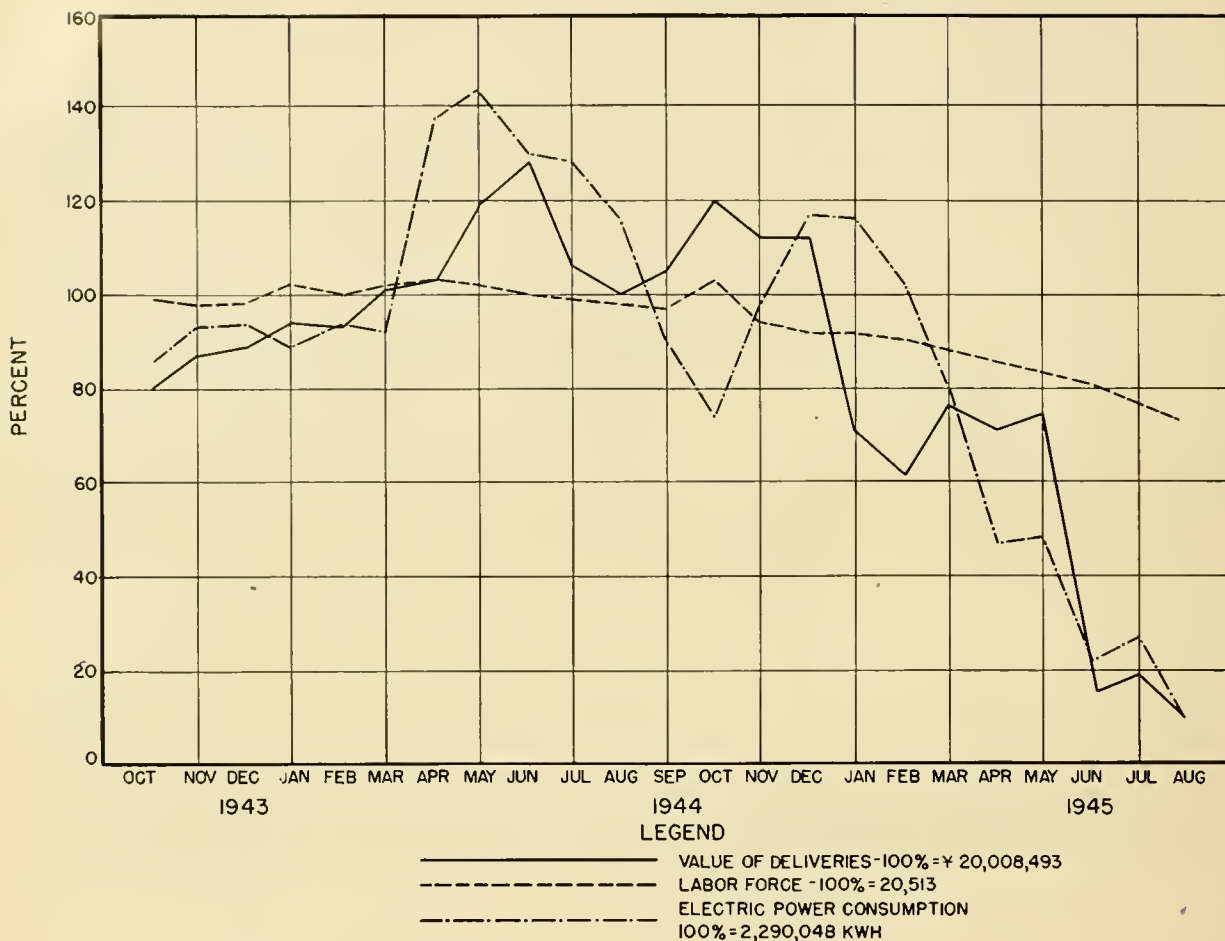


EXHIBIT 31

concentrated at this plant and at other large integrated mills outside the region.

Thus the pattern of operations was changed considerably at Osaka's few large steel fabricating mills. Local production of iron ended in mid-1944 and manufacture of carbon steel was sharply reduced. Fabricating operations continued but primary rolling and forging was carried out elsewhere. Production of special steels by the electric furnace process was increased, however. These changes were also related to the over-all decision to reduce steel deliveries to local shipyards. As a result, aggregate volume of output dropped at local primary fabricating units but value of product increased. Less fuel and energy was required after rolling of ship plate was cut down in favor of specialized products for the ordnance and aircraft industry. Greater electric power consumption for special alloy steel produc-

tion made up for much of the reduction in rolling mill requirements. Finally, these changes enormously reduced the demands of local industry on bulk commodity transport, and, to an increasing extent, finished shapes and ingot replaced fuel, ore and pig iron imports. The decision to continue distributing orders in proportion to capacity resulted in a great deal of labor hoarding in these primary fabricating plants and wastefully scattered available inventories.

Chemicals

The chemical industry was severely affected in urban attacks. Although not dependent upon subcontracting activities, it proved particularly vulnerable to incendiary damage. Exhibit 33 summarizes data on this industry. Sharp cutbacks in nonessential output occurred during 1944. This over-all decline also reflects reductions enforced

PRODUCTION DATA SELECTED STEEL PLANTS-OSAKA

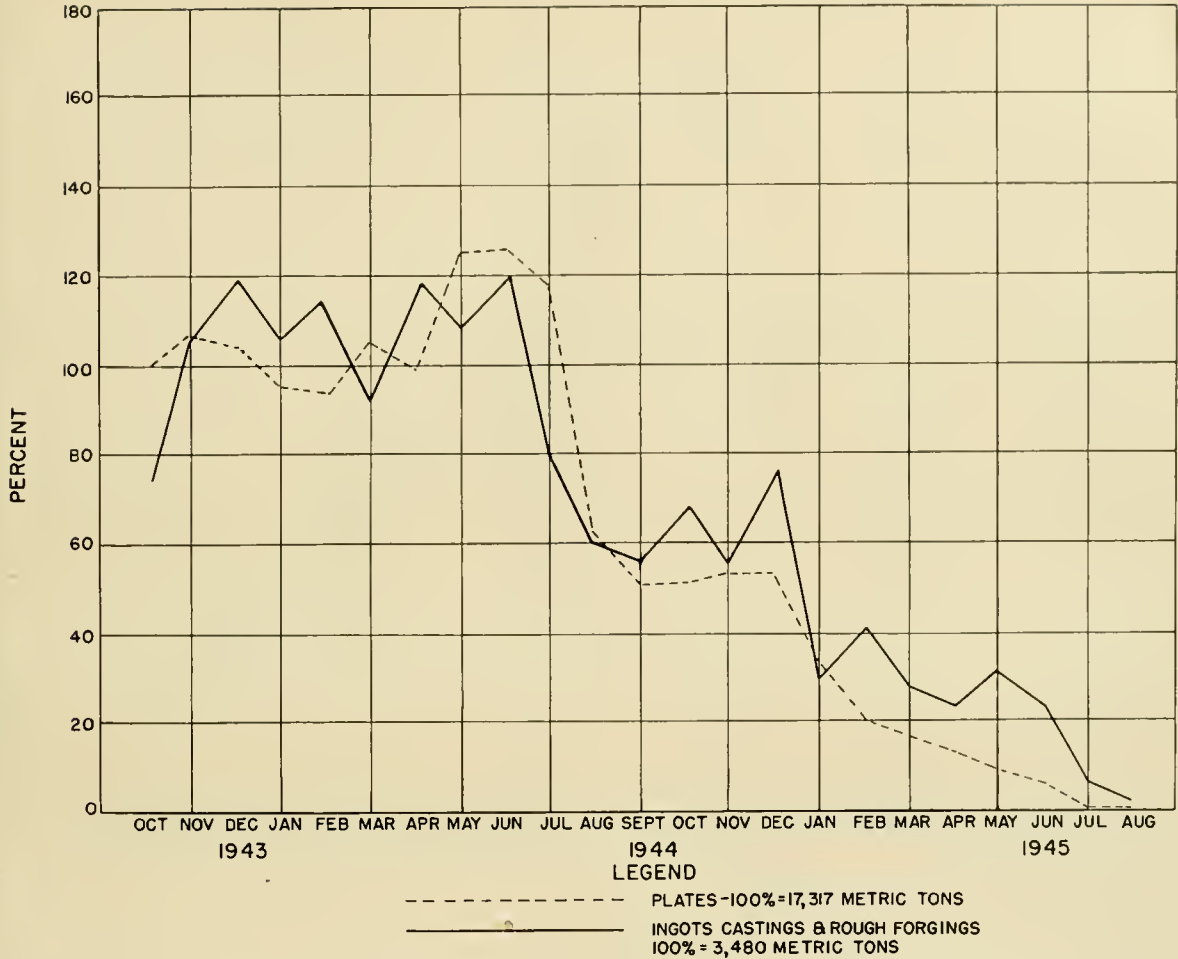


EXHIBIT - 32

by over-all coal shortages at Osaka's cement plants which are also included in this group.

Damage was moderate in March but labor problems and shortages of packing materials affected many firms thereafter. June damage was very heavy and halted output in many major units. Production of alcohol fuel for aircraft was pushed energetically during late 1944 and 1945. The city's two main units were steadily increasing production through May but were heavily damaged in June.

The rubber products industry was relatively important in Osaka, including 71 out of the country's 370 principal units. Seventeen of these were heavily damaged, reducing the aggregate capacity of local production by about two-thirds. In addition, a large number of minor subcontracting units were destroyed. During the latter part of the war, this industry had been heavily concentrating on hose, belting, bulletproof tanks, and other items

for aircraft, shipbuilding and various war items. Despite labor problems and severe curtailment of nonessential use, this group had operated at high levels in Osaka prior to air attacks, but these plants proved highly vulnerable to incendiary attack and to subcontracting disruption.

Exhibit 34 includes a wide range of other industrial activities, including consumer goods, woodworking and industrial belting. The aggregate production trends are fairly clear, including slight cutbacks during 1944 and initial drops in March 1945. The greater part of damage occurred in June, however. Most of these industries had been combed out for able-bodied manpower earlier in the war. It is evident that few firms made any effort to reduce payrolls or report actual man-hours during the latter phase of the attack period.

One of the most critical shortages in its effect upon priority dispersal and repair activities occurred in industrial belting. Japan continued to

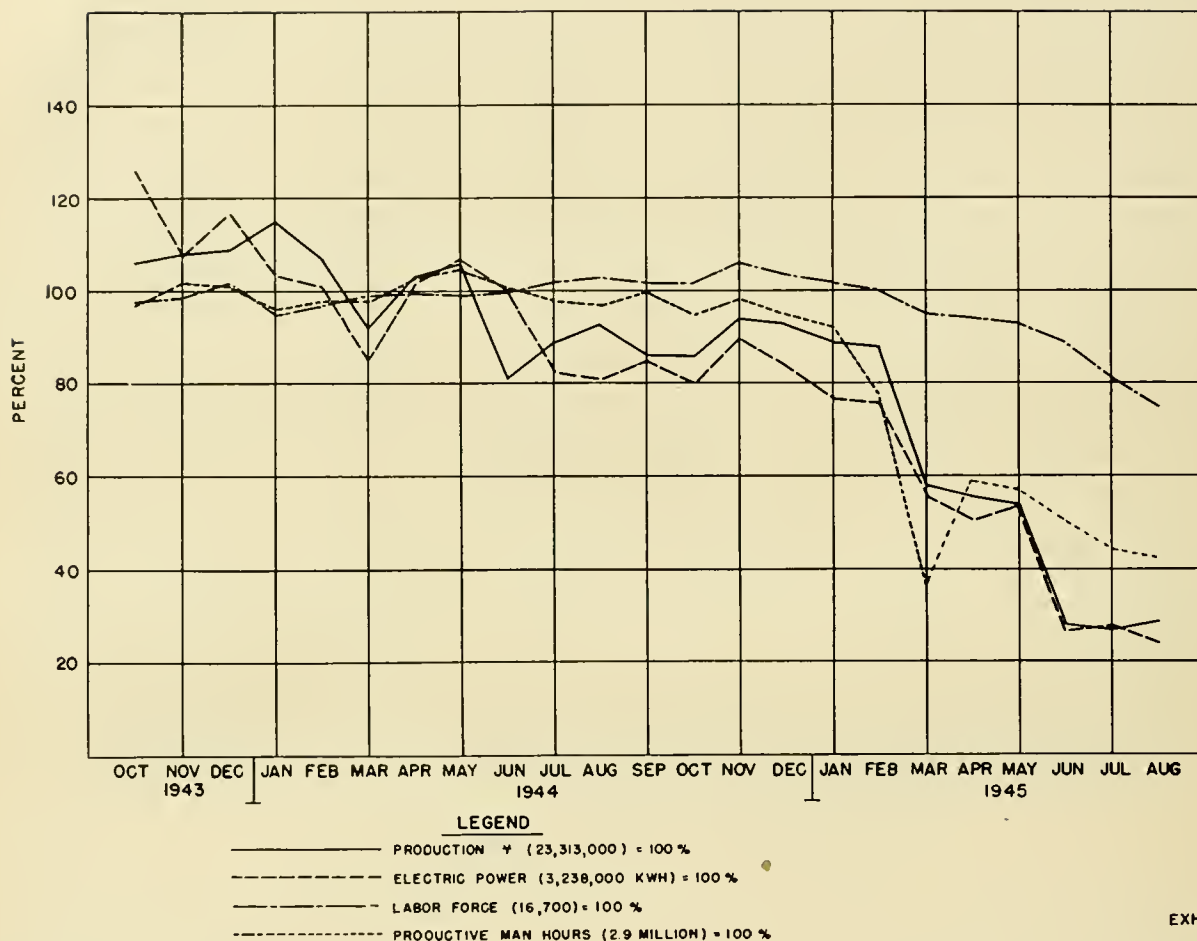


EXHIBIT 33

depend upon belting for power transmission to a much greater extent than the United States and it was particularly crucial for getting partially damaged, smaller plants back into production, and integrating orphaned machines, as well as carrying through dispersal.

Except for two related plant units, all major Osaka producers of this item were located within the target area of the March attack and were heavily damaged, including major losses of canvas, rubber, leather and adhesives, as well as finished and semifinished goods. Damage in mid-June and July brought the other two important units to a standstill.

A 25 to 60 percent expansion in production which took place during the last half of 1944 reached its peak in November and December. After a 10 percent drop in January and February due to limited raw rubber deliveries, the two undamaged plants also slumped heavily in March; but the largest Osaka unit had a six-months' supply of all materials including rubber when it was destroyed. The net effect of production declines was to reduce over 90 percent of the deliveries of belting after February. Destruction of stocks also interfered with emergency repairs as well as disposal and new plant construction.

MISCELLANEOUS

OSAKA

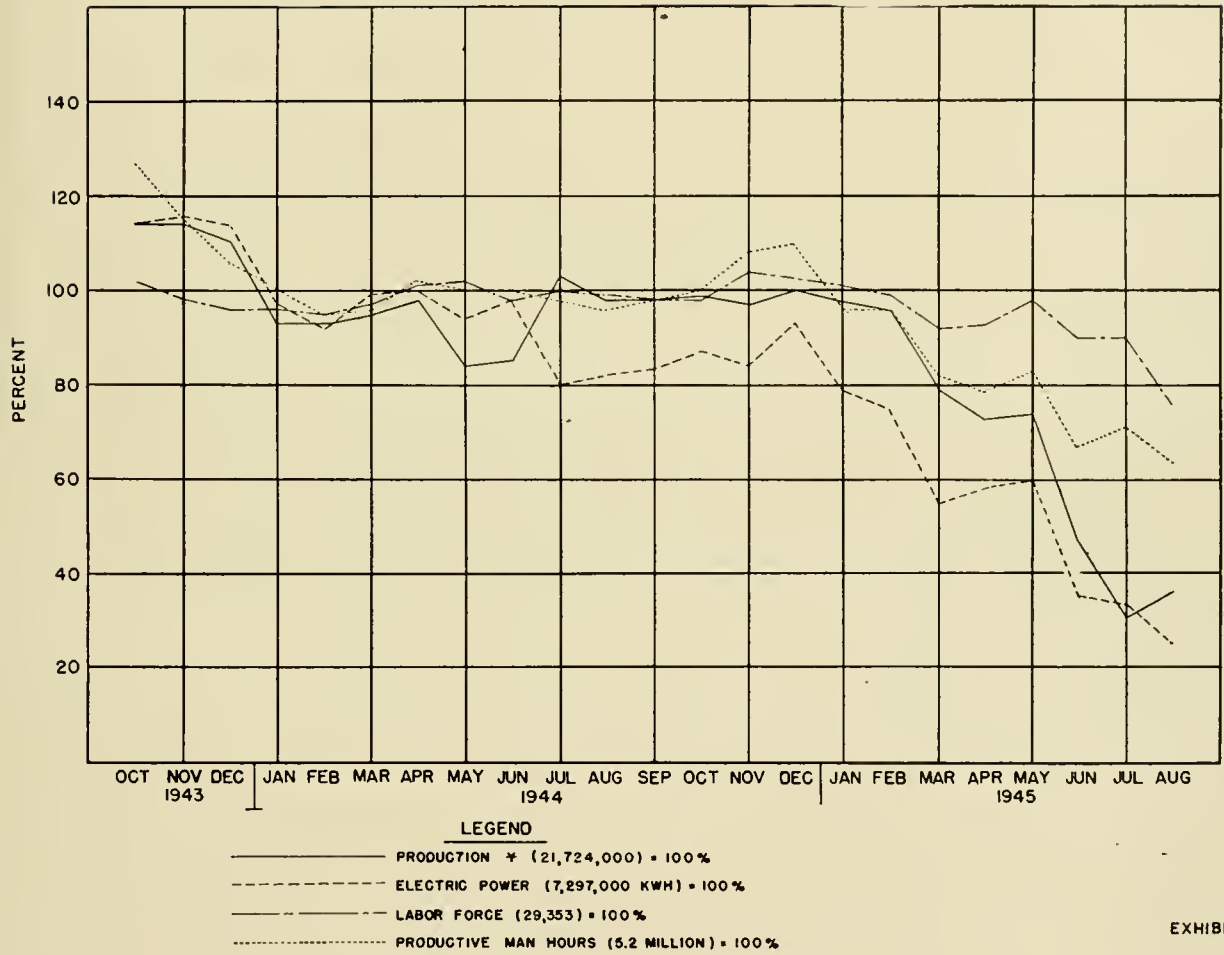


EXHIBIT 34

II. KOBE REPORT

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PHOTO 1. Central Kobe before the attacks. The photograph, taken early in the war, looks south over Kobe harbor and the central commercial district. Part of the main railway station is visible on the left with the conspicuous elevated right-of-way leading westward. Between the station and the main wharves are concentrated most of Kobe's modern business buildings. This view indicates the importance of lighterage for vessels moored in the harbor. The Kawasaki shipyard complex occupies the first peninsula on the west side of the harbor while the Mitsubishi shipyard and Mitsubishi Electric cover the point beyond. Contrast detached western-type residences on foothills in foreground with typical congested section closer to railway. Except for a few dozen structures in right foreground, this entire area was burned out, including many of the multistoried business buildings near the water front.

THE CITY

Kobe, a center of heavy industry before the war, Japan's chief overseas port and sixth largest city, is situated on the northwest shore of Osaka bay at the eastern end of the Inland Sea. Located midway between Tokyo and Shimonoseki, Kobe is the terminus of direct rail lines connecting these points and also has excellent road and rail access to near-by central Honshu cities, including Osaka 25 miles to the east.

Hills running parallel to Osaka bay confine Kobe's urban development to a narrow congested strip some ten miles in length. Suburbs along the bay east of Kobe have grown together, forming a mixed residential and industrial belt that extends almost to Amagasaki. A conspicuous railroad right-of-way, elevated through most of the city, divides the crowded but predominantly residential sector sloping back toward the hills from the industrial, commercial and warehouse districts along the waterfront.

Kobe's well-protected harbor and extensive deep-water wharves were never fully utilized during the war. Their initial role in supporting the southern invasion subsequently declined with the reduction of overseas traffic in favor of Osaka's port facilities, which had been considerably developed prior to the war. Kobe harbor continued to handle a substantial amount of local marine traffic along the Inland Sea, however, as well as bulk shipments related to the city's heavy industry.

Located east and west of the central harbor and commercial district in Kobe were large industrial establishments devoted to naval and merchant shipbuilding, to related steel fabricating, and to the production of railroad and electrical equipment, marine engines, tires and rubber products, ordnance and aircraft parts. Small-scale supporting industries were located near the main factories and adjacent to the railroad lines. In general, however, miscellaneous and light industries were less important in Kobe than in most other large Japanese cities.

Lay-out of the City (Maps 1 and 2)

The over-all street pattern of Kobe is roughly rectangular, with the more important streets roughly parallel or perpendicular to the bay and the precipitous row of hills back of town. Many streets are too narrow for vehicular traffic. Except in one industrial section, Kobe has no inland

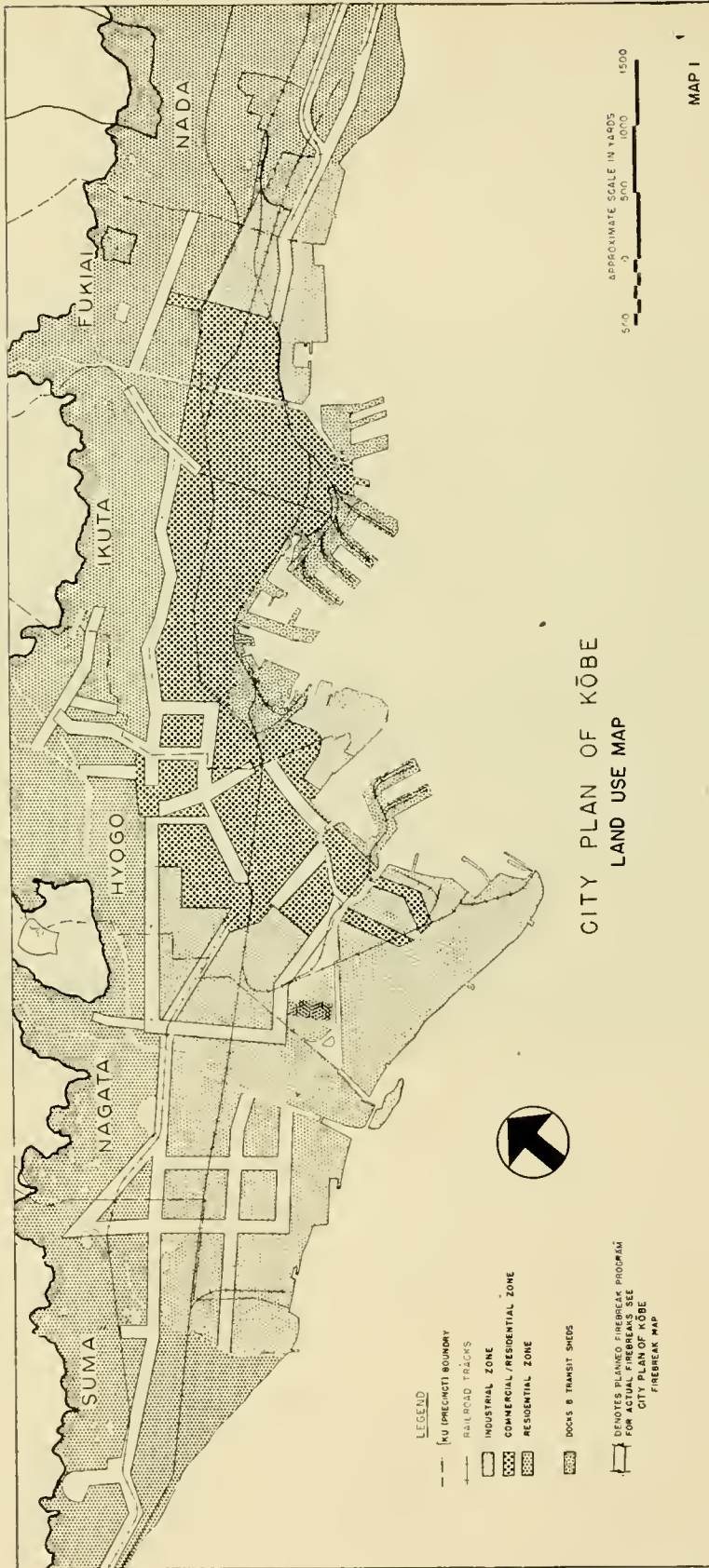
waterway system to provide firebreaks, although small streams do run through the city at intervals, and there are a few parks in the residential sections. In shape, the city of Kobe is narrow and elongated. The built-up section, approximating 14 square miles when open areas are eliminated, extends along Osaka bay for almost 10 miles and varies in width from 1 mile to 2½ miles. There are no outstanding landmarks comparable to Osaka's castle but the elevated railway and harbor configuration provide ready orientation. Kobe gave excellent radar response.

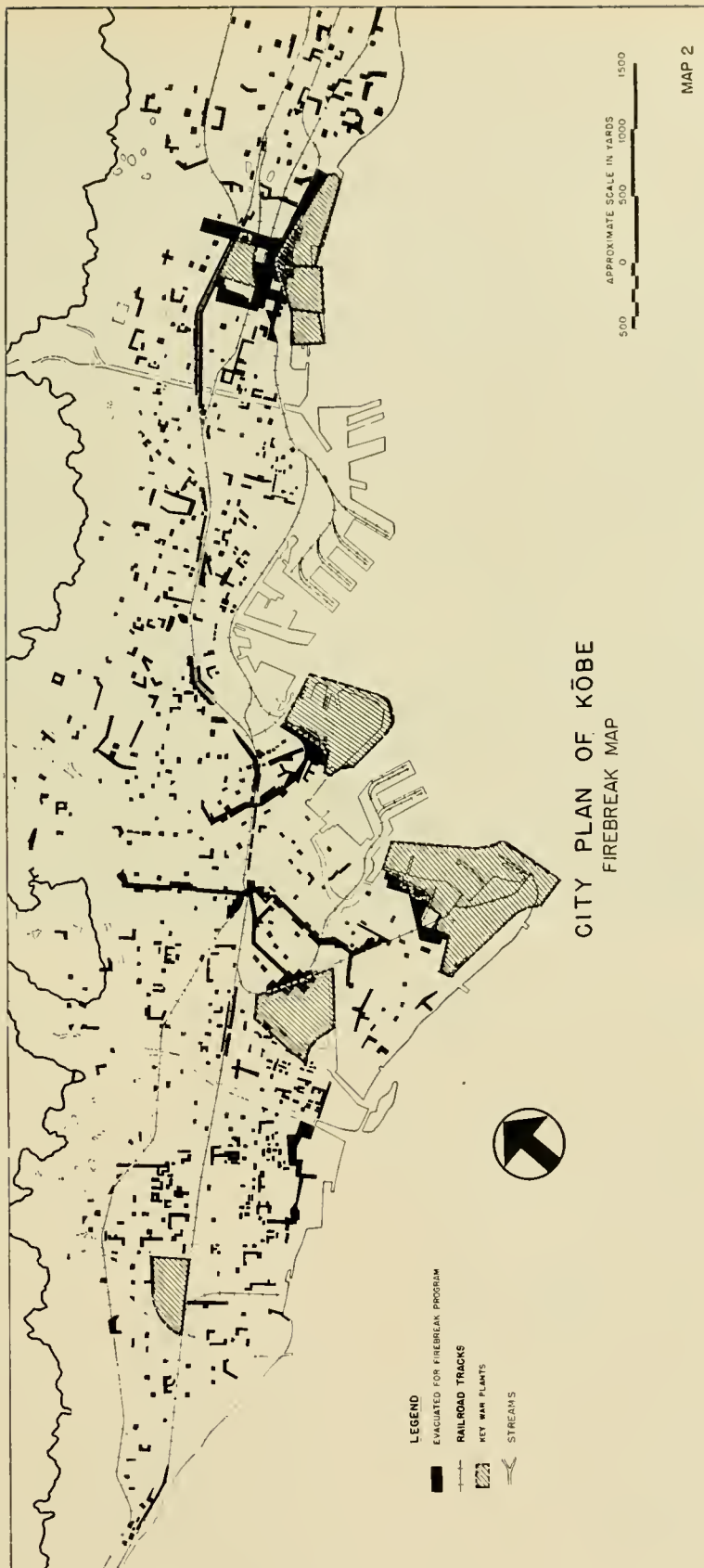
The center of the old town, lying between the main railroad station and the waterfront, was zoned for commercial use. In this area were concentrated most of Kobe's fire-resistant business buildings. The areas which were zoned for industry extended east and west of this district along the waterfront. Residential areas run back from these zones on higher land and extend up to the hills. Throughout the industrial zones were congested residential districts. All zones were highly vulnerable to incendiary attack.

A firebreak construction program was started in March 1944, most of the work being concentrated on the protection of individual plants and public buildings. In contrast to Osaka's program, relatively little work was done on long firebreaks aimed at preventing the spread of fire from one section to another until 1945. Earlier an elaborate linear firebreak program had been planned but was cancelled on the ground that such firebreaks were unnecessary in Kobe, because of the long narrow lay-out of the city and the protection afforded by the main streets and railroad right-of-way. Nevertheless, 21,379 buildings were ultimately removed from 446 acres. This represented slightly more than 25 percent of the firebreak removals undertaken in Osaka.

Population and Housing (Map 3)

Kobe, a city with a 1940 population of 976,234 as compared with over 3,200,000 for Osaka, had experienced a decline to an estimated 784,000 at the end of January 1945, just before the first attack on the city. This decline—relatively less drastic than in Osaka—was attributed by the Japanese to conscription, organized and volunteer evacuation, and removal from the city of persons displaced in the firebreak program, but above all to considerable wartime shifting of labor. With an over-all population density of more than 30,000





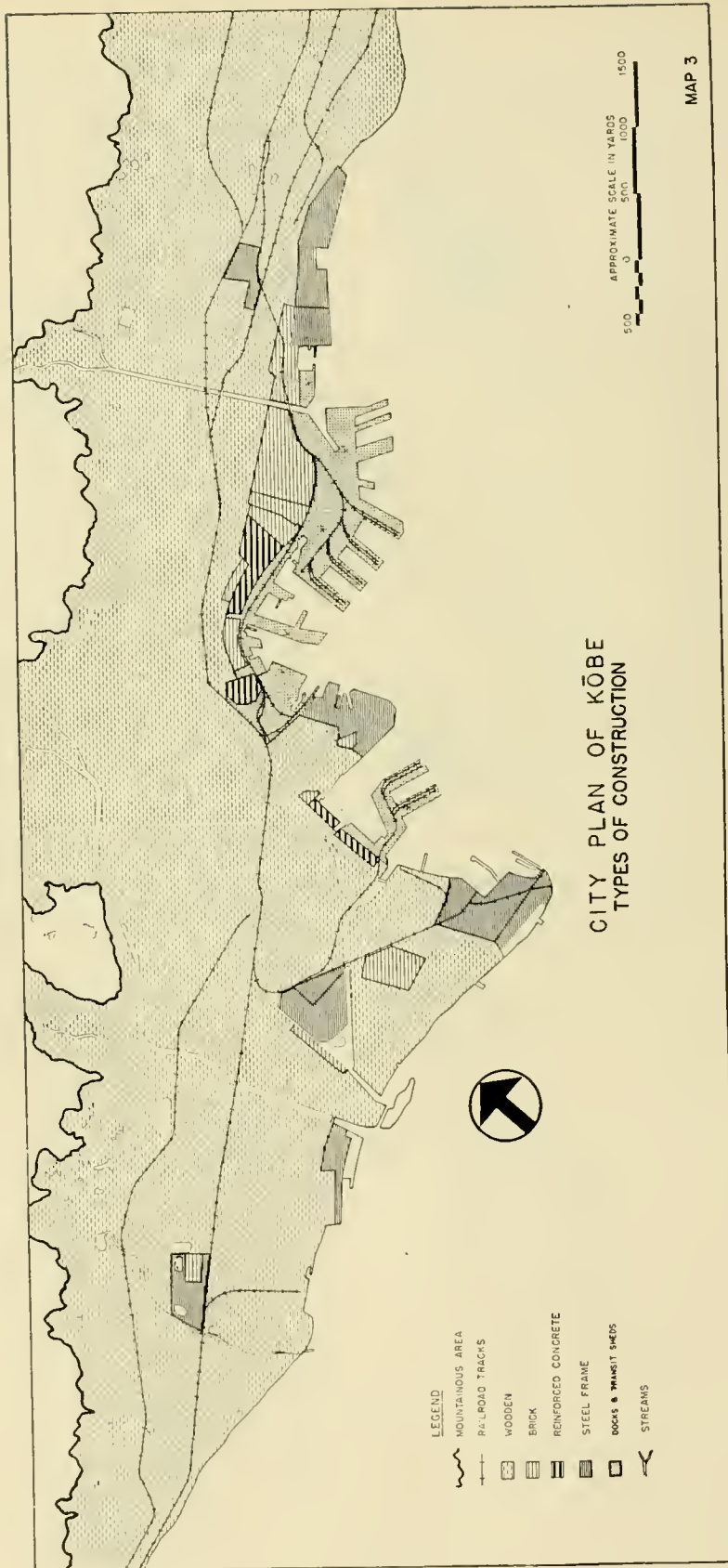
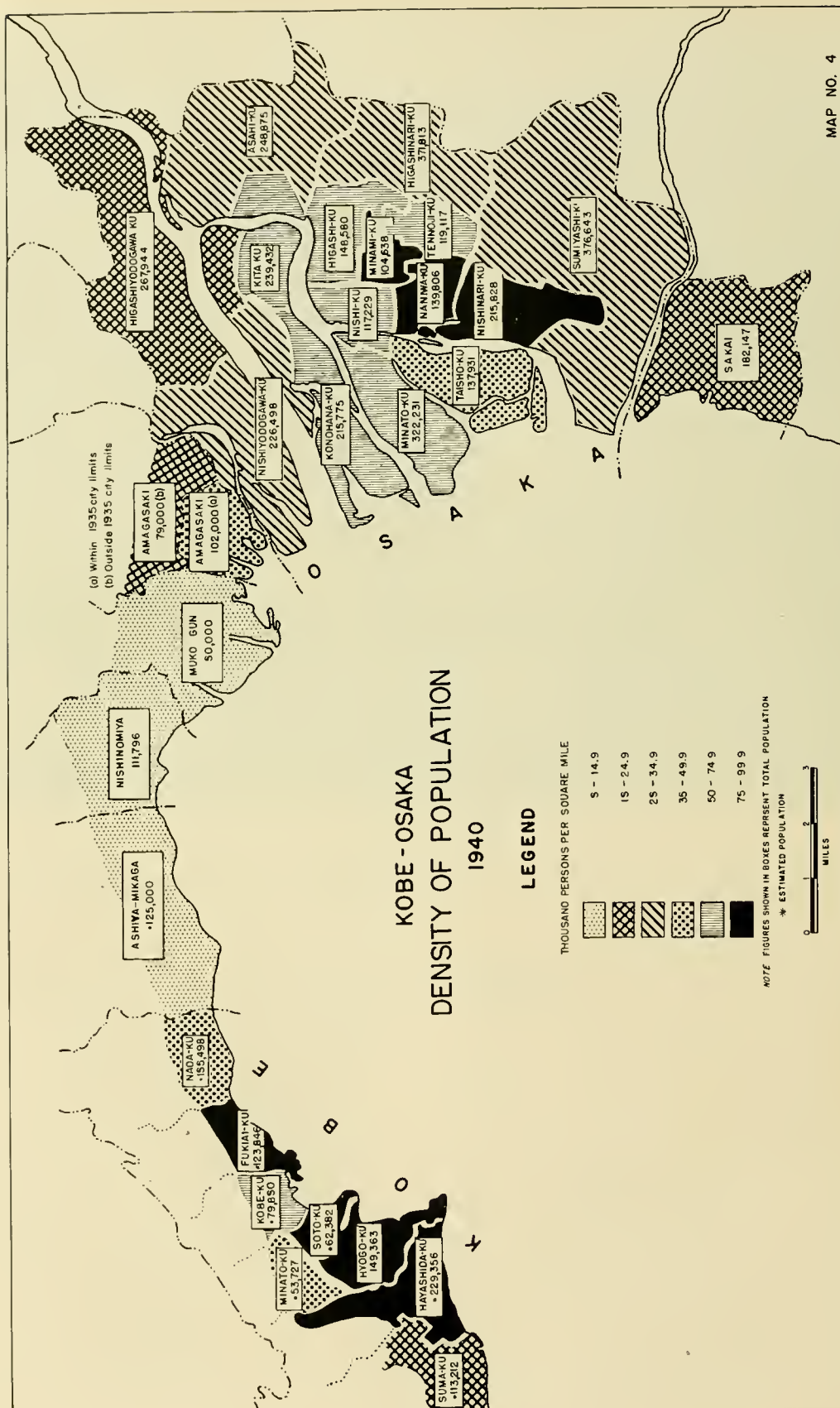




PHOTO 2.—Pre-attack view of eastern Kobe. Looking east along shore of Osaka Bay. Below the conspicuous railroad right-of-way is a major industrial complex including Chuo Rubber Company, various units of Kobe Steel Company, and many smaller war plants. (See Photo 16 for detailed post-attack view of this complex.) Area above elevated railway is predominantly residential and extremely congested. The June 1945 incendiary attack destroyed practically all of the city visible in this photograph.

persons per square mile, and concentrations of well over 60,000 in the central districts, Kobe ranked among the most densely populated cities in Japan. In August 1944, the month in which construction of firebreaks was started, there were 199,256 residential buildings listed in Kobe as containing 386,883 residential units, or an average of 2.1 units per building. With no new construction, and the firebreak program resulting in a continual decline in the number of buildings, there were 170,053 residential buildings listed (only units) at the end of January 1945, just before the first area raid on Kobe. The fact that the number of residential units declined much more sharply than the number of residential buildings indicates that the program, which aimed at the elimination of particularly inflammable areas around key plants,

resulted in the removal of many old multiple-dwelling buildings. In industrial construction, there was a slow but steady increase up to 2,148 buildings by the end of January 1945. This figure covers main production buildings only—not auxiliary buildings. Nor does it include small workshops and home industries which were listed among residential buildings by local authorities. The high proportion of wooden construction in Kobe, as in all Japanese cities, is indicated on Map 3. The few fire-resistant steel-and-concrete business buildings were mostly located in the small commercial district to the south of the main railroad station. The city's large industrial enterprises contained many steel-frame buildings and some of reinforced concrete, but small supporting industries were in typical highly combustible



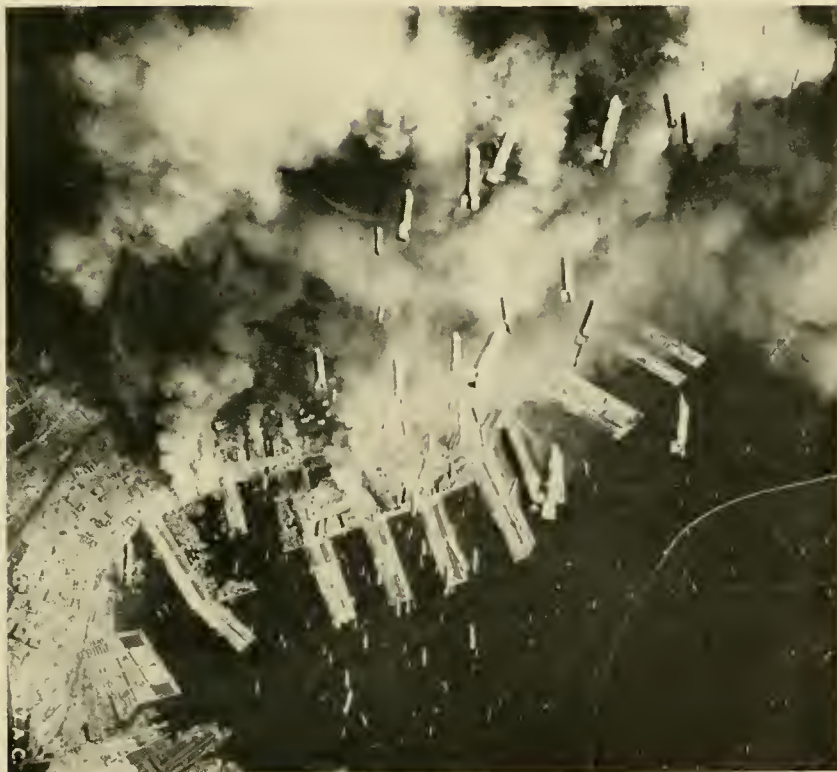


PHOTO 3.—Over Kobe on 5 June 1945.

structures. Larger warehouses were concrete or brick.

Importance of Urban Area

Included in the Kobe urban area were two of Japan's largest shipyards and supporting marine-engine and steel fabricating mills, an important tire and rubber plant, and large producers of ordnance, electrical equipment and aircraft engine parts. The city's extensive port and storage facilities continued to be utilized to a considerable degree. A railway equipment concern and large railway repair shops were key elements in locomotive and car building and in maintenance for lines in central Japan. East of Kobe proper were the airframe-assembly facilities of Kawanishi Aircraft, Japan's fourth largest producer of combat type aircraft, which depended on the city for components and for part of its labor. Within the congested central area were many smaller producers of machine tools, aircraft and ship components and rubber and electrical products, but less than a dozen large plants dominated the industrial scene in Kobe. Except for the railway equipment works, each of these facilities was engaged almost exclusively in war work, either in the form of merchant and naval shipbuilding and finished ordnance or in production of steel shapes, components and accessories for these items or for aircraft. Production in Kobe rose to peak levels at the end of 1944 and was continuing at a high rate until the B-29 attacks. Thus, the Kobe urban area offered a promising target for incendiary attack—a compact area of high density and of considerable importance to current war production.

AIR ATTACKS

Like Osaka, Kobe was not included in the first series of B-29 operations from the Marianas during late 1944 and January 1945. A small trial use of our light incendiary bombs against one waterfront heavy-industry section of Kobe, on 4 February, damaged several important factories, but the main urban area attacks against Kobe were delivered on the night of 16-17 March and on 5 June 1945. Some spill-over residential damage also occurred as a result of the 11 May precision attack on the Kawanishi aircraft plant, located in the suburbs east of Kobe. A few B-29s dropped high-explosives on two Kobe

plants as alternate targets on 24 July. Likewise, the 5 August urban attack on the near-by town of Nishinomiya resulted in slight additional damage to Kobe. In the last weeks of the war, Kobe harbor was also mined by B-29s and there were a few fighter sweeps in the vicinity.

Each of the three urban area attacks on Kobe caused considerable industrial damage (including the February test raid) and the last two destroyed much of the city. Altogether, an estimated 37 percent of Kobe's industrial building area and 56 percent of total building area was destroyed or heavily damaged. Few casualties resulted from the first attack but ultimately almost 60 percent of the inhabitants were de-housed and 3 percent killed or injured. Approximately 7.2 square miles were burned over, out of a total built-up area of some 14 square miles. All important industrial installations in the city sustained damage. Five thousand four hundred seventy-five tons of incendiaries, but only 105 tons of high-explosives, were aimed at Kobe in the three main attacks—slightly more than half the tonnage used against Osaka in four urban attacks. Of the 874 B-29s participating in these three missions, 11 were lost.

Listed below are the attacks on Kobe and its environs which were carried out by the Twentieth AF:

1. Kobe urban area—Southwest industrial district

Date	4 February 1945 (day)
Number of planes	98 (24,100 ft. altitude)
Duration	1 hour
Type and weight of bombs	159.2 tons IB 13.6 tons HE

2. Kobe urban area

Date	17 March 1945
Number of planes	307 (6,830 ft. altitude)
Duration	2 hours
Type and weight of bombs	2,308.7 tons IB

3. Kawanishi aircraft plant, Mikage

Date	11 May 1945
Number of planes	93 (18,000 ft. altitude)
Duration	10 minutes (spill-over only)
Type and weight of bombs	459.5 tons HE

4. Kobe urban area

Date	5 June 1945 (day)
Number of planes	480 (16,000 ft. altitude)
Duration	85 minutes
Type and weight of bombs	3006.3 tons IB 71.0 tons HE

5. Nishinomiya urban area

Date	6 August 1945 (night)
Number of planes	258 (14,500 ft. altitude)
Duration	90 minutes (spill-over only)
Type and weight of bombs	1,322.8 tons IB 81.1 tons HE

BOMBING RAIDS ON KOBE

1945

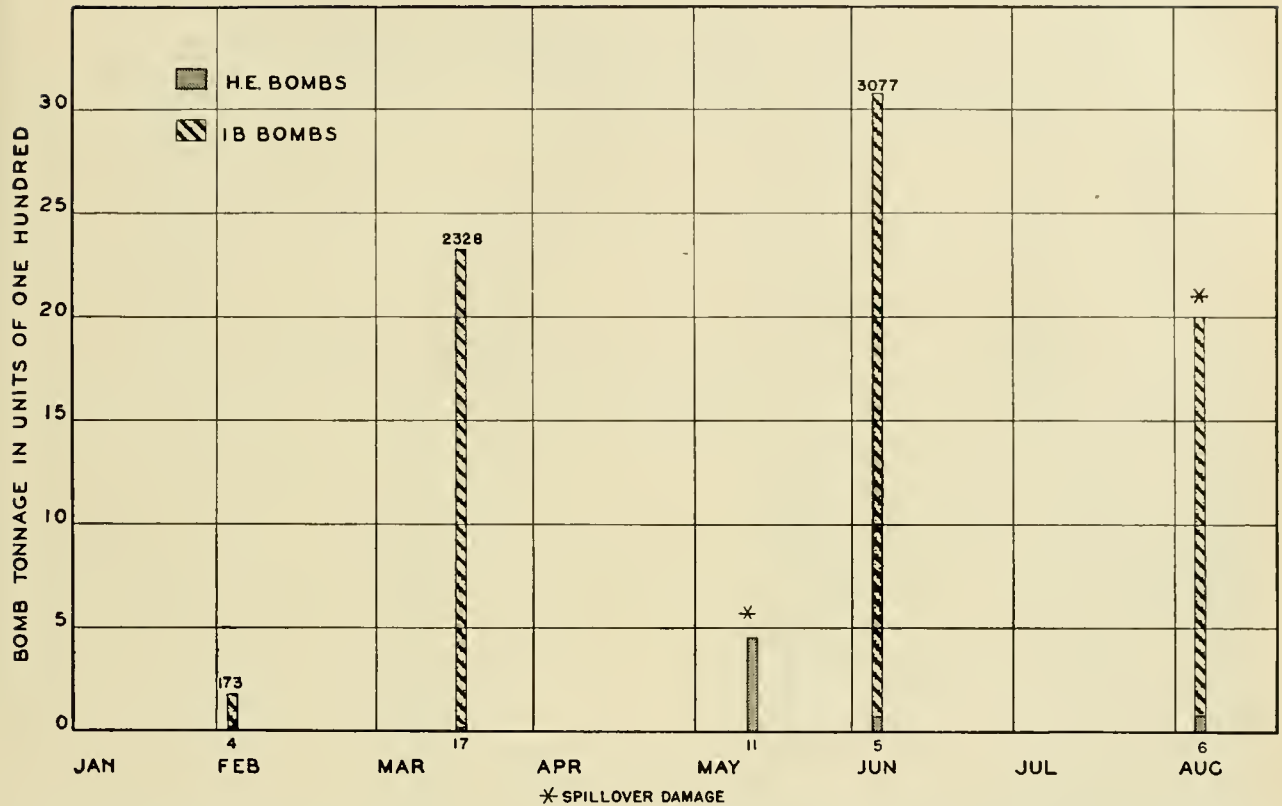


EXHIBIT I

Physical Damage (Exhibit 2, Map 4)

A total of 8.8 square miles of Kobe was burned over out of a total built-up area of 15.7 square miles and a planned target area of 7 square miles. In the 5 raids under discussion, local authorities list 121,019 residential buildings as totally destroyed and 5,407 residential buildings as badly damaged. Together, these represented 74 percent of all residential buildings in the city in January 1945, with damage amounting to 11¼ billion yen. In the same raids, 1,714 major industrial structures were destroyed and 235 were badly damaged, together representing 54 percent of the total listed in the city. 91 percent of the city's 1,758 listed industrial establishments were damaged. Three hundred thirty-seven buildings of other types (hospitals, public offices, and large commercial structures) were destroyed and 65 were badly damaged. Total damage to this category was placed at more than 90 million yen. The figures on residential buildings include small stores and workshops, which were usually inhabited by the owner or some of the employees. In-

dustrial buildings include only major structures listed in the official census of manufacturing facilities.

Total damage estimates for Kobe have also been prepared by the Joint Target Group based upon measurement of roof coverage as determined from aerial photography. Total pre-attack roof area in the city was placed at 149,700,000 sq. ft. Of this total building area, almost 56 percent was determined to have suffered complete destruction or heavy structural damage. The total roof area of industrial facilities in Kobe was placed at 35,600,000 sq. ft., of which 37 percent was destroyed or showed evidence of serious structural damage.

Exhibit 2 presents data by raid on the yen value of damage to residential, industrial and other property, as determined by local authorities on the basis of ratio of damage and assessed values (prewar and official price levels) for buildings and contents. The accompanying table supplements this information with data on the number of individual structures destroyed and damaged in each attack.

YEN VALUE OF BOMB DAMAGE IN KOBE CITY

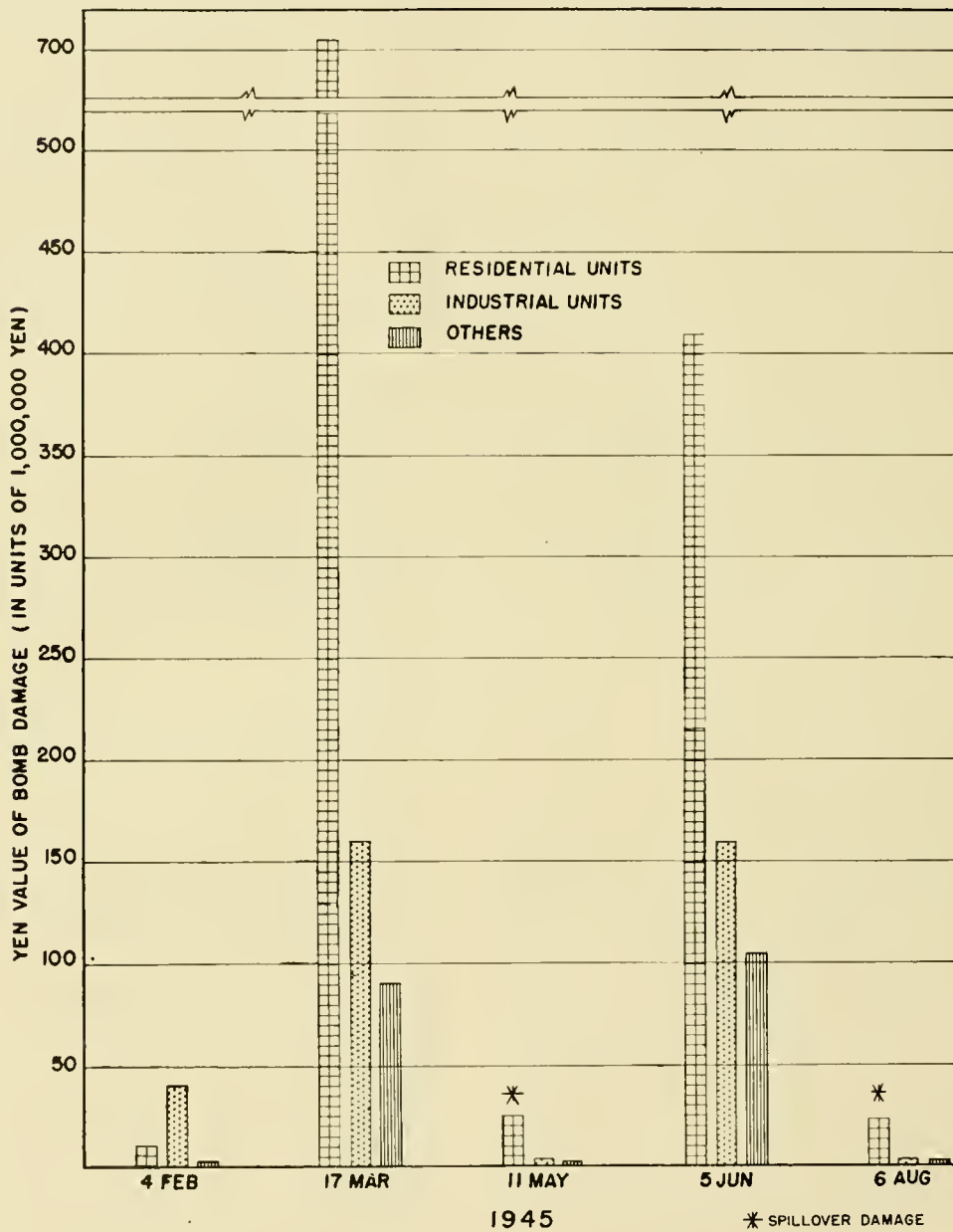


EXHIBIT 2

Date of raid: 4 February 1945 (0.09 sq mi destroyed or damaged):

	Number of resi- dential build- ings	Number of in- dustrial build- ings	Number of other build- ings
Completely destroyed_____	864	20	7
Heavily damaged_____	129	17	2

Date of raid: 17 March 1945 (2.9 sq mi destroyed or damaged):

Completely destroyed_____	65,951	500	242
Heavily damaged_____	1,711	162	25

Date of raid: 11 May 1945 (39 percent of Kawanishi Aircraft Co. destroyed or damaged):

Completely destroyed (in Kobe)_____	1,241	7	5
Heavily damaged (in Kobe)_____	2,617	3	8

Date of raid: 5 June 1945 (4.35 sq mi destroyed or damaged):

Completely destroyed_____	50,680	642	77
Heavily damaged_____	855	50	23

Date of raid: 6 August 1945 (2.8 sq mi of Nishinomiya-Mikage area destroyed or damaged):

Completely destroyed (in Kobe)_____	2,283	5	6
Heavily damaged (in Kobe)_____	95	3	7

The 4 February 1945 raid hit part of the shipyard and heavy industry area in the southwest section of the city. Less than one-tenth of a square mile was burned over but factory damage was heavy. In this raid, 1,039 buildings of all kinds were seriously hit or completely destroyed. Damage to the 37 classified as industrial came to 39,500,000 yen. It should be noted that those buildings used both as dwellings and for small industries are listed under the residential category. With only 172.8 tons of bombs (92 percent incendiaries) being used, an average of 5 buildings was destroyed by each ton of bombs. Over 10 percent of total industrial damage was achieved in this test raid with about 3 percent of total effort. This attack, directed by radar against a triangular peninsula, resulted in many bombs falling short in Osaka bay, but nevertheless the industrial damage was high, and its effect on local war production decisive, as will be shown.

The 17 March 1945 raid heavily hit the western and central part of Kobe extending north and east of the target area of the 4 February raid. This section was zoned for industrial and residential use and included part of the main com-

mercial district. In this raid, 66,693 structures of all kinds were destroyed, including many converted school buildings and 500 classified as industrial. With 2,381 tons of bombs (over 99 percent incendiaries) being used, an average of 28.6 buildings was destroyed by each ton of bombs. Every major factory in the area suffered some damage. An area of 2.9 square miles was destroyed and a third of the population was dehoused. The February test raid and the heavy March attack resulted in damage to seven million square feet of industrial building area and 36 million square feet of residential floor space.

On 11 May 1945 the Twentieth AF staged a precision attack on the Kawanishi aircraft plant in Mikage, a suburb to the east of Kobe, but some high-explosive bombs spilled over at three points on the northeast edge of Kobe. A total of 1,253 buildings of all kinds, including 7 industrial buildings, were destroyed. Photo-interpretation indicated that 39 percent of the primary target in Mikage was destroyed; in addition, considerable damage was done to near-by light industry and residential areas.

The 5 June 1945 urban attack was the largest mounted against targets in this region. It hit large sections in the eastern half of Kobe and an untouched area in the extreme western part of the city. Three thousand seventy-seven tons of bombs (97 percent incendiaries) were used, destroying or damaging 4.35 square miles. A total of 51,399 buildings of all kinds were destroyed—17 buildings per ton of bombs. This attack was highly effective against several key plants not damaged in previous attacks.

On 6 August 1945 an area attack was aimed at Nishinomiya, Ashiya and Mikage, residential suburbs east of Kobe with considerable small industry. A few incendiaries fell in one of the eastern sections of Kobe that had been hit in the 5 June raid, destroying 2,294 more buildings of all kinds. Altogether, 18,240 buildings were destroyed in Nishinomiya, Ashiya and Mikage, including some 1,840 with high-explosive damage sustained in the Kawanishi attack of 6 May. Photo-interpretation indicated that 2.8 square miles of the built-up area was destroyed in the August incendiary attack.

Kobe's firebreak policy proved to be particularly ineffectual. The original grandiose plan as outlined on Map 1 had been abandoned but those linear firebreaks actually completed (Map 2) were of little value. The small protection they

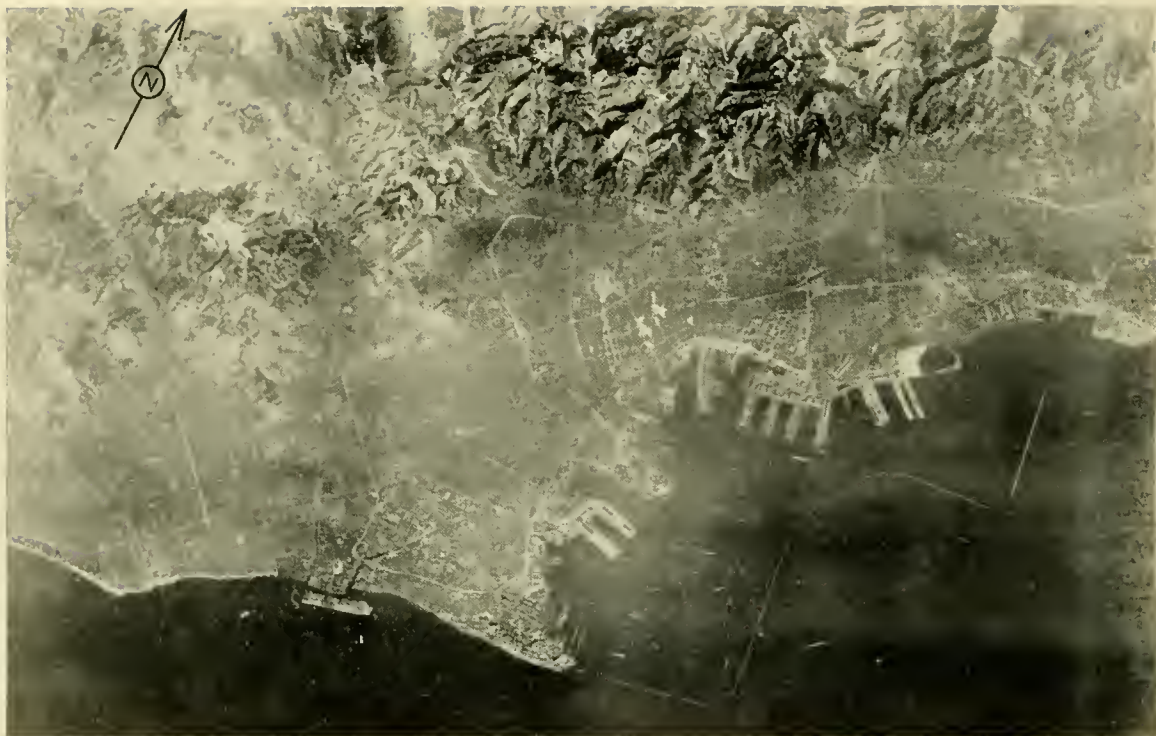


PHOTO 4.—Aerial view of Kobe in January 1945. Note many ships in harbor.



PHOTO 5.—Kobe after 5 June 1945. Light-colored ashes clearly mark burned-over areas.





PHOTO 6.—Western Kobe. Looking southeast toward Mitsubishi shipyard complex across part of small factory district destroyed in March incendiary attack. Note that multistory concrete structure near railroad is gutted.

might have afforded proved totally useless against attacks of the size mounted against Kobe. As in Osaka, however, previously burned-out areas sometimes acted as firebreaks limiting the spread of later fires. Firebreaking around key plants was undertaken extensively in Kobe but did not prove particularly successful, mainly because of the relatively heavier bomb concentrations achieved.

Although figures reported by the authorities on building repairs and on new construction are incomplete, they do indicate only a slight amount of rebuilding and repair, with the main emphasis on industrial structures belonging to key plants. Moreover, the already insufficient volume of repair and rebuilding decreased further after March 1945 as building materials grew scarcer than ever, and as the cumulative effect of the raids was felt on labor and transportation.

Casualties (Exhibits 3 and 4)

Ultimately, there were 7,051 deaths credited to Kobe air attacks. After the 5 raids under discussion, a total of 6,298 persons were listed as killed, 15,823 injured, and 479 missing. Over 90 percent of these casualties were a result of the two heavy incendiary attacks. This total compared with 9,914 killed, 27,073 injured, and 2,115 missing in Osaka as a result of four heavy urban attacks. Some 452,059 Kobe residents were dehoused, of which two-thirds left the city, and 174,921 others also evacuated after the attacks. A tabulation by attack of casualty figures as com-

piled by Kobe authorities follows:¹

Date of raid	Killed	Injured	Missing	Dehoused	Evacuated
4 Feb 1945	38	150	0	4,350	1,910
17 Mar 1945	2,581	4,794	57	237,948	97,867
11 May 1945 ²	405	503	0	20,351	1,021
5 Jun 1945	3,192	10,064	422	179,980	73,343
6 Aug 1945 ²	81	285	0	9,430	780

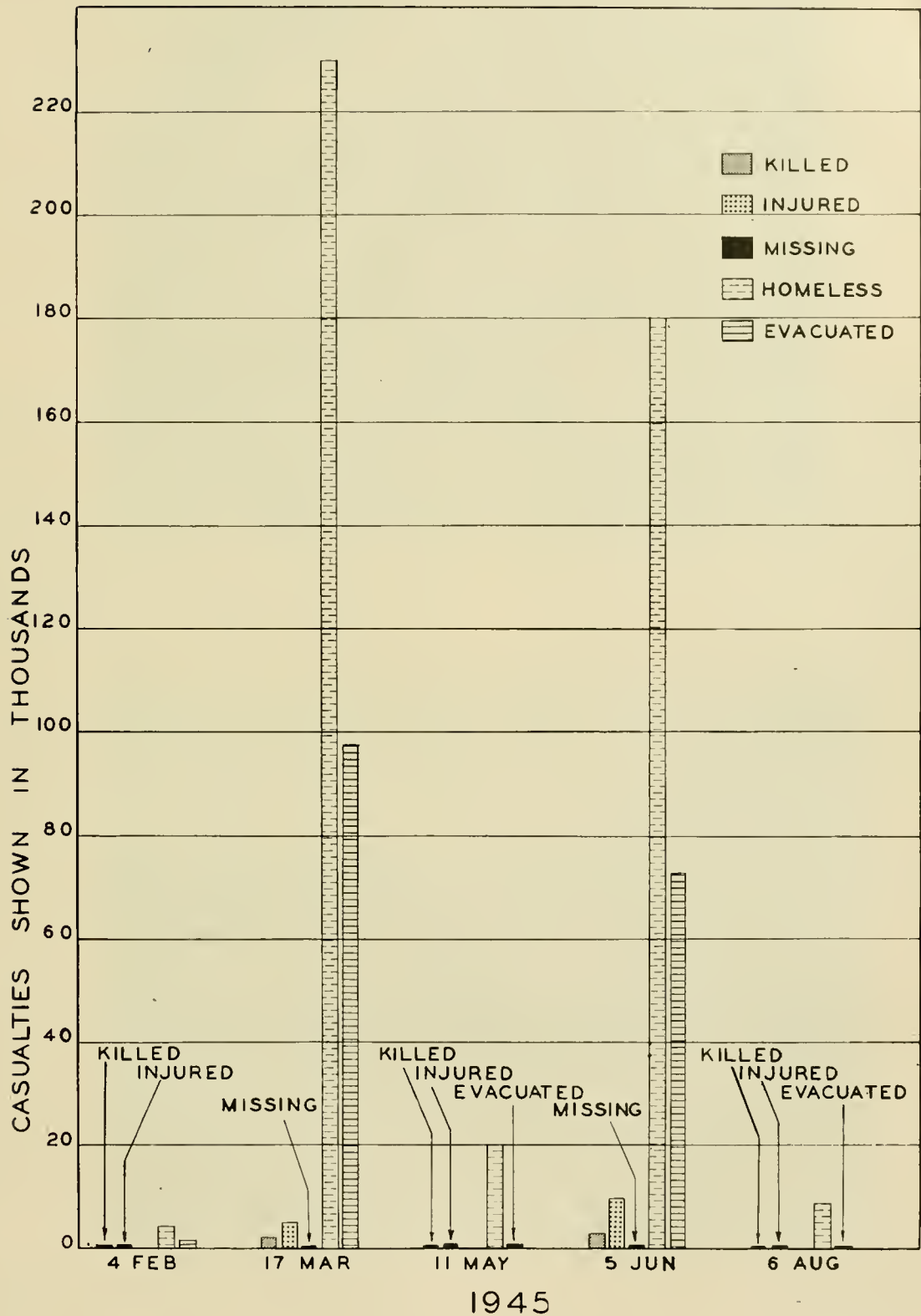
At the end of the war, Kobe had only 41 percent of the 967,234 inhabitants which it possessed in the 1940 census. Conscriptions, migration for war work, and pre-raid evacuation had already caused the departure from Kobe of some 180,000 people by February 1945. The air attacks resulted in further large evacuations from the city. There were small declines as a result of the 4 February, 11 May, and 6 August raids, and a large-scale exodus after each of the heavy incendiary attacks of 17 March and 5 June.

At the end of hostilities in August, the total population of Kobe was only 393,000, half of its pre-attack population, which had already been reduced by 18 percent from the 1940 figure. Of Kobe's pre-raid population, almost 1 percent was killed, 2 percent injured, 58 percent dehoused and 32 percent evacuated as a result of these 5 attacks. A handful of casualties occurred in Kobe on 24 July when a few B-29s dropped high-explosives on two plants, and from haphazard bombings by individual planes on other occasions.

¹ In addition, over 81,000 were dehoused in Nishinomiya and intervening suburbs as a result of these May and August attacks. Some 1,452 persons were killed and 2,270 were injured.

² Spill-over raids.

AIR RAID CASUALTIES IN KOBE



POPULATION IN KOBE CITY

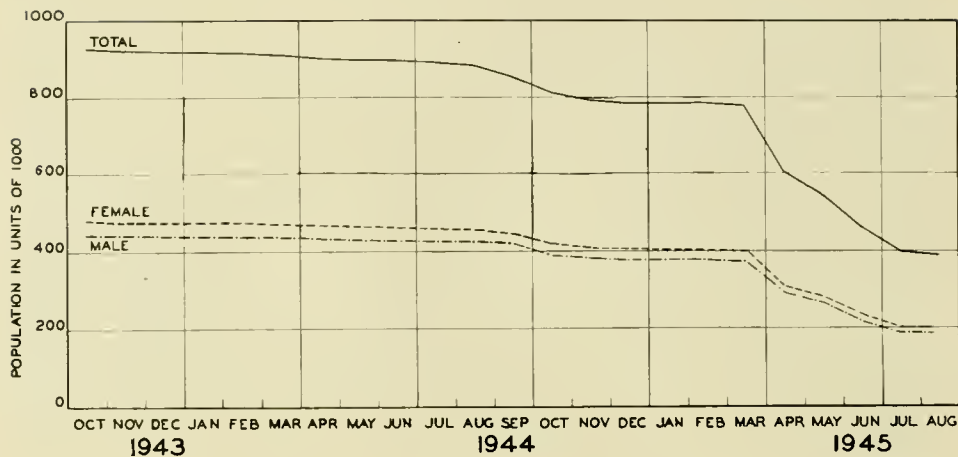


EXHIBIT 4

Civil Defense

To an even greater extent than in Osaka, defense measures in Kobe proved inadequate. Aside from shallow dugouts, practically no shelters were prepared in Kobe proper and after the first heavy raid, every air alert resulted in a mass rush into the near-by hills where tunnels accommodating a few thousand were constructed. In order to maintain factory discipline, it became necessary to delay the normal warning until it was certain that the Kobe district was the object of attack. Nevertheless, work stoppages due to alerts were serious. The following table summarizes official data on the number of alerts during the critical months for B-29 operations:

1945	Number of alerts
February	47
March	28
April	29
May	30
June	46
July	94
August	61

Prior to March 1945, the complacent attitude of the military authorities had been accepted by responsible officials in Kobe as well as by the general citizenry. Accordingly, there was no serious attempt to perfect requisite administrative arrangements or to train auxiliary civil defense groups. The lack of equipment served to dampen any enthusiasm that might have existed among some neighborhood leaders or public officials. For the average resident, civil defense meant blackout precautions and a concrete water container in front of his flimsy home.

It is true that some officials were gravely alarmed

at the implications of the February test raid in which almost 1,000 houses and several factories were destroyed or seriously damaged by our small gasoline-jel incendiaries. But in no sense was Kobe prepared for an attack of such magnitude as that of 17 March. Although Kobe was the last city to be visited in the March series of heavy incendiary raids against major cities, the previous week's attacks seemed to paralyze rather than to prepare the officials and inhabitants of Kobe for their ordeal.

In contrast to a rather complete breakdown of the fire-fighting and other emergency services in Kobe, both in March and again in the heavy June attack, defensive measures were relatively effective in a few of the city's large factories. Because a few plants dominated the industrial picture in Kobe, more vigorous measures were taken by regional officials to supply them with fire-fighting equipment, to train plant workers in defensive techniques and to carry out other protective measures. Thus a considerable part of the firebreaking program in Kobe was directed toward clearing around these key war plants and their more important subcontractors. The concentration and weight of attacks in Kobe were such that these plant protection measures were not highly successful, but there was a marked contrast between the relative adequacy of key industrial preparations and those for the city as a whole, although some reorganization of civil defense forces was attempted after March.

The ten-week lull between heavy attacks did not result in improvisation of effective defense methods. Because of the heavy losses of fire-fighting



PHOTO 7.—Some that escaped. Typical two-storied row-structures in congested residential district. Small workshop occupied ground floor in section to right. Only fire protection was provided by concrete water container and sand buckets.



PHOTO 8.—Air-raid shelters in central Kobe. Elevated railway provided far better protection than primitive shelters constructed in center parking strip along thoroughfare leading southwest from main station.

and other equipment in March, there was an even greater disposition among responsible individuals to acquiesce in face of the magnitude of the June attack and to do what they could to save themselves and their families.

Post-attack measures in Kobe were handicapped by the fact that Osaka was hit just prior to each heavy attack on Kobe. Accordingly, it was not possible to call upon facilities in Osaka or other near-by towns to care for those injured or de-housed in Kobe. Attempts were made to aid victims for 2 or 3 days, but thereafter they had to find shelter on their own initiative, with nothing but rail transportation provided by the government.

The post-raid food problem was especially serious in Kobe and forced the immediate evacuation of air-raid victims. Over 12,000 tons of rice—the complete stock of Kobe's emergency supplies—were destroyed in the March and June attacks. After the June attack, food distribution was completely disorganized and never got back to anything approaching normal. As a consequence, black market activities and absenteeism due to the necessity of foraging became extremely serious despite efforts to mitigate the problem at key factories by direct food distribution.

A report prepared for the Survey by the Hyogo prefectural police chief gives an authoritative and revealing picture of general conditions in Kobe during the raid period. The following excerpts outline the general civic breakdown and, incidentally, show how those directly responsible for coping with production and administrative problems felt about the local civil defense efforts. The report puts considerable emphasis on overconfidence as a minor but basic element in the local catastrophe.

When the Greater East Asia war broke out, the announcements of the naval battle off Hawaii, the naval battle off Malaya, the fall of Singapore, etc., told of great victories scored and of the lightning operations of the Imperial Army, so the people placed their full reliance on the military and the government. The subsequent announcements in rapid succession—especially in the various areas of the southern regions—gradually aroused flippant and frivolous attitudes and a tendency among the people on all steps of the social ladder to view the future optimistically, to take advantage of the munitions boom for selfish profit, and to profit without laboring—all these became conspicuously evident.

Not until the invasion of the Marianas in mid-1944 was civic training for air defense taken se-

riously in Kobe. The first B-29 bombings of northern Kyushu caused some panic evacuation at this time, but there was a further lull, despite highly exaggerated reports of raid damage, until 1945.

The first bombing in this prefecture was on 19 January 1945, on a part of Akashi city and in the Akashi factory of the Kawasaki Aircraft Company. Since Tokyo and Nagoya had been raided previously, a raid was expected sooner or later, and the people of Kobe had started evacuating personnel and dispersing clothing under the guidance of the prefecture and city. However, since the majority relied on the military on the one hand, and on the other did not know what an actual air raid was like, they were completely indifferent. There had been transportation difficulties, and evacuation activities were not brisk; civilian air defense which had been practiced over a period of years deteriorated, and there were loud voices of criticism.

However with the bombing of Akashi * * * the feeling that bombings were sure to come permeated the ranks of the general populace. They galvanized into action in the enforcement of civilian air defense training and the speedy establishment of civilian air defense facilities. * * * But, at the same time, the average worker found out that essential factories were the bombing targets, and began to seek shelter simultaneously with the sounding of the air defense alert, so that production efficiency avalanched to an extreme low. The reliance once placed on the military for air defense gradually changed into criticism; however, the majority still expected a "sure-victory" strategy on the part of the military and held firm to their belief that ultimate victory would be achieved. * * *

Not until March was the utter helplessness of the city revealed.

The raid of 19 January on Akashi, and even that of 4 February on Kobe served at first to enhance hostility. However, in the great air raid on 17 March the military proved totally impotent against the B-29s and the defense activities by the people against the incendiaries were so pathetic that their efforts only served to aggravate the increase in number of houses burned and in the number of dead and wounded. * * *

The psychological effects of such mass bombings concerned the police chief as much as did the physical damage.

Although the people fought well against positive incendiary attacks, the raids were so large-scale that the greater part of them became victims. Their homes were destroyed; the number of dead and injured was considerable; they experienced the horrible holocaust caused by the conflagrations following the bombs; they felt acutely the incompetence and helplessness of the civilian air defense, and the air defense fighting spirit collapsed completely and was replaced by fear; they hoped only for the safety of their persons and the security of their own homes and fortunes. Paralleling the group evacuation of students and school children, they resorted to evacuation that bordered



PHOTO 9.—Central Kobe. Brick schoolhouse occupied by municipal offices after the March attack—until June.



PHOTO 10.—Schoolgirls cleaning up debris and preparing gardens in western Kobe. Roof tiles are stacked along property lines. Gas and water pipes provide only evidence of former habitation in many districts.

on mass fleeing. * * * Finally, (in the June attack) the civilian air defense set-up collapsed completely. * * *

This breakdown of morale and local organization had profound effects on the city's industrial activity and economic life.

Due to the overwhelming strength and propaganda of the U.S.A.A.F., the fighting strength and strategy of our Army were considered hopeless. To the relentlessly mounting damage and their ever-menacing imminence was added the daily pressure on all phases of living—food, clothing and lodging. With the feeling of irritation of the populace in their daily living thus heightened to the extreme, there had been a wave of desertions by conscripted laborers and the turning of men and youths to delinquency, to the buying up of food and to other black market transactions. Of necessity, these invited a lowering of the attendance rate and of production efficiency in the factories and offices. Black market prices of the various commodities skyrocketed.

While the police chief's report was primarily concerned with industrial labor problems after the attacks, he also touched upon their broader political effects.

It was in April and May that the decisive struggle for the homeland was championed and coastal defense set-ups and coastal defense itself was activated. However, there was an inexorable element of danger involved in a "sure-victory" decisive battle for the homeland. With the intensity of air raids and the difficulties of daily living, fighting spirit completely vanished and an anti-war, anti-military trend appeared. Through the destruction of great cities the people's mind had revolted. Despite the propaganda by the government, the atomic-bombing of Hiroshima and the entrance of Soviet Russia into the war caused the permeation among all ranks of the people of a feeling of utter self-desperation and defeatism. The announcement of the end of the war on 15 August amazed and astonished the people, but there were no feelings on the part of the people to dare resist to the bitter end. Their minds were greatly agitated. They were terror-stricken.

These excerpts from the prefectural chief's report to the Survey epitomize the statements volunteered at some point by almost every competent observer in Kobe.

Effectiveness of Effort (Exhibit 5)

Comparative data on the physical effectiveness of incendiary attacks against the six major urban centers were presented in the Osaka report. Among these key cities, Kobe sustained the second highest ratio of damage—both with respect to industrial facilities and total building area—as computed from aerial photography by the Joint Target Group. Structural damage to industrial roof area was placed at 37 percent and over-all damage at 56 percent as compared with only 25 percent industrial damage in Osaka and 35 per-

cent over-all damage. Slightly more than half as much bomb tonnage was directed against the much more compact city of Kobe as against Osaka in urban attacks but the various air operations had rather different consequences in the two cities.

It will be recalled that from the standpoint of gross physical damage, the most effective urban attack on Osaka was the initial March operation but that most of the damage to larger factories did not occur until the three heavy urban attacks in June. Even after three attacks, one large district of relatively dense industrial and residential occupancy was untouched in Osaka. Elsewhere in that city, remaining installations were scattered and of secondary importance, except for two industrial concentrations that were the object of subsequent precision attacks. Direct damage to industrial facilities in Osaka was relatively lighter and in large part did not occur until June, and at least one industrial-residential target area of considerable importance in northwest Osaka was never attacked.

The impact of air operations on Kobe was different in several respects. Direct damage to key factories was much heavier and was initiated early in the air-attack period. Moreover, at many plants damage was extended in successive attacks. At the end of the campaign, all profitable target areas in Kobe had been heavily damaged. Kobe industrial facilities were seriously crippled at the beginning of February 1945 in the first trial incendiary raid against Japanese urban industrial concentrations. With a relatively slight expenditure of effort, this experimental mission forced an immediate reduction in much of the city's priority end-product output, but caused very little non-industrial damage. Two heavy incendiary attacks in March and April extended this plant damage and also achieved a level of general urban destruction at least as disruptive as that occurring in Osaka. Both in dimensions of time and of direct plant damage, the Kobe attacks were considerably ahead of the operations against Osaka and total casualties in Kobe were proportionately twice as heavy, although in both cities they were relatively light as compared with Tokyo, Hiroshima and Nagasaki.

Exhibit 5 presents in graphical and tabular form the essential information relating physical damage to air effort for the three urban attacks on Kobe. The wide range in tonnage effectiveness is clearly illustrated, as is the relative importance

EFFECTIVENESS OF EFFORT KOBE URBAN ATTACKS

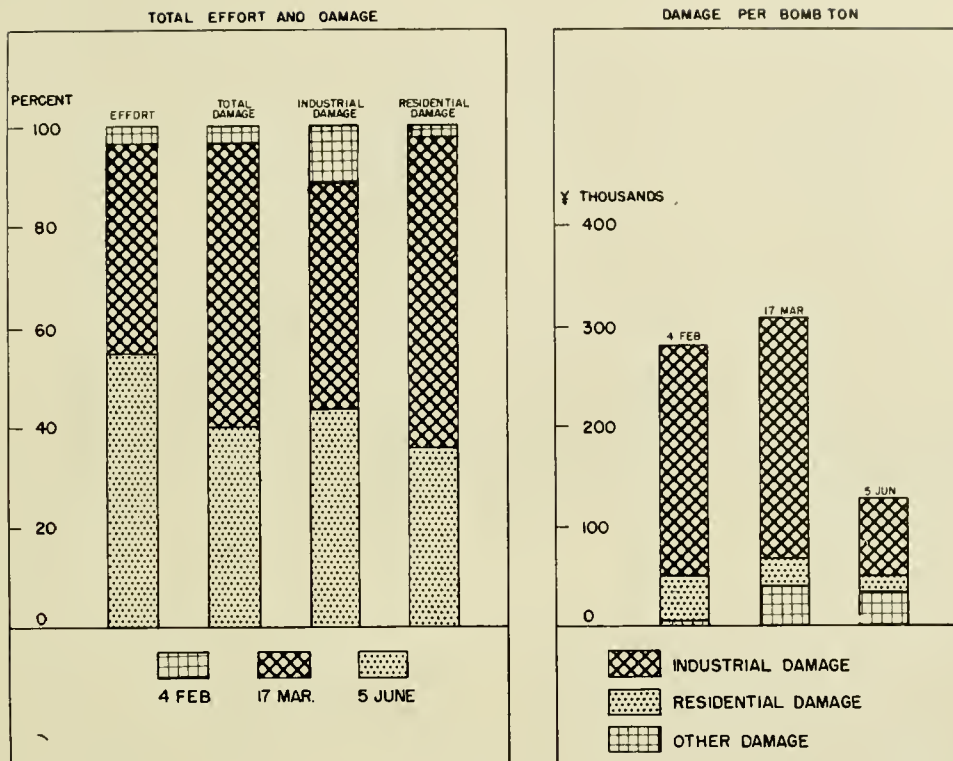


EXHIBIT - 5

of the initial attack as far as industrial damage is concerned.

The 4 February trial of light incendiaries against major factories concentrated in the southwest section of Kobe proved to be remarkably effective considering the weight of attack. Of 173 tons released over Kobe in this first effort—as compared with nearly 2,400 tons in the March attack and over 3,000 tons on 5 June—indications are that a considerable proportion fell in the water bordering the target area. Nevertheless industrial damage was very heavy.

Of the dozen most important factories in Kobe, which accounted for over 90 percent of the city's essential war activity, one was almost completely destroyed, two were severely damaged and three others were lightly damaged. As a result of this relatively light effort, February operations were reduced 40 to 60 percent at one of the city's two major shipyards and at the two large producers of electrical equipment and rolling stock, and local output of fabric and synthetic rubber for Kobe's important rubber products industry was perma-

nently wiped out. In addition, several food-processing and woodworking plants were destroyed.

After a six weeks interval, the heavy March attack caused further damage at all key plants previously hit. With one exception, this operation also severely damaged all other important factories in the western and central parts of the city. Finally, over 30 percent of all inhabitants were deboused and the level of general urban destruction was relatively even more critical to the life of the city than that achieved in the Osaka attack of considerably less weight four nights earlier. However, the gross area burned in Kobe was less than half as great.

As in the case of Osaka, Kobe thereafter had a ten week respite from direct attack, even though some residential destruction was caused by spill-over from the near-by precision attack of 11 May. During this period, certain damaged factories managed to achieve considerable recovery despite the general widespread absenteeism. As in the case of Osaka, it is clear that a shorter interval



PHOTO 11.—Western Kobe. Looking northwest toward upland outskirts near edge of area destroyed in June incendiary attack. Group of small machine shops in foreground was completely burned out and scrap equipment was only partially removed. Modern fire tower was one of few concrete structures in photo where building contents were not destroyed.

between major attacks on Kobe would have enhanced their cumulative effectiveness.

When the third Kobe attack did come, it proved to be the heaviest mounted against any objective in central Japan. The area of damage was extended considerably in the eastern section of the city and also covered sections in the western part. All four of Kobe's principal war factories thus far untouched now sustained damage and most of the others were hit again. A considerably larger area was burned over than in the March attack but gross building damage was somewhat lower when compared with weight of effort because of lower density in some districts affected and because many incendiaries landed in previously destroyed areas. With this 5 June attack, total urban destruction in Kobe reached a far higher ratio than that ultimately achieved against Osaka or any other major city except Yokohama. This attack affected residential districts already flooded with victims of earlier damage and also burned many emergency barracks that had been set up for factory workers near plant sites. As a consequence, dislocation was intensified and industrial absenteeism became far more critical. In the three urban attacks, all of Kobe's key factories sustained damage—most of them more than

once. After 5 June, Kobe was correctly dismissed as a profitable target either for incendiary attacks or for precision high-explosive operations.

UTILITIES AND PUBLIC SERVICES

Despite the relatively heavier damage in Kobe, local and prefectural administrative services did not appear to be as severely disorganized as in Osaka. The city was relatively easier to administer, both on account of its smaller size and its highly integrated industrial structure. Damage to public buildings and official facilities was very great—124 out of 234 structures being destroyed and 34 others damaged—but the two main prefectural buildings were successfully preserved. A number of modern fireproof buildings were available as emergency quarters for other burned-out offices that could not be moved into the prefectural buildings. Kobe's school buildings and comparable structures suffered relatively greater fire damage than Osaka's, however. As discussed above, the breakdown of machinery for welfare, civil defense, and food distribution was very serious and contributed much to the collapse of economic activity after area attacks. Along with the widespread destruction of food stocks, clothing and housing, the destruction of public offices and rec-



PHOTO 12.—Central business district in Kobe. Strike photo of 5 June 1945. This district escaped serious damage in March, but June casualties included all but a few major business offices. Note lighters clustered at wharves. Few of the large harbor transit sheds were destroyed but there was extensive fire damage to factory warehouses.



PHOTO 13.—Gaunt skeleton of factories and warehouses east of the central business district.

ords played an important part in this breakdown.

Among public utilities, damage to the power and water systems was extensive but had little economic effect. As in Osaka, power lines were destroyed in those parts of the city which themselves were burned over and had little need for electricity. The concentration of industry in large plant units made it easier to restore damaged circuits to the plant boundaries although repairs to electrical facilities within plants constituted a serious obstacle to resumption of activity. Use of power fell, then, for reasons other than damage to the public utility system. Water shortage was not serious and had its principal effect on the inhabitants rather than directly on production. Damage to a pumping station controlling 20 percent of the system's capacity, along with the widespread post-raid leakage, may have been responsible for a typhoid epidemic which accelerated absenteeism during late June and July.

Utility gas service was maintained despite damage, but only at a heavy price. Even more than in Osaka, Kobe industry was feeling the strain of coal shortages and decline in receipts of basic materials at the time air attacks began. In part, these problems reflected administrative decisions to reallocate available supplies but transportation difficulties were a major factor—especially after April 1945, when mining of the Inland Sea gravely

reduced waterborne shipments of bulk commodities and placed new burdens on the railroads. It is in this context that the heavy losses of utility gas in Kobe from raid-induced leakage takes on particular importance. Gas was the chief source of fuel for many smaller industries and also had important uses in most of Kobe's large plants. The latter could substitute use of coal in some operations but small components plants were usually dependent upon a regular supply of gas. Meeting essential gas requirements despite leakage losses called for allocation of a relatively large share of Kobe's dwindling coal supplies after the March urban attack. Thus there was a close relation between the effect of area attacks on this utility and the fuel and transport problems.

The breakdown of internal transport in Kobe reached formidable proportions during the period of air attacks. The critical problem here was the movement of people, not freight. Local movement of goods had been far less extensive than in Osaka and it was not as seriously affected by the attacks. The few large plant units responsible for most of the city's war production had direct or convenient access to rail and water transport. Local subcontracting was only important for a few of these plants and subcontractors were not as widely dispersed. Plant damage and absenteeism gravely reduced post-attack activity in any

event and only a modest dispersal program was attempted. Finally, Kobe authorities were allocated additional trucking facilities after the March and June attacks to keep essential items moving to and from key plants and there was relatively less diversion of such facilities into illegal channels. Thus, despite heavy damage to vehicles, maintenance difficulties and fuel stringency, essential activity in Kobe was not directly curtailed to any appreciable extent by delays in the local movement of goods.

There was a severe disruption of local mass transportation in Kobe which had much to do with post-raid absenteeism and the failure of local industry to recover from the incendiary attacks. On the average, Kobe workers employed in large units lived relatively closer to their jobs than did those in Osaka. But the two urban attacks paralyzed most of the street railway system and at the same time forced workers to seek lodging at much greater distances from the factories where they were employed. After the March attack, many streetcar routes were abandoned, as was the subway system, and others were reduced to stub lines. After 5 June, the system was virtually inoperative for weeks and never recovered significantly, since most equipment had been destroyed or damaged. In general, Kobe citizens did their local traveling—to work or in search of food or shelter—on foot. Even bicycles were scarce and only a few privileged officials had cars in operating condition or the fuel to power them.

Closely related to the collapse of mass transportation facilities in its effect on industrial activity was the almost total paralysis of the telephone system after the March attack. Despite vigorous efforts, it proved to be impossible to restore either local or long-distance service except for a handful of administrative offices. Some circuits were repaired in the lull between area attacks but were destroyed again in June. Telegraph facilities were not as seriously affected but traffic declined severely.

It is difficult to assess the economic effects, direct and indirect, of all this area attack damage to public services and utilities. The available data seems to confirm local testimony that such disruption did much to undermine Kobe's capacity for continued resistance. Kobe was the administrative center for Hyogo prefecture, which included such important war industry towns as Himeji, Akashi and Amagasaki. Regional as well as local admin-

istration was thus seriously handicapped by the breakdown in local communications and transportation. Interurban transportation was not seriously interrupted but with mail deliveries very slow and unreliable and practically all telephones inoperative, the time required to transact business was increased enormously. After mid-March 1945, it became necessary to send couriers or call meetings in order to exchange information or implement decisions. The same difficulties, of course, faced business and government.

Aside from this growing administrative paralysis, local industrial activity was also profoundly affected by the disruption of the city's internal transportation facilities. Here, the critical factor was not the decline in local freight movement but the interruption of streetcar and subway services, which contributed directly to worker absenteeism. Damage to other utilities—gas, water and electricity—was extensive, but with minor exceptions did not have an immediate effect upon essential economic activity. However, raid-induced leakage enforced disproportionately large allocations of coal for gas production during the raid period and thus put added pressure on available facilities for moving fuel and other bulk commodities into the city. Internal transport, public services and utilities were all severely disrupted as a consequence of the urban attacks. Among these, the collapse of streetcar, subway and telephone services proved to be the most serious obstacles to recovery.

Electric Power (Exhibit 6)

Kobe was an integral part of the regional power system serving Osaka and the discussion of power supply and rationing in connection with that city is equally applicable here. The sharp decline in industrial activity in Kobe after the March incendiary attack helped create the large unused surplus of electric power subsequently prevailing in the region. To prevent diversion of resources to unessential use, rationing of power was continued but Kobe plants no longer had to stagger periods of maximum electricity consumption. With all thermal generating stations shut down, the region's coal position was eased, permitting larger allocations to basic industry.

At the end of 1944, use of power for industrial purposes in Kobe was roughly 10 percent below the peak or level reached in November 1943. This decline, which in part reflected curtailment of local steel production during the summer of 1944,

ELECTRIC POWER CONSUMPTION KOBE CITY

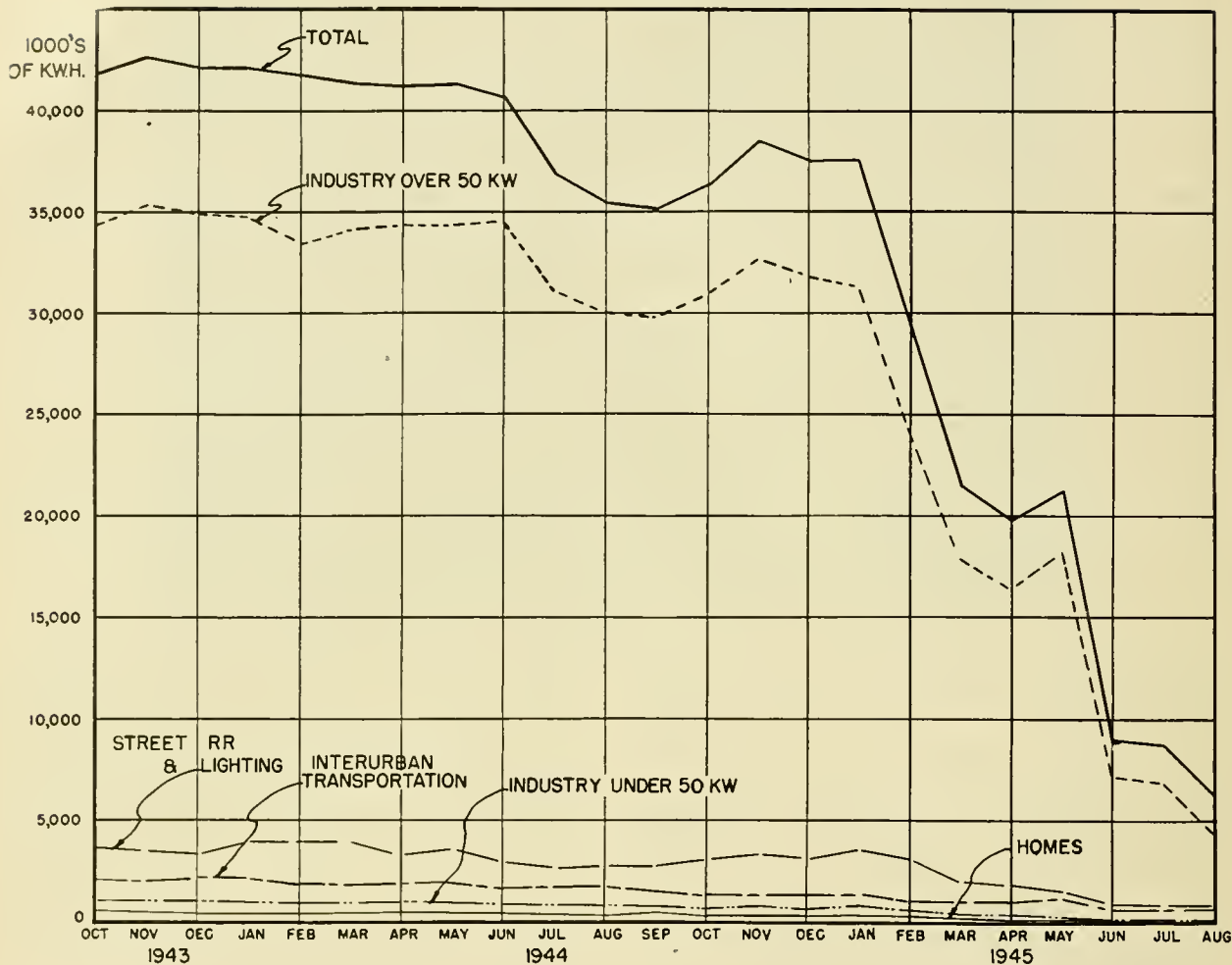


EXHIBIT 6

compared with an all-time peak of industrial activity and power consumption attained in Osaka during December 1944. In each city, however, there had been a spurt in power use along with the production drive at the end of 1944 and a return from this winter peak to previous lower levels during January 1945. In Kobe, most of the unprecedented February drop was caused by damage to three key plants in the trial incendiary attack of that month. After the heavy urban raids in March and June, consumption fell as drastically in Kobe as in Osaka. There was some slight recovery in May but none after the June attack.

Exhibit 6 gives a breakdown by major power-consuming categories for Kobe. The overwhelming importance of large-scale industry is obvious. Street railway and lighting consumption, which consisted mainly of street railway use, during this

period dropped heavily but interurban traffic was not seriously curtailed. "Industry under 50 KW" includes all other commercial users and, like domestic consumption, was rigorously restricted.

There was extensive damage to power facilities in Kobe but this did not interfere with industrial activity to any appreciable extent. Distribution circuits serving the large factories were repaired promptly after attacks. All important substations were located in the hills back of the city and escaped damage. Kobe's one generating station was an old stand-by plant and all power was being supplied from the regional network. But as in Osaka, transformers and other electrical equipment located within plant boundaries was often extensively damaged and difficult to repair or replace. Although ample electric power was available, the equipment that should have been using it in many factories was frequently idle for long

GAS PRODUCTION & CONSUMPTION KOBE

SOURCE: KOBE GAS COMPANY

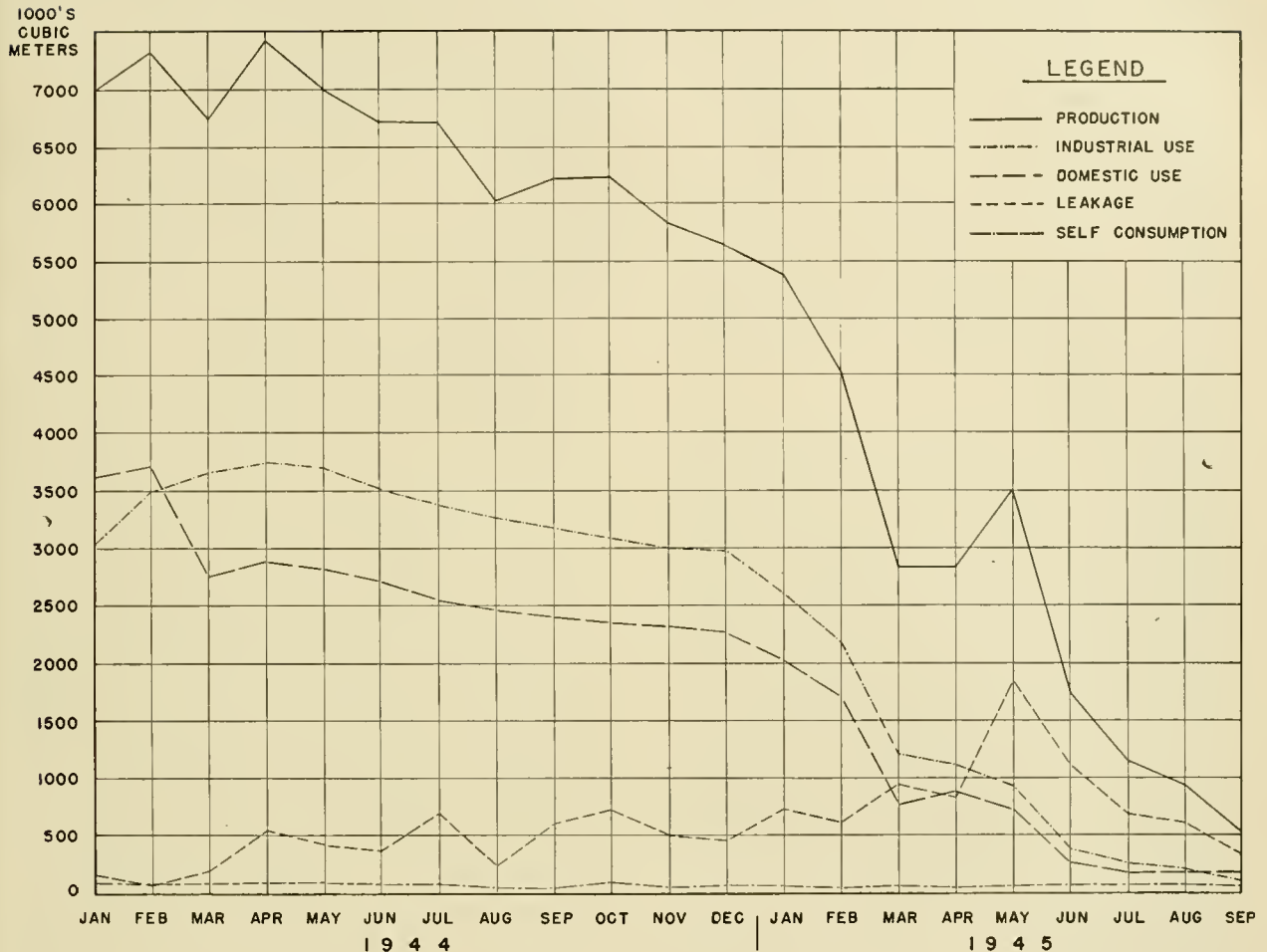


EXHIBIT 7

periods after attacks because of inability to cope with incendiary damage to transformers, switchboards and other power facilities located within the plants.

Gas (Exhibit 7)

Gas production in Kobe was limited, as it was in Osaka, by shortages of coal and was not reduced after area attacks merely as a result of lowered industrial demand, as was the case in electric power. With one exception, there was no significant damage to Kobe's gas generating and distributing facilities, in contrast to the fairly extensive damage in Osaka. There was widespread leakage from local mains and individual outlets as a direct result of urban raid damage, however.

Destruction of a gas holder and substation in the eastern suburbs, in May, did hinder subsequent activity of some factories in that district. The more strict rationing system instituted early in 1944 was thus continued after March 1945 in the effort to make up for leakage and declining coal receipts, even though industrial requirements were severely reduced because of air attacks.

Exhibit 7 presents output, use and leakage data for Kobe city and the suburbs directly east. From March 1944 until the end of the war, well over half the available gas was consumed by the city's large factories, leaving 40 to 45 percent for small plants and for domestic use. There was little change in this ratio despite ruthless curtailment of domestic use and a fall in total production

from a peak of 7.4 million cubic meters in April 1944 to less than 1 million in July 1945, indicating the relatively heavy reliance of industry—especially light industry—on gas for fuel. Although many small plants, using gas exclusively, were burned out in area attacks, most of those remaining in operation were making components for military end-products. Thus, despite the waste of fuel energy involved, the gas company continued to have a major claim on the city's dwindling coal supplies. Moreover, coal for gas production declined in quality, as deliveries from Hokkaido were cut off and low-grade Kyushu coal had to be increasingly substituted. Thus even greater tonnage was required to meet essential needs, despite the leakage.

Before the March raid, leakage was approximately 10 percent of production—largely due to firebreaking. Consumption had been progressively reduced, especially in certain large plants where fuel substitution was feasible. February and March damage reduced consumption substantially. After the March attack service could be cut off completely from certain districts in which all essential consumers were burned out, but despite vigorous efforts, leakage for March rose to more than 35 percent of output and after the 11 May precision attack which hit a substation in eastern Kobe, to over 50 percent. Before all this damage could be repaired, the June incendiary raid again boosted the leakage ratio to more than 60 percent of remaining production. As in Osaka, labor shortages delayed the repair of damaged outlets and were a substantial contributing factor in proloing the effect of the attacks. Except for a few components plants in the eastern suburbs, there was no evidence that gas shortage was itself the direct cause of serious production delays. But in order to keep the gas system operating despite leakage, it was necessary to use an inordinate share of available coal supplies.

Water (Exhibit 8)

Raid-induced damage to Kobe's water system had very little effect on industry or even upon essential domestic consumption. Extensive leakage caused by the raids was offset by increased deliveries and by a fall in demand. Kobe's water supply was furnished by three reservoirs which tapped streams in the mountains north and north-east of the city, and from a connection with the Osaka system and the Yodo river northeast of

Osaka. Water flowed into Kobe mains from the three reservoirs by gravity, but stand-by pumps were available for use in maintaining pressure in the higher residential districts. In addition, there was a pumping station in the eastern suburbs to handle the Osaka connection, which supplied 20 percent of Kobe's wartime water requirements.

Damage from the heavy area raids resulted in extensive leakage, caused by a few broken mains and thousands of burned-off household outlets. Firebreaking also contributed somewhat to overall leakage, which rose from 30 percent of total water output in February 1945 to almost 60 percent in April and 80 percent in June. A third of the usable stand-by distribution pumps were destroyed by fire raids, and in the 5 June attack the pumping plant essential to operation of the Osaka connection was put out of action. Consequently, adequate pressure could not always be maintained in the higher residential districts after that date.

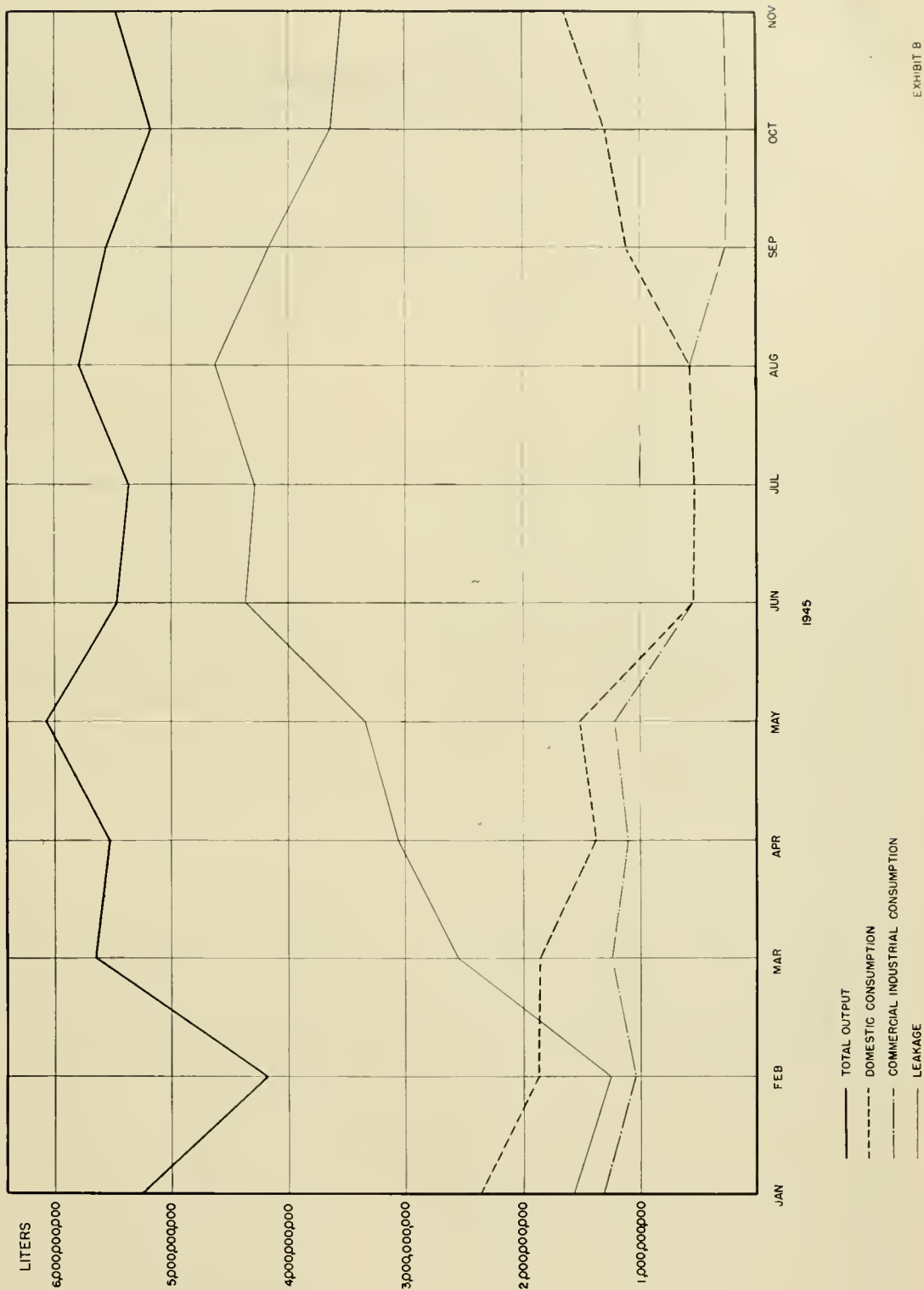
In general, water shortage was not a serious problem to industry. Large plants were all close to the harbor and many had their own wells, in addition to their connection with the city system. Industrial supply was not curtailed until June. After that, the reduced consumption permitted was generally adequate for the prevailing level of industrial production. The estimated fall in domestic consumption from March to July about paralleled the fall in population. There was a rise of typhoid cases in Kobe to epidemic proportions after the June attack and local officials were of the opinion that this may have resulted from damage and subsequent pollution of the water system, in certain districts and use of old private wells in residential sections where public supply was curtailed or temporarily interrupted.

Local Transport (Exhibit 9)

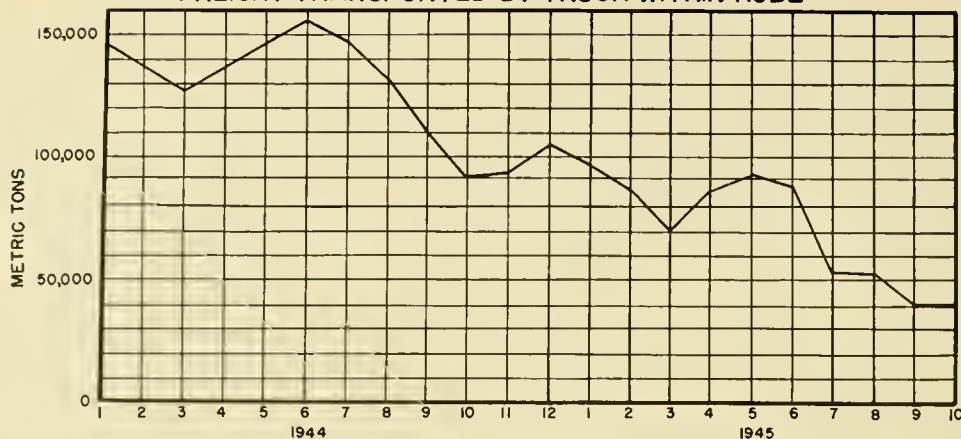
Disruption of local transportation was one of the most important consequences of the Kobe area raids. Because most of Kobe's industry was concentrated in a few large units, the effect on essential freight was less generally felt than in Osaka. Circulation of people was seriously hampered, however. The city's well-developed streetcar system as well as its truck, bus and auto facilities were under strain before the raids. Repair parts and skilled mechanics were equally scarce and all motor vehicles were restricted on fuel. As was the case in Osaka, the raids aggravated these shortages and at the same time destroyed many vehicles

KOBE CITY

WATER OUTPUT & DISTRIBUTION



FREIGHT TRANSPORTED BY TRUCK WITHIN KOBE



SOURCE: TRANSPORTATION SECTION KOBE POLICE BUREAU

EXHIBIT 9

and most of the repair shops.

The March raid heavily damaged 95 percent of Kobe's streetcar repair facilities and burned about 120 cars. An additional 100 cars were destroyed or damaged in June. The daily average of operating cars had fallen from 204 to 192 in the year before the 11 March raid. In March this daily rate fell to 92, recovered to 112 in May, and then fell to 29 in June and July. Many of these remaining cars were antiquated. Prior to attack, the number of passengers carried fell from an average of 19 million per month to 10 million in March and 2.5 million in June 1945. Kobe's one subway, although undamaged, was abandoned in March as part of the program for dispersing essential industry. Statistics on buses, which were relatively unimportant, show a steady decline in the average number operating during 1944 and their practical disappearance after March 1945. The deterioration of all these facilities for transporting workers to and from the large factories contributed greater to industrial absenteeism and general labor demoralization during the rest of the war. In effect, most of the average citizen's movement within the city after March was on foot.

About 700 trucks were destroyed by incendiary damage in March and June. Even with the decreased number of vehicles, Japanese officials still considered the shortage of repair facilities and skilled labor the greatest factor limiting trucking activity. But efforts to maintain priority traffic were more successful here than in Osaka. Additional trucks were assigned from governmental truck pools and repair work was undertaken by

the local railway shops. Freight movement by trucks inside Kobe city had declined from an all-time peak of 155,000 tons in June 1944 to 97,000 tons in January 1945. There was a further drop to 87,000 tons in February, the month of the first attack which seriously damaged Mitsubishi Electric, Kobe's largest employer of subcontractors. After a low of 70,000 tons in March, when the first heavy area attack occurred, there was subsequent recovery in local trucking of freight to 93,000 tons in May, as outside vehicles were brought in, and to 90,000 tons in June despite another heavy attack. But tonnage carried locally fell to 55,000 tons in July, mainly in response to reduced production. The over-all scarcity and progressive deterioration of trucks aggravated the shortage of materials and components for some producers and made adjustment to raid damage through repair and dispersal almost impossible even for some top-priority plants. There was a consistent and fairly successful effort, however, to equalize allocation of available trucking facilities for movement of freight within the city and for traffic to and from Osaka and near-by suburbs. Leakage of available trucking into illegal channels did not become extensive, as was the case in Osaka, mainly because a few plant units and agencies were directly accountable for all trucking activity.

The raids destroyed about 200 operable automobiles, and fuel as well as repair problems continued to limit the use of those remaining. This vehicle shortage contributed much to the general breakdown of governmental and business administration in Kobe, and was especially serious in

TOTAL TELEGRAMS KOBE 1945

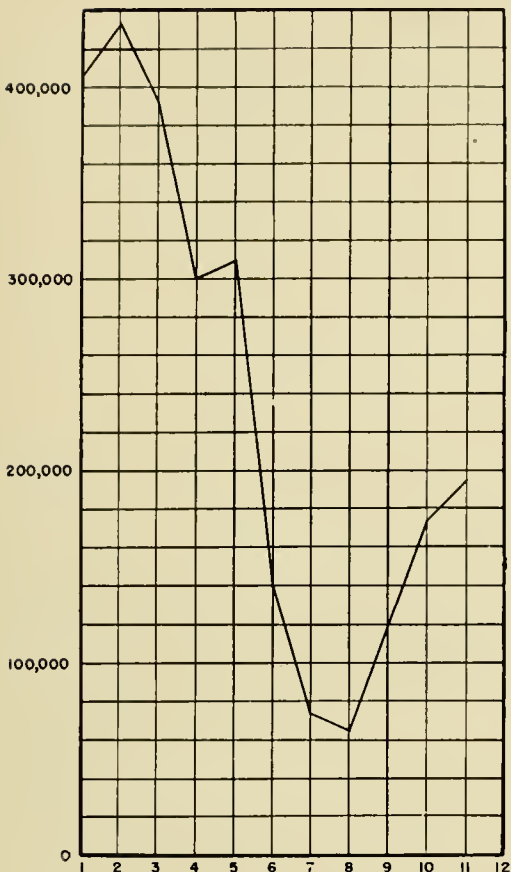


EXHIBIT 10

view of the interruption to telephone and public transport services.

Communications (Exhibit 10)

The disruption of mail, telephone, and telegraph services in Kobe by the March and June area attacks was even more extensive than in Osaka and contributed substantially to the failure of industrial recovery. Like other utilities, communication services were under strain before the major raids as a result of shortages of maintenance supplies and labor. The area raids caused widespread damage to poles, cables and other equipment and destroyed the central telephone exchange. At the same time they intensified shortages of material and labor and delayed what little restoration of service would have been feasible.

Local telephone traffic reached peak levels at the beginning of March 1945, but after the mid-month attack which destroyed the central exchange the system was so disrupted that the average num-

ber of local calls never again exceeded 6 percent of the pre-raided figure. There was no recovery during the 11-week lull between urban attacks, and after 5 June local telephone traffic fell to less than 1 percent of the pre-March figure. The March raid had an even more drastic effect on long distance telephone services for Kobe. After the March raid, which also destroyed most of the long-distance switchboard facilities, calls were a mere fraction of 1 percent of pre-raided totals and never again reached 2 percent of earlier figures. This almost complete cessation of telephone services proved a tremendous obstacle to communication necessary for industry and government—both locally and throughout the region—coming as it did at the same time that internal transportation facilities were so greatly reduced.

As in Osaka, the disruption of telephone facilities by far exceeded that of telegraph services. The decline in traffic in the latter was much greater in June than after the March raid, partly because of area attacks and damage to facilities elsewhere, but principally reflecting the local collapse of activity. Telegraph traffic had held up relatively well in Kobe before the urban attacks, but after a February 1945 peak of 432,000 telegrams, traffic fell slightly in March and heavily in June. During the last full month of the war, only 74,000 telegrams were handled—about 17 percent of the February total. Local damage to telegraph equipment was probably less important from June than reduced demand.

TRANSPORTATION AND BASIC MATERIALS

Prior to the war, Kobe had been important as a heavy industrial center and also as Japan's chief overseas port. Only a fraction of this maritime activity was related to local manufacturing. With the collapse of foreign commerce, it was therefore inevitable that the city's ample maritime facilities should operate at reduced tempo. After reaching a wartime peak in May 1943, port activity began to decline at even a faster rate than did total overseas military shipments and bulk commodity imports, as shipping was diverted to points of ultimate destination or to safer routes. Nevertheless, most of the tonnage handled through Kobe harbor until late 1944 continued to represent transshipment of freight moving to or from other points in the region. Thus the 90 percent decline from peak wartime levels of port activity had

little direct effect on industrial activity in Kobe itself, except to make additional labor available for local factories. Accordingly, this discussion of Kobe's port and transportation facilities during the period of air attacks is chiefly concerned with that residual volume of traffic which was related to local industry—in particular to the supply of fuel and basic materials for the city's large factories. Because of the emphasis in Kobe on shipbuilding and related heavy industry requiring large amounts of coal, iron and steel, examination of bulk commodity deliveries and inventories is essential to assessment of causes for the industrial decline in Kobe during the period of air attacks.

In contrast to the situation at Osaka, where port activity continued at a relatively high level into 1945, the urban attacks on Kobe had little direct effect upon harbor functions. Several Kobe factories had their own facilities for direct handling of bulk materials. With such extensive modern facilities available, other freight transshipment problems were not serious and there was little destruction of goods in port warehouses. Temporary delays occurred in handling freight after the March attack but these were easily made up when dock workers returned to their posts. The April decline in shipments out of Kobe primarily reflected the fall in local industrial output due to previous urban attacks. On the other hand, unloadings at Kobe increased during April when every effort was made to sustain local bulk materials requirements, but these dropped more than 70 percent in May as Inland Sea mining became effective. Subsequent waterborne receipts were less than one-sixth of the February level and stopped almost completely in August when Kobe harbor was itself mined.

Rail facilities likewise suffered little from absenteeism and damage after the Kobe area attacks. Interurban passenger service was maintained and through freight movement was held at top levels until July 1945. When mining restricted Inland Sea shipping, the railway system in this region was able to take over much of the priority freight movements formerly handled by water and a considerable part of the bulk commodity movements. The Osaka report deals with transport and commodity movements for the region as a whole. Only after March 1945 did rail deliveries of coal begin to decline in Kobe and not until June did shipments of finished products drop. In the case of coal, reallocation of declining supplies was the

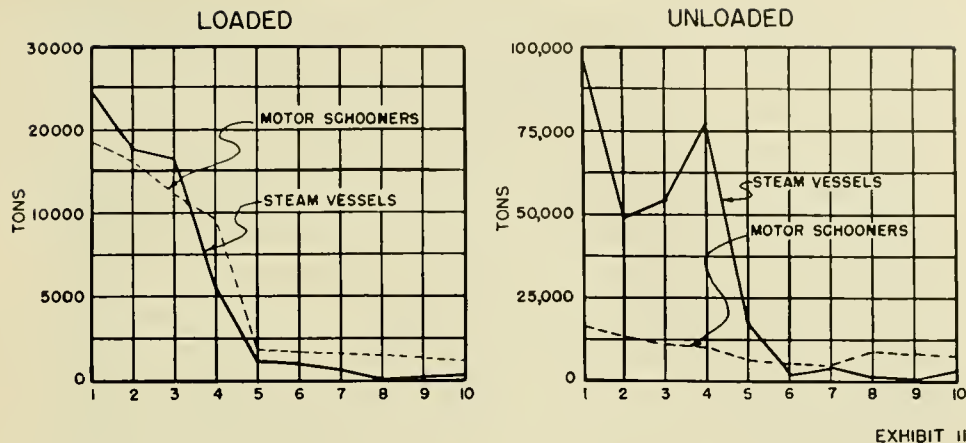
primary cause—not transport difficulties. In the latter case, decline in local production, not availability of rail facilities, was responsible. In general, there were no local freight handling delays. The distances in Kobe between factories and freight stations was much less than in Osaka, and most production was concentrated in large plants located on the waterfront and having their own direct rail connections. Thus, despite heavy urban attacks, there was less reason for disruption of essential rail freight activity due to internal transport breakdowns such as occurred in Osaka. Furthermore, Kobe factories did not burden the rail system with emergency dispersal efforts. As previously discussed, sufficient trucking facilities were made available in Kobe to prevent freight station congestion and there was no evidence of serious delays in car utilization.

Rail facilities at Kobe were under heavy pressure to maintain a large volume of through traffic during the period of air attacks. This traffic included military movements as well as food and priority industrial items. Perhaps of greatest importance though, was the distribution of the largest possible amount of coal from mines in Kyushu and western Honshu to the main productive centers of central Japan and to the various division points of the rail system. In order to prevent a collapse of the rail facilities themselves, much of the capacity of the Sanyo line, running from Shimonoseki to Kobe, had to be devoted to this essential item, especially after B-29 mining of the Inland Sea cut off most water shipments. Pressure on already overburdened maintenance facilities were belatedly given top priority in allocations of materials, but the June urban attack on Kobe heavily damaged the region's main railway shops. The important Kawasaki railway equipment plant in Kobe was also practically inoperative as a result of previous urban damage and efforts to utilize it for repair work proved abortive. By this time all other railway repair facilities in central Japan were also damaged. If the war had continued beyond August, it is indicated that the cumulative effects of this breakdown in the maintenance system would have seriously reduced the coal-carrying capacity of the critically important lines running east and west through Kobe.

The decline in bulk movements of industrial raw materials to Kobe necessarily had its primary effect on local steel fabricating plants associated with shipbuilding and other heavy industry. The

SHIP FREIGHT KOBE 1945

(SOURCE KOBE MARITIME BUREAU)



decline in receipts of coal and iron at Kobe during late 1944 and early 1945 was, in the first instance, the result of over-all administrative decisions to conserve transport facilities and available supplies by concentrating iron and steel output elsewhere—not the result of actual inability to meet scheduled deliveries. In May 1945, however, when the railways had to take over practically all east-west freight movement, there began a progressive decline in bulk commodity receipts that would have had serious effects on end-product industrial activity in Kobe if damage resulting from the February and March area attacks had not already forced output well below the basic materials ceiling. Receipts of materials continued, however, at reduced levels. Thus it was that Kobe ended the war with inventories of basic materials in most key end-product plants sufficient for 8 to 10 months' production. Coal inventories, however, had been on a hand-to-mouth basis in most large plants for most of late 1944 and 1945. Some minor reallocation of coal supplies might have been undertaken in the spring of 1945, had transport facilities and administrative flexibility permitted, but there were no large unused stocks of coal in Kobe such as existed in nearby Amagasaki. In general, the available supplies were handled intelligently from the standpoint of maintaining maximum activity in end-product output.

Shipping and Harbor Facilities (Exhibit 11)

Although Kobe was the most important prewar port in Japan, by 1943 tonnage handled there was much less than in Osaka. The flow of maritime traffic through Kobe reached a wartime peak of 1,588,000 tons in May 1943. This figure had fallen

to 448,000 tons by May 1944, the month when the total traffic handled at Osaka reached an all-time peak of 1,322,000 tons. By January 1945 maritime tonnage handled at Kobe was down to 154,341 tons or less than 10 percent of the 1943 peak. Tonnage handled at Osaka that month was 723,000 or well over half of the peak level.

It will be noted in Exhibit 11, which presents data on all tonnage except coal handled through Kobe harbor during 1945, that very little was being received by motor schooner (and lighter) prior to attacks (Exhibit 14 gives data on waterborne coal movements.). Most of these schooner receipts represented foodstuffs, which continued to come in at reduced rate throughout the attack period. Loadings by lighter and schooner were relatively heavier—19,000 tons in January 1945 as against 15,000 tons received—representing principally shipments of manufactured items, destined for Amagasaki, Osaka and other near-by points. Large vessels brought in basic materials required by Kobe factories and some few transshipment items but outgoing shipments by large vessel—representing military supplies and local manufactures—were less than a third of receipts. The following table summarizes tonnage data presented in Exhibit 11.

	Unloading	Loadings	Total
	Tons	Tons	Tons
February	64,445	33,377	97,822
March	66,805	29,111	95,916
April	87,992	15,232	103,224
May	27,983	6,179	33,262
June	7,102	5,739	12,697
July	9,206	4,431	13,697
August	9,638	3,243	12,881

Source: Kobe maritime bureau, December 1945.

As in Osaka, the principal reason for the decline up to May 1945 was the general shortage of shipping, coupled with the allocation of available tonnage to other and safer ports. The precipitous drop in May 1945 coincided with the aerial mining of this section of the Inland Sea beginning on 3 May.

The effect of the urban raids on port activity was not serious. In causing some physical damage to harbor facilities and in aggravating harbor troubles, they caused temporary delays which somewhat reduced the effectiveness of the shipping available. Operable lighters available at Kobe declined to a fraction of the former number, through damage and diversion to Osaka. But even when operating at capacity Kobe harbor had been able to handle over 5 percent of all freight at modern deep-water wharves. As a result, the shortage of lighters was far less important, with such a low operating level, than at Osaka. The following statistics from maritime bureau records indicate for selected months the relative delay from lighterage deficiencies and from labor problems as against delays due to failure of scheduled rail shipments to arrive and other factors not related to port efficiency.

	Total delays in loading and unloading	Delays due to lighter shortage	Delays due to labor shortage
	<i>Ship days</i>	<i>Ship days</i>	<i>Ship days</i>
July 1944-----	90	15	48
Oct 1944-----	200	17	34
Feb 1944-----	109	23	40
Apr 1944-----	90	29	45

During this period, tonnage handled monthly fell from 400 to 100 thousand tons. After April 1945, the tonnage decline was so great as to remove manpower and labor problems from consideration. A large number of Kobe's longshoremen were shifted to north coast ports.

Physical damage from the area raids included several large wharves and some equipment. Among virtually destroyed mechanical facilities were 5 of the port's 107 cranes, its one loading escalator, 3 pneumatic elevators, and 2 conveyors. However, since the port was operating so far below capacity during 1945, this damage was not functionally significant. Most of the extensive modern warehouse facilities constructed for Kobe's prewar use as a principal cotton forwarding port remained intact. These were never wholly uti-

lized during the war, and as the war progressed, they were almost emptied of goods. Thus in contrast to the experience at Osaka, relatively little in the way of materials or finished items was destroyed in the large port warehouses. However, Kobe warehouse losses were very extensive outside the harbor area. Such destruction occurred mainly to storage at factory sites and to food stocks dispersed throughout the city.

Railway Facilities

The transportation section of the Osaka resort discusses the general status of rail facilities and service during the attack period for the whole region, including Kobe. There were no sustained interruptions of interurban passenger service eastward to Osaka and Kyoto and westward to Akashi and Himeji. Through freight traffic, which represented a major part of Kobe rail activity, was not delayed following local attacks and signal and communications circuits were not seriously disrupted except for brief periods. There was some damage to local transit sheds and freight yard facilities but this was not sufficient to interfere with port operations at the current low level. The larger plants had direct rail sidings and there was no evidence of freight car tie-ups. Maintenance and communication breakdowns became increasingly serious in the general operation of the system after April, but railway authorities were able to meet declining local needs despite the growing car shortage. In the June attack, damage to the government railway shops at Kobe was especially serious but the effects had only begun to be felt at the time of the surrender.

Seventy-five percent of all railway maintenance work for the region was handled at the Takatori shops in Kobe, including rebuilding of steam locomotives and cars. With total employment of 4,300 and extensive facilities, this plant bore the brunt of the increased maintenance problem when virtually all east-west traffic in western Japan had to move by rail. Aside from locomotive maintenance, the most critical problem was that of keeping sufficient gondola cars operating to move required coal. The Takatori shops were not hit in February and sustained only minor damage in March. The semimilitary discipline which prevailed was effective in combating post-raid absenteeism. Activity was maintained at a very high level until the June urban attack, which destroyed over one-third of the shop facilities, the power plant and



PHOTO 14.—Heavy machine shop at the Takatori railway repair works in western Kobe. Results of incendiary damage in June urban attack.



PHOTO 15.—Other sections of the Takatori car repair shops. Collapse of roof girders and traveling cranes prevented salvage of any equipment.

much of the components and supplies on hand. Car repairs were completely halted and locomotive maintenance could only be resumed at less than 30 percent of the former level. Since other shops in the region were also damaged, this decline was extremely critical.

Basic Materials

Available data on total freight movements of different commodities in and out of Kobe are incomplete but are sufficient to serve as the basis for general conclusions. Here the analysis must be concerned with administrative decisions affecting production changes and reallocations of materials as well as with the actual decline in facilities for freight movement. During 1944, there had been an even greater relative decline in shipping handled at Kobe than had occurred in Osaka. But aside from a scheduled drop in coal and iron deliveries, most of this decline at Kobe represented a reduction of overseas transshipment through the port and did not seriously affect local industry. As far as Kobe's own freight requirements were concerned, an effort was made to supplement available maritime shipping space by greater use of the railroads, so that freight movements to and from Kobe manufacturers were sustained far better than over-all figures would indicate, even after mining of the Inland Sea placed severe burdens on the rail system.

Rail imports of pig iron, for instance, fell steadily from March 1944 to the end of the war, reflecting the scheduled decline in steel production at local fabricating mills. Likewise, shipments of pig iron by water reached a peak in June 1944 and declined steadily thereafter. But until February 1945, larger receipts of ingot steel made up this difference. On the other hand, shipments of machinery and of finished metal products, which moved principally by rail, rose steadily to a peak at the end of 1944 and continued well above the average 1944 level until May 1945. The decline at that point was due primarily to the fall in production in Kobe and other urban centers, not to transportation or basic materials' difficulties.

This contrast between the behavior of basic materials and finished products movements during and just prior to the period of air attacks suggests the importance of examining the change that was taking place in local metal fabrication and in the inventory position at different stages of production. Two Kobe steel plants using pig iron

in large quantities—primarily in open-hearth steel production for ship plate and other basic structural forms—suffered heavy reductions in allocations after mid-1944, with ore deliveries being reduced to negligible proportions in early 1945. Ingot steel deliveries to these plants, however, tended to make up this decline until February 1945. Especially after April 1945, however, coal deliveries to these plants were also cut drastically so that pig iron and ingot steel supplies no longer were the only limiting problems. But after the 5 June area attack, damage and labor problems were primary. If these problems had been overcome, local steel fabricating would have again been limited by materials' shortages.

From mid-1944 there had been a growing tendency to concentrate steelmaking as close to the source of materials as possible, thereby minimizing transport requirements. After January 1945, this cutback also began to affect local fabricating as well as steelmaking activities. But deliveries to end-product plants from these and other fabricators continued at moderate levels throughout the raid period. Thus, at the end-product plants, stocks of basic materials, including steel products, generally appeared to be sufficient from a tonnage standpoint for several months operations at a high level at the time of surrender. Inventories and deliveries of other bulk supplies were generally adequate. If plant damage, absenteeism and other factors related to the urban attacks had not reduced activity after January 1945, it would appear that output of ordnance, electrical equipment, aircraft components, machinery and even of ships could have been maintained through the second quarter of 1945 at scheduled high levels on the basic materials actually available in Kobe. But at least in shipbuilding, there would have been a third quarter decline with the rate of deliveries of steel products which actually prevailed during the spring and summer of 1945.

According to company officials, the large size of plant inventories in basic metal products was often deceptive because types and grades on hand were not suitable for current requirements without reworking. In some cases, such rehandling not only consumed time and skill but would have been hindered by shortages of fuel and suitable equipment. With the possible exception of shipbuilding, there is little evidence to suggest that existing basic materials shortages themselves need have significantly reduced scheduled Kobe output

COAL DELIVERIES KOBE CITY

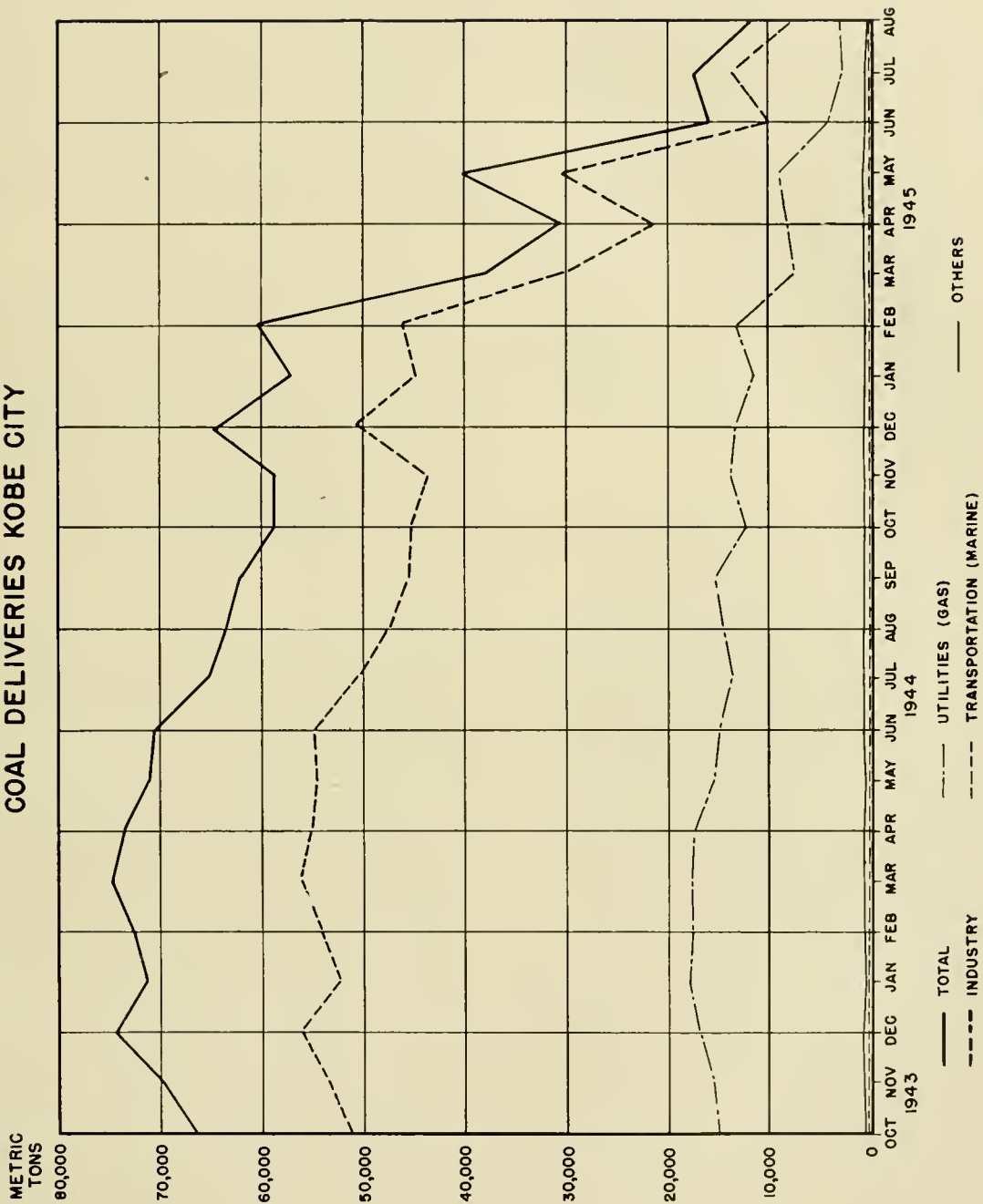


EXHIBIT 12

of war items before the invasion. Most plants had large materials inventories and continued to receive further shipments during the period of air attacks. This widespread existence of large inventories was in certain cases due to changes in production during late 1944, and partly to the inadequacy of allocations machinery which often resulted in plants receiving grades and types of basic products different from those which they required or could best use in their current operations. Such materials were not recaptured and tended to pile up as the war continued. These and related problems of duplicate allocation and black market diversion have already been discussed in the Osaka report. The net effect of these basic materials' factors will be discussed later in relation to each industry. At this point, attention is turned to the problem of fuel supply, which was so intimately related to transportation difficulties and to basic industry activity.

Fuel Supply (Exhibits 12, 13, 14, 15)

In general, an inspection of statistics for the large heavy-industry plants indicates a successful effort to balance coal deliveries with other supplies. There was a growing stringency in coal supplies during late 1944 and early 1945 but no direct interruptions as a consequence. Coal stocks were placed on a day-to-day basis, however. During the attack period, plant deliveries were cut down in line with actual output possibilities but were not permitted to curtail output directly except in one industry, steel fabricating. Here allocations were consistently held down to two-thirds or less of the city's total receipts, with the result that coal actually moved ahead of other factors limiting steel fabrication at the city's largest steel mill during one month—May 1945. Total coal requirements were reduced during 1944 but Kobe continued to feel the pressure of the over-all fuel stringency as well as the transport problems related to it, even after industrial activity had been so heavily reduced as a result of air attacks. This pressure had its main effect on basic fabrication rather than end-product output. In the absence of area attacks, producers of end items could still have been taken care of, but only at the expense of local steel fabricating and, consequently, of shipbuilding.

The steel fabricating plants associated with Kobe shipbuilding had consumed large tonnages of coal, and made Kobe relatively more sensitive

than Osaka to the declining coal supply situation in 1944 and 1945. Analysis of coal deliveries and stocks at individual plants indicates that reduced coal deliveries imposed a rapidly falling ceiling on 1945 output, but with one exception, this did not constitute a direct limiting factor on essential production. Distribution of available supplies were adroitly adjusted to maintain maximum end-product output. Shortages of other basic materials and production loss factors related to the air attacks were even more critical during 1945 for all major industrial units, except in the one case cited above, despite declining supplies.

Allocations for Kobe were handled through the regional branch of the Japan Coal Company, with headquarters in Osaka. Local officials blamed Tokyo and Osaka for lack of coordination and resilience in over-all planning that resulted in the regional maldistribution of available supplies during the latter part of the war. This criticism was in part aimed at the decision in 1944 to reduce local steel production and fabrication in favor of other heavy-industry centers. But local authorities also were aware that unused stocks of coal had been available at nearby cities during period of critical shortage. However, it was evident that the disruption of transport facilities in the region had most to do with failure to reallocate such surplus stocks as did exist at Amagasaki and elsewhere. Kobe's coal supply came from the same sources as Osaka's and regional supply and allocation was largely handled as a unit. In Kobe, inventory control and allocation of available supplies seemed to be handled intelligently—given the existing priorities—to assure maximum output of end-products during the period of air attacks.

Exhibit 13 presents detailed coal allocation data for this attack period. Iron and steel fabrication and gas production accounted for a very large proportion of coal used in Kobe during 1945. In January and February these facilities used about 86 percent of all coal consumed locally, exclusive of that used by the railroads. The proportion supplied to these units never fell below 78 percent. Distribution of the balance was also efficiently controlled, even though the volume required for each plant was relatively small. There was careful adjustment of coal inventories in light of actual production requirements and even priority end-products plants were often held to a few days' supply. But coal was supplied in sufficient quan-

COAL CONSUMPTION KOBE CITY 1945

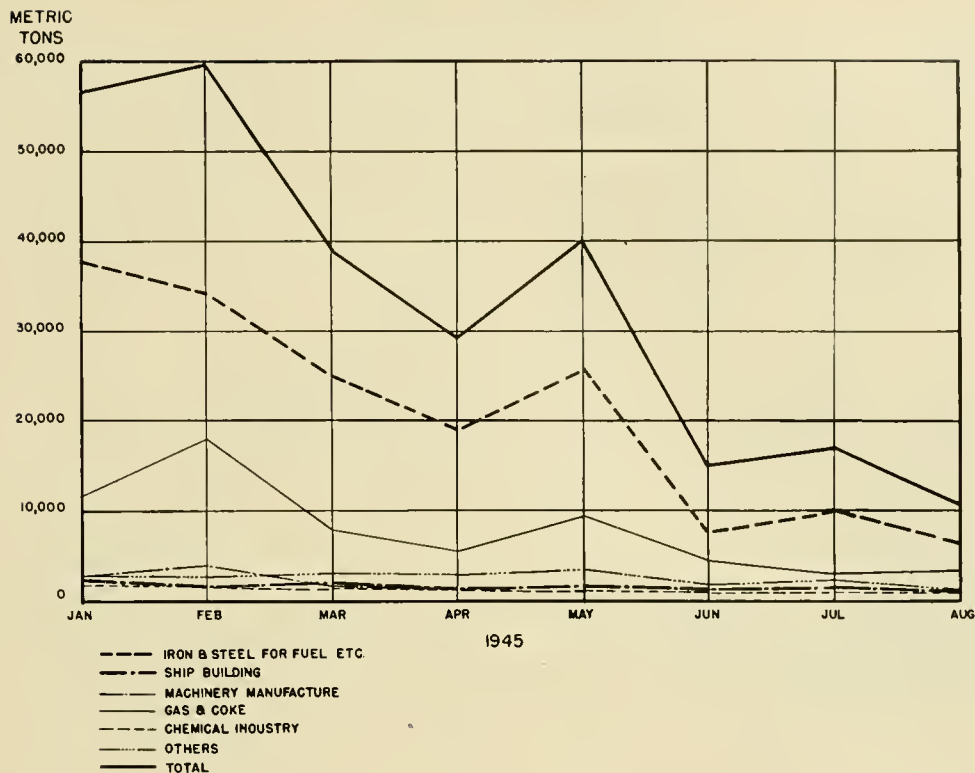


EXHIBIT 13

tity to meet current needs in practically every case throughout the period of attacks. Kobe harbor was not important for coal bunkering and no coal was used during 1944–1945 in Kobe, for generating electric power. From a tonnage standpoint, coke and charcoal consumption was relatively unimportant compared with coal, although required for domestic use and by certain small factories producing essential components.

As indicated in Exhibit 14, the relative importance of rail and water shipments changed considerably during the period of analysis. Prior to February 1944, waterborne coal arrived only by lighter and schooner, but larger colliers subsequently were utilized in this vital traffic. Total water shipments of coal were reduced during 1944 but were maintained relatively well through April 1945. Coal imports into Kobe by rail were maintained during 1944 and early 1945, but after March rail receipts fell, along with marine traffic, as it became necessary to supply other Japanese industrial centers by rail. Beginning in May, water receipts of coal were largely cut off due to aerial mining of the Inland Sea and it was even more difficult to satisfy all requirements by rail. Cer-

tainly after 1 May, coal deliveries were reduced to a perilous level and were largely dependent upon regular arrivals over the one rail line leading from the mines of Kyushu and western Honshu. Except for the previous reduction of industrial output as a result of the urban attacks, coal shortages would have forced curtailment of steel fabrication for shipbuilding—even before curtailment of water shipments in May—and possibly might have affected even more urgent end-product items. Even at the level of output which did prevail and with coal inventories so close to the zero point, any sustained interruption of coal movements by rail after April would have had direct repercussions on the general level of activity in Kobe. By immediate curtailment of basic fabrication and other activities related to shipbuilding, it would still have been possible to defer the effect of such interruption on some priority industries for a month or more. In addition to supplies in the process of distribution, a full month's coal reserve was always maintained at Kobe's largest steel works and could have been redistributed to other plants. But the assessment of possible countermeasures for the sort of heavy drop in coal

COAL TRANSPORTED INTO KOBE



EXHIBIT 14

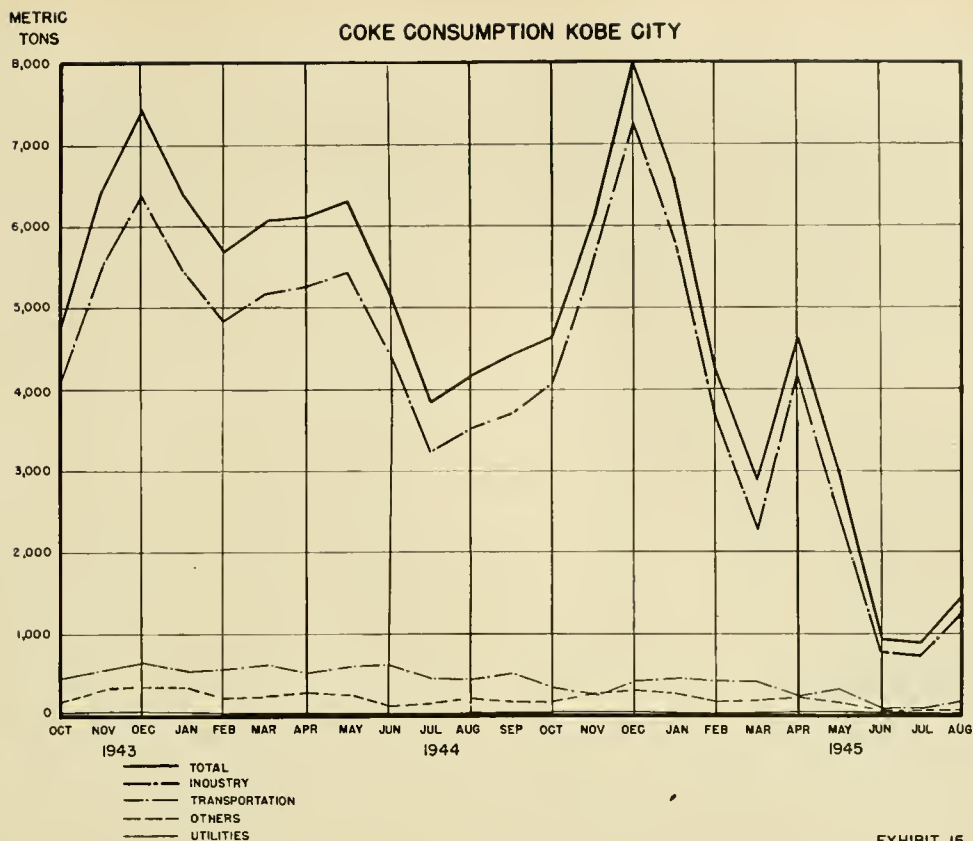
receipts which did develop in the last weeks of the war becomes extremely problematical. Actual events in Kobe provide little help, because of the general breakdown. The local problem would have been maintenance of minimum gas supplies, if the B-29 program against rail transport which was initiated on 14 August had continued. Fuel shortage need not have been decisive at most end-product plants—given vigorous reallocation—until late September or October.

INDUSTRY AND MANPOWER

Ranking lowest in size and population among Japan's six principal cities, Kobe stood fourth in terms of war production. Kobe's industrial facilities accounted for approximately one-tenth of all naval tonnage, one-sixth of Japan's wartime merchant shipbuilding and repair activity and one-eighth of all marine-engine production. Ten percent of Japan's capacity for locomotive and rolling stock manufacture was located here and, in addition, the Takatori railway shops handled 75 percent of all major repairs for railway equipment in central Japan. Local steel mills supporting this basic activity had 6 percent of the nation's

open-hearth capacity and about 8 percent of its fabricating facilities. During the war, Kobe contributed approximately one-third of all tire output and one-tenth of other industrial rubber products. Heavy electrical equipment completed here came to 8 percent of the national total and electronic tubes and components to about 5 percent. Kobe's share in the production of aircraft components was also roughly 5 percent and its output of various armament items ranged from two to 5 percent of the total. Thus, while the main emphasis in Kobe was on heavy industry, the city also had a vital part in the supply of many military end-product items and critical components for ordnance and aircraft.

In the aggregate, however, industrial capacity and activity at Kobe was far below that maintained at nearby Osaka. There was less than one-fourth as much factory floorspace and at the beginning of 1945, the total industrial labor force was roughly 180,000 as compared with 505,000 in Osaka. In terms of industrial power consumption, the preattack position of Kobe was relatively better. As late as January 1945, Kobe factories still used roughly 35 million kilowatt hours of



electricity, or almost half as much as the 72 million consumed that month by factories in Osaka. Osaka, like Tokyo and Kyoto, had a great deal of nonessential and lower priority industry which, by 1944-45, was operating far below capacity. Kobe, on the other hand, had always depended upon other cities for its consumer goods. Prior to the war, its magnificent port facilities handled much of the raw materials and finished goods for the region's textile and other industries, now classified as nonessential. But all the large factories located in Kobe, and practically all the small plants as well, were engaged in production required for the war effort. Among the principal Japanese cities, only Nagoya rivaled Kobe in its concentration on priority industrial activity.

The Pattern of Industry in Kobe

Functional emphasis and plant size in Kobe industry has been touched upon in previous sections but, as in the Osaka report, a more detailed picture can be constructed from labor force and plant data used by prefectural police authorities in the allocation of manpower and factory rations. This material clearly shows the high degree of unit con-

centration in Kobe as compared with other major cities. Destruction of many police records in the March and June urban attacks renders the Kobe data less detailed and complete than comparable material obtained in Osaka. In the reconstruction of factory data after the March and June raids, rough estimates were frequently made. Also, an undetermined number of smaller plants that suffered heavy damage and did not have essential work orders were dropped completely. Thus, to some extent, the prefectural factory data certainly underestimates the number of units and workers in the small plant and nonessential categories. Despite these recognized shortcomings, the Kobe information is regarded as generally adequate, for such a high percentage of total manpower and industrial resources were employed in larger priority plants.

The factory labor figures provide one rough indication of the functional pattern in Kobe industry and underline the high degree of concentration. Student workers and supervisory and clerical personnel are included along with regular adult shop employees. Of 155,00 industrial workers specifically accounted for in police records of January

1945, 57,000 were employed in the building or repair of ships and marine engines, 24,000 in steel fabricating and heavy metal working, 22,000 in manufacturing aircraft components, including electrical items and instruments, 18,000 in ordnance and 34,000 in all other industry, including almost 10,000 in "chemicals," mainly production of tires, synthetic rubber and industrial rubber products. The following tables provide a breakdown of these figures by plant size.

Aggregate employment

Plant size	All plants	Over 500 employees	50-500 employees	Under 50 employees
All industry-----	155,430	125,400	20,450	9,580
Shipbuilding-----	57,000	52,700	3,500	800
Metal fabrication ¹	24,130	15,500	6,000	2,630
Aircraft components ² ----	22,000	17,000	3,600	1,300
Ordnance ³ -----	18,000	16,400	1,200	400
Other-----	34,400	23,800	6,150	4,450

¹ Includes machinery manufacture.

² Includes electrical accessories.

³ Includes communications equipment.

Number of plant units

Plant size	All plants	Over 500 employees	50-500 employees	Under 50 employees
All industry-----	846	50	169	627
Shipbuilding-----	95	5	32	58
Metal fabrication--	247	7	46	194
Aircraft components-----	103	6	26	71
Ordnance-----	29	2	7	20
Other-----	372	30	58	284

These divisions as between industries are necessarily rough since several large plants and many smaller units contributed to more than one of the broader categories. In addition, 23,000 of those registered as industrial workers in Kobe are not accounted for in the factory census data compiled from police records. A minor part of this number represents those who had been employed in small factories that were completely destroyed in the March and June area attacks and for whom no records exist. The balance include some "floating" labor employed in transporting factory goods about the city and the net deficit among those regularly employed who commuted daily to and from plants or residences located in the suburbs. It is estimated that over 15,000 more Kobe residents worked in suburban factories at the beginning of 1945 than commuted to Kobe from homes outside the city.

In taking up the question of unit size and concentration, we note that police records list only

846 factories in Kobe, as compared with more than 16,000 listed in Osaka. It will be recalled, however, that 9,000 of those Osaka units employed less than 10 workers each and in the aggregate accounted for about one-tenth of all industrial employment. Even on the assumption that the Kobe records overlook some of the workshops of comparable size destroyed in the urban attacks, there remains a striking contrast between the two cities in the number of plant units. Among the 846 plants listed as operating during January 1945, in Kobe, 627 each had total payrolls of less than 50 workers, 169 factory units employed 50 to 500 workers each and 50 plants had pay rolls of more than 500.

The full significance of this plant size distribution in Kobe is brought out when the data on gross employment by size group are examined. The tables were compiled from police records on individual plants and cover about 87 percent of all the 178,000 inhabitants who were registered as industrial workers and listed by the police as located in Kobe during January 1945. Of this group, roughly 80,000, or 55 percent, were employed by Kobe's five largest plant units. The next 5 units had more than 10 percent. In other words, about two-thirds of Kobe's industrial labor force worked in 10 factories. Fifty Kobe plants, including these 10, had pay rolls of more than 500 and together accounted for 125,500, or 80 percent, of the factory labor force. Of the remainder, 15 percent worked in 169 medium-sized factories employing between 50 and 500 each and only 6 percent in the 627 workshops listed as having less than 50 workers each. A comparison of these figures with the Osaka distribution is illuminating. In Osaka, 41 percent of all factory labor was accounted for in January 1945 by plants with payrolls over 500, 31 percent by the 50-500 size group and 28 percent by workshops with less than 50 employees each.

The high degree of industrial concentration in Kobe is clearly indicated by the official plant employment data just cited. Even these figures fail to convey the full degree of integration which existed. Not only were individual plant units very large, but there also were close managerial and functional interrelationships between the principal factories as well as considerable physical concentration. In addition, most of the city's smaller plants were intimately linked with the major units.

Two "Zaibatsu" concerns dominated Kobe—Kawasaki and Mitsubishi. The Kawasaki and Mitsubishi shipyards were by far the city's largest industrial units, with Kobe Steel, Mitsubishi Electric and the largest Kawasaki steel mill making up the "big five" among Kobe factories. Closely related to the Kawasaki yard was another fabricating mill and a railway equipment works, while the original plant of Kawasaki Aircraft and the Kawasaki Electric works were also located here. Mitsubishi Electric was closely linked to its shipbuilding affiliate, although it also produced heavy electrical equipment of all types and had become an important producer of aircraft instruments and electrical items. The only "independent" among the "big five" was Kobe Steel, a highly integrated plant which produced finished ordnance items as well as marine engines and heavy castings and forgings for other concerns. Among the other plants employing more than 500 were important producers of aircraft components, rubber tires, marine engines, ordnance, communications and electrical items, and machine tools. Over half of these plants and two-thirds of the medium-sized (50 to 500 workers) group produced components for Mitsubishi and Kawasaki. Kawanishi Aircraft, with three plants in the eastern suburbs, also depended on subcontractors located in Kobe but did not play so dominant a part in the life of the city.

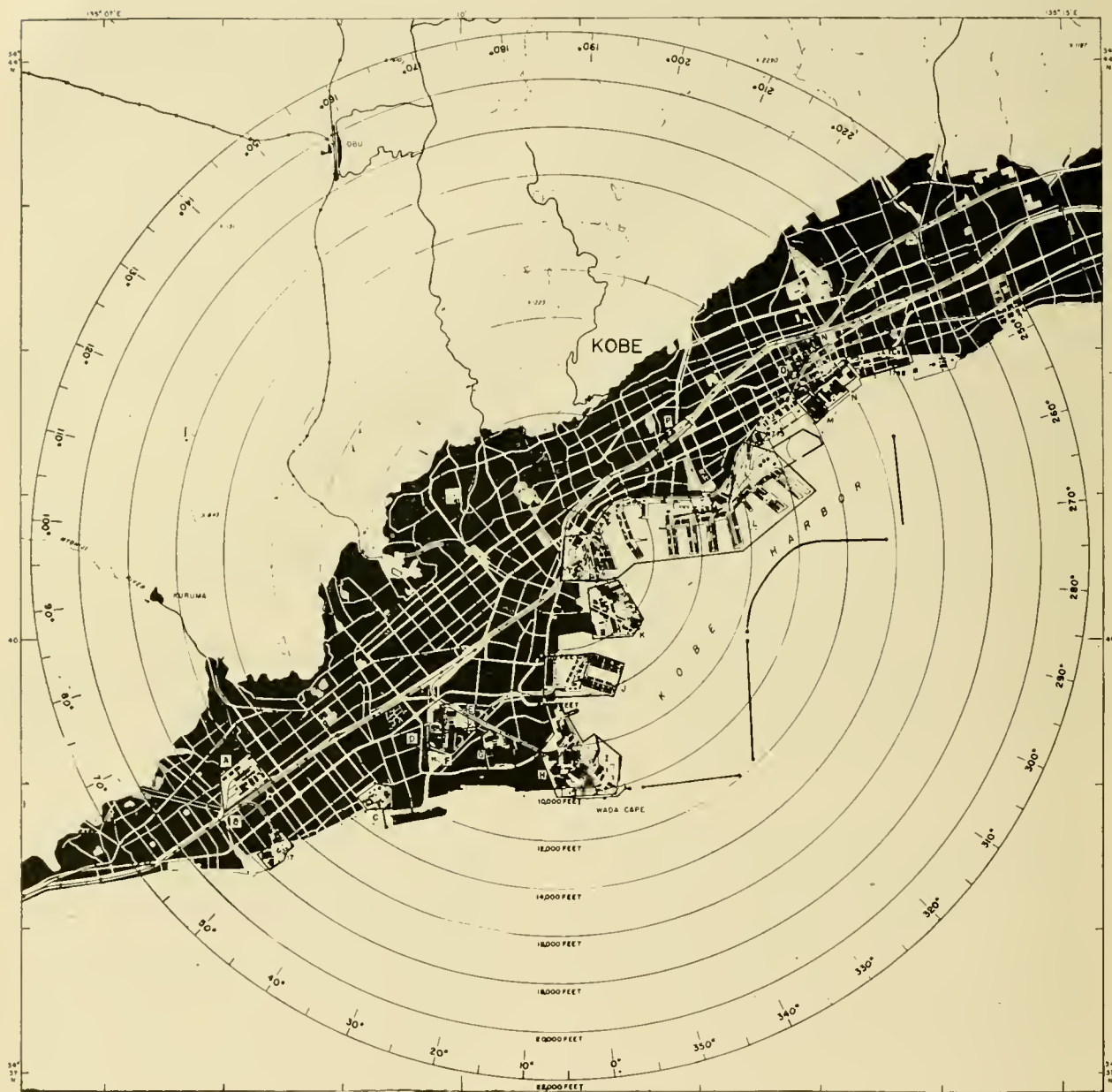
Kawasaki, Mitsubishi and Kobe Steel were the controlling elements in the industrial life of Kobe. This city was the administrative headquarters for all Kawasaki operations and, except for one aircraft complex north of Nagoya, all its factories were located in Kobe and nearby towns. Kobe Steel also was a local concern, although it operated small plants in the Nagoya region and a light metals fabricating mill near Shimonoseki. Mitsubishi interests were, of course, scattered throughout Japan, but the largest units of its shipbuilding and electrical equipment concern were located here. While Mitsubishi interests had always played an important part in local industrial and commercial activities, they did not dominate Kobe as completely during the war as they did Nagasaki, or even Nagoya. The Mitsubishi position was very important, however, particularly since Kobe was the operating headquarters for its many electrical equipment plants in the region. It will be noted that Sumitomo interests, which figured so

largely in the Osaka report, had no important place in Kobe.

This discussion of industrial concentration in Kobe has dealt with the size of plant units and with functional and managerial inter-relationships. The dominant position of five plant units and three operating groups has been emphasized. Brief attention must also be given to the high degree of physical concentration. It will be recalled that in Osaka, principal industrial concentrations were located around a large commercial-residential core and that within these concentrations, important plants were often located at a considerable distance from each other. Earlier chapters have discussed the relatively greater industrial concentration prevailing here and it will suffice to point up that general discussion with a brief statement on plant-clustering among major units. Among the key factories discussed above, Mitsubishi Electric adjoins the Mitsubishi shipyards. One of the Kawasaki foundries and fabricating mills adjoins the Kawasaki shipyard and the other is located at one end of the Kobe steel works. Similarly, the Kawasaki railway equipment and aircraft engine plants shared a compact triangular site with a large producer of electronic and ordnance items. Chuo Rubber, which produced a third of Japan's wartime tires and supplied Kobe's many rubber products plants, adjoined the northern half of Kobe Steel.

As suggested by an examination of Map 6 and other maps accompanying this report, these large, closely integrated plants, which employed roughly two-thirds of Kobe's industrial labor force, may be grouped in four major clusters. In almost every case, they are surrounded on two or more sides by other important factory units or by small feeder plants and warehouse areas. Only the Takatori railway shops, among the industrial facilities most critical to the war program during 1945, were isolated from other large units. All important Kobe plants were located well within the area of urban congestion, however. Three of the major industrial concentrations, including both Mitsubishi and most of the Kawasaki units, were in the western half of the city hit in February and March while Kobe Steel and its neighboring units were in the eastern half, which was not severely damaged until June.

The high degree of physical and organizational concentration prevailing in Kobe enormously simplified the task of administration—both from the



KOBE

KEY FACTORIES AND TRANSPORT FACILITIES

- | | |
|--------------------------|----------------------------------|
| A TAKATORI RR SHOPS | I MITSUBISHI SHIPYARD |
| B OIL STORAGE | J NO 2 WHARVES |
| C POWER & GAS WORKS | K KAWASAKI SHIPYARD |
| D KAWASAKI ROLLING STOCK | L MAIN WHARVES AND FREIGHT YARDS |
| E KAWANISHI MACHINERY | M KAWASAKI STEEL |
| F KAWASAKI AIRCRAFT | N KOBE STEEL |
| G KANEGAFUCHI MFG | O CHUGO RUBBER |
| H MITSUBISHI ELECTRIC | P MAIN RR STATION |

1 1/2 0 2 STATUTE MILES

MAP NO. 6

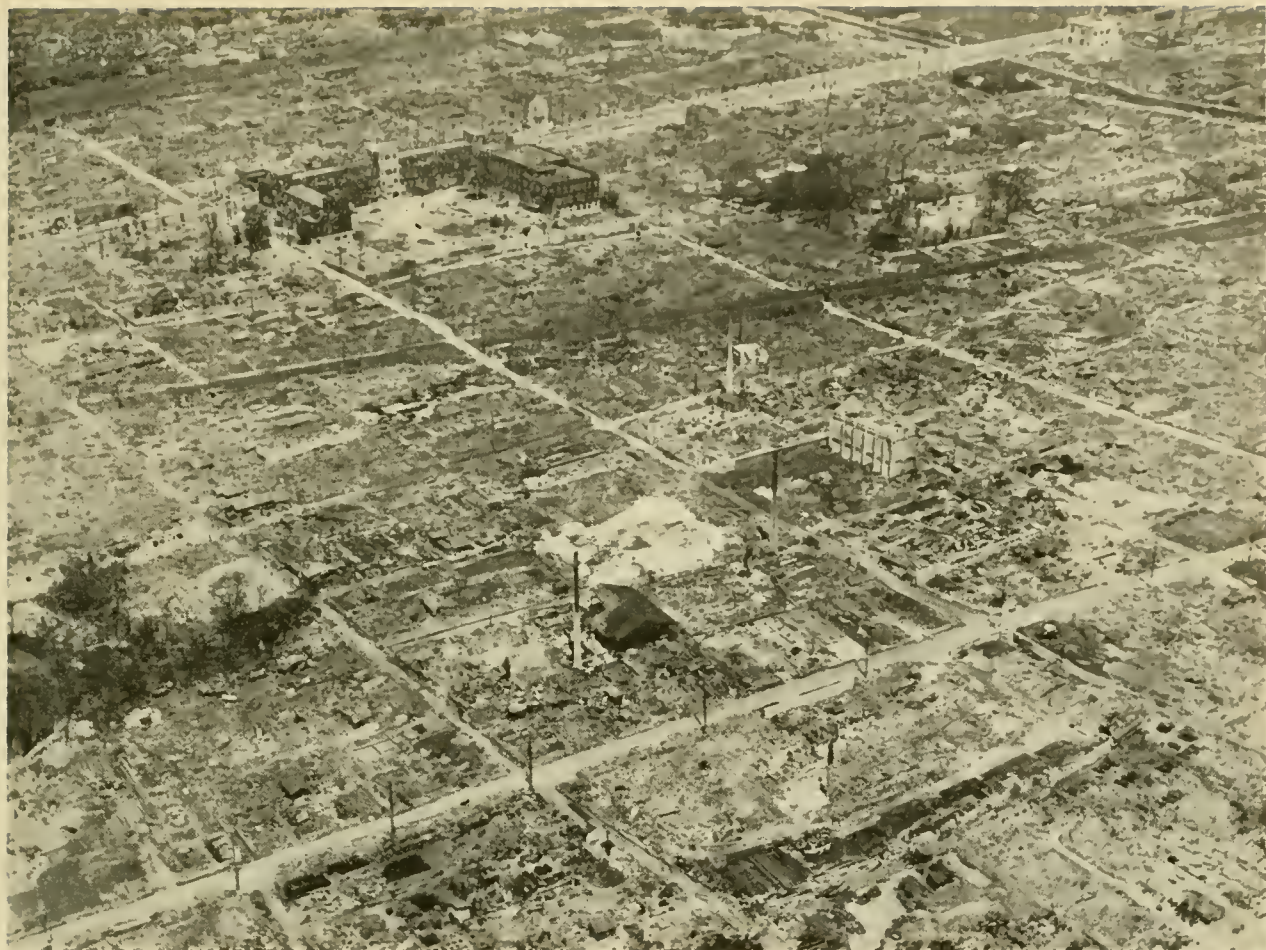


PHOTO 16.—Group of small factories in eastern Kobe destroyed 5 June 1945. Close examination of almost any factory site in this photo will reveal large stocks of materials and dozens of burned-out machine tools and other equipment items. The six sizable plants and several workshops included in this group were engaged in components production for nearby war plants. Practically all buildings were of wood, "dozo," or sheet metal construction. In most cases, not even the chimneys remain as landmarks. Contents of the concrete school building in the left background were seriously damaged.

standpoint of factory managers and public authorities. This comparative organizational advantage over conditions prevailing in Osaka and most of the other Japanese industrial cities, proved of considerable value during the 1944 production drive as well as in the period of air attacks. The existence of close-knit managerial control, with final policy decisions being settled locally, was no less important than the long history of relatively close collaboration between prefectural officials and the big concerns. There was a better prospect for flexibility and prompt action in the operation of controls over manpower, fuel, local transport and electric power which was generally credited with helping to overcome some of the obstacles to maximum output of end-products here during late 1944 and early 1945. The habit of technical cooperation among affiliates was well es-

tablished—including temporary interchange of materials and skilled personnel—and served to mitigate some of the many defects in central production planning and allocation. Parent concerns were able to maintain a much tighter hold on subcontractors. Thus, despite growing shortages of manpower and materials, delivery delays and production changes, the level of industrial activity at Kobe was maintained almost at the maximum until the February 1945 attack.

Most of the discussion of organizational problems elsewhere in these reports has dealt with the shortcomings in over-all industrial mobilization policy and its practical operation. Kobe officials and businessmen provided eloquent testimony as to the presence of these difficulties. At the same time, there can be no doubt that the simplified and integrated control pattern which existed in Kobe

EMPLOYMENT IN KOBE CITY

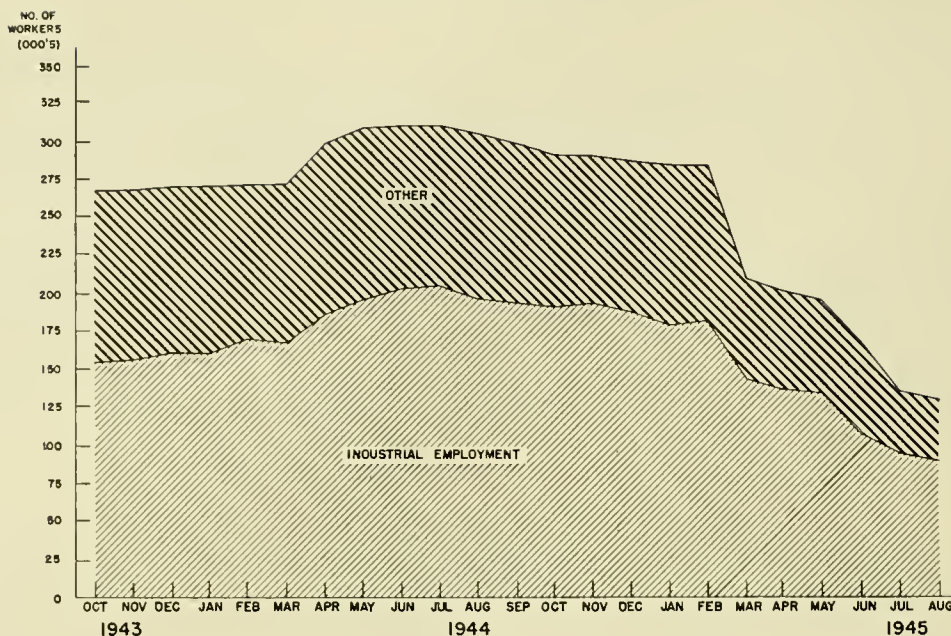


EXHIBIT 16

not only gave the city a decided advantage in the production drive of late 1944 but also considerably improved its chances for coping with air attacks. The technical problems of damage repair, dispersal and replacement will be discussed later in relation to each industry. It is sufficient to mention the decided advantages of local integration during the period when transport and communications were disrupted and when planning authorities in Osaka and Tokyo were unable to function effectively. Similarly, the relative freedom of the large Kobe firms from dependencies upon outside repairmen and upon a scattered network of independent subcontractors must be noted.

Such a high degree of concentration among large plant units as existed in Kobe also had its drawbacks during the attack period. The physical factors seemed less important than the psychological reactions to them. While obviously involving a great risk from the standpoint of precision attack, because of this concentration, Kobe plants probably would have been almost as vulnerable to heavy area attacks if they had been more widely distributed throughout the city. Apparently of very serious concern to officials was the effect of this concentration on the labor forces. Kobe plant concentrations were obvious B-29 targets. General consideration has already been accorded to transport, housing and other factors affecting the working population after the urban attacks. These and

other problems related to absenteeism and labor productivity will be discussed later in connection with the specific recuperation and output obstacles facing each industry. But in turning from an examination of the industrial structure in Kobe to the subject of labor mobilization and labor difficulties, it is appropriate to mention one most compelling results of Kobe's industrial concentration—the growing conviction of every worker that he was a likely target while at his workbench. The average Kobe workman was “target-consciousness” even before the first B-29 shadow fell on the city. After 17 March that shadow haunted every surviving factory and workshop.

The Industrial Labor Force (Exhibits 16, 17)

Among a resident population in January 1945 estimated at 784,000, 277,000 inhabitants, or approximately 35 percent, were listed as gainfully employed and 178,000, or 23 percent, as employed in manufacturing—approximately the same ratio to total employment as was represented by Osaka's 505,000 industrial workers.

Exhibits 16 and 17 present monthly employment estimates for the period of analysis. During the summer of 1944, total employment in Kobe pushed slightly above the 300,000 mark, having registered a gradual increase through 1943 and a sudden jump in April 1944 with the mobilization of student and non-essential labor. There was a decline

CATEGORIES OF EMPLOYMENT IN KOBE CITY

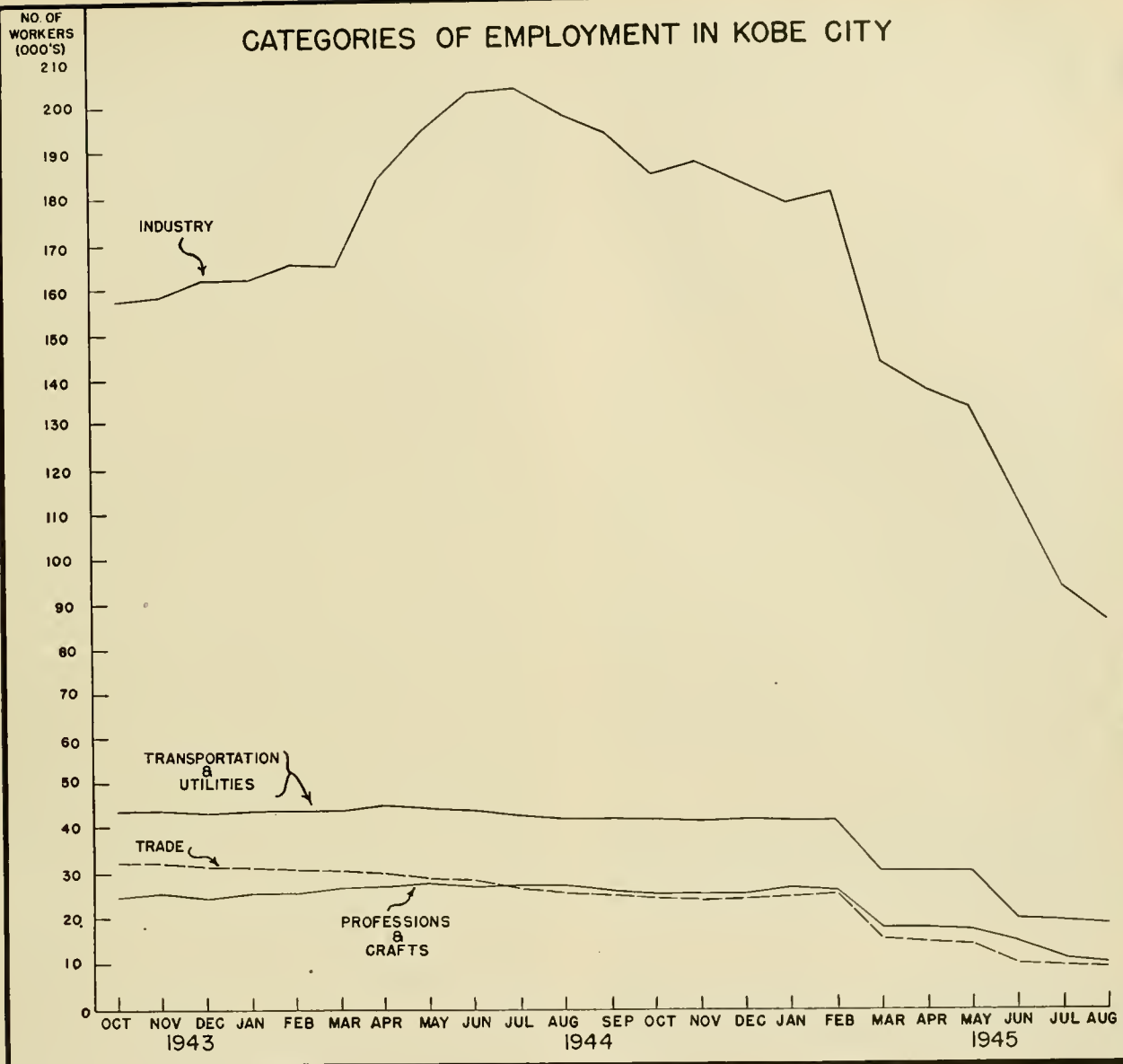


EXHIBIT 17

in total employment after July 1944 associated with further military conscription, and with the shifting of more labor to aircraft and other war plants outside the city. From October 1944 through February 1945, total employment remained almost constant, then dropped almost 25 percent in March, the month of the first heavy urban attack. By July, total employment was down to 137,000—less than half of the pre-attack figure—and it dropped still further before the surrender.

The analysis of employment by category makes it clear that the 1944 employment increase was due principally to mobilization for industry. There

was a sizable reduction in commercial employment along with the recruitment of students and others not formerly in the labor market. Aside from industry, employment remained highly stable until the declines associated with the March and June attacks. The net increase of some 30,000 industrial workers during the spring of 1944 was due to the mobilization of students and women who gradually replaced those conscripted or shifted elsewhere during the balance of the year. Student mobilization in late 1944 and early 1945 tended to compensate for further military conscription.

The over-all decline in the industrial labor force is indicated by Exhibit 17, while the following table summarizes payroll and attendance estimates, based upon prefectural police records.

Month	Index	Pay roll	Rate	Attendance	Index
			<i>Percent</i>		
January	100	155,000	85	132,000	100
March	80	125,000	60	75,000	56
May	74	115,000	65	75,000	56
June	58	90,000	40	36,000	27
July	54	84,000	45	38,000	28

The data cover plants employing almost 90 percent of Kobe's total industrial labor force. Compared with the Osaka figures, this table indicates a payroll decline 10 points greater in Kobe for March, but an attendance drop some 25 points greater. By June and July, the decline in the Osaka payroll index placed it only half as far away from Kobe; the Osaka attendance index was 30 points higher in June but dropped to within 16 points of Kobe in July. This evidence tends to confirm other indications that industry in Kobe suffered more immediately and directly following both the March and June area attacks than did Osaka.

In view of the detailed attention given to labor mobilization procedures in the Osaka and Kyoto reports, further consideration of labor force data will be reserved for the analysis of specific industries.

Before turning to a general discussion of manpower problems and their effect on recuperation and output during the attack period, it will be helpful to review the over-all decline of Kobe's industrial labor force during 1945 as reflected in prefectural police records. By July 1945, almost 84,000 were still carried on factory payrolls according to these records, or 54 percent of the number listed for January 1945. Of these, 71,700, or more than 80 percent, are accounted for by 44 of the original 50 units employing more than 500 each. Total employment in all 50 of these larger plants now represented almost 90 percent of the greatly reduced industrial labor force. As will be developed later in connection with the analysis of individual industries, student labor proved much more dependable during the attack period, both from the standpoint of intermittent absenteeism and outright desertion.

Labor Problems During the Attack Period

General policy and arrangements for mobilization of manpower were outlined in the Osaka report and apply to the Kobe district as well. Further analysis of labor assignment procedures will be found in the report on Kyoto, where complete data are available on the emergency mobilization program. Accordingly, it is proposed to conclude this general discussion of Kobe's industrial and manpower resources with a summary of official views on labor problems in Kobe, particularly concerning recovery of industrial activity following air attacks.

Because of the highly integrated character of Kobe industry, it was possible for the Survey to arrange extensive interviews with officials of all principal plants and, in addition, to check such findings against the experience of public authorities intimately acquainted with manpower difficulties in Kobe. In the following summary discussion, particular weight will be given to reports on labor and morale problems prepared for the Survey by the mayor of Kobe and by the chief of the prefectural police. Under the Japanese form of local administration, the mayor occupied a position somewhat removed from the direct and ubiquitous network of economic controls operated by prefectural authorities, especially in cities, like Kobe, which also were prefectural capitals. Nevertheless, responsibilities of the city government in connection with public welfare, civil defense and related activities brought the mayor into continuous contact with business officials and leaders of the neighborhood associations (*tonari gumi*). By reason of his official activities and his personal relationships in the local business community, the mayor's statements seem to provide an accurate reflection of management views on labor problems and on shortcomings in the system of manpower control.

Along with much else, the prefectural police were directly responsible for the assignment of labor to priority plants, for the distribution of special food and clothing rations to industrial workers, and for measures to combat labor absenteeism, desertion and disaffection. Thus in the special report prepared by the chief of police and in supplementary interviews with subordinate officials, there is provided additional revealing material based upon the experience of those directly responsible for administering labor controls.

There is a large measure of agreement among these official, semi-official and management assessments of labor difficulties in Kobe and their effect on industrial activity during the attack period.

Although his official responsibilities were largely confined to the welfare and non-industrial aspects of manpower problems, the mayor of Kobe was keenly aware of the labor and production difficulties experienced at Kobe's major plants by virtue of his intimate connection with the Kawasaki and Mitsubishi interests which dominated the city. He shared the opinion of most informants that military conscription policy had always been shortsighted regarding the deferment of key industrial workers. For established concerns the progressive dilution of labor and supervisory personnel did not become truly critical until the attacks. The mayor also criticized the program of emergency labor mobilization during 1944-45 as being initiated too late and operated in too lax and haphazard a fashion.

The student labor program was generally regarded as highly successful in Kobe, especially where students were assigned appropriate work with adequate technical direction. The mayor thought well of the local measures (in which he had actively participated) for organizing production in the schools and for evacuating younger children and other unemployables. In Kobe practically the whole body of secondary school students had been mobilized for production during the latter part of 1944. In most cases they worked in groups under the quasimilitary direction of their former teachers—frequently at machines brought into the school buildings themselves. As a consequence, the student record of attendance and productivity demonstrated remarkable stability during the attack period.

It was the mayor's opinion that much more could have been achieved with other conscript and volunteer labor categories through earlier and stricter mobilization, more careful assignment in accordance with physical capacity and prior work experience, and more vigorous enforcement procedures. Many eligible adults managed to escape labor mobilization altogether, and many others, when assigned, were deemed unfit by factory officials and were not utilized effectively. Thus in the absence of strict controls, few of the adults mobilized during the 1944 production drive felt any strong compulsion to remain in Kobe's war plants after the air attacks started. Another gen-

eral criticism of official manpower policy voiced by the mayor applied as well to the whole wartime administration—the failure to inform those concerned about actual requirements and difficulties. The mayor related the lack of detailed statistics in his own office to general organizational shortcomings before and during the attacks. "As to laboring and productive conditions, no one but the national or prefectural authorities could realize the real state of things because of the excessive secrecy enforced by the state." The implication was that they had failed to derive the proper sense of urgency from the information at their disposal.

While critical of various administrative measures, the mayor agreed that availability of industrial manpower had been generally satisfactory during 1944, despite chronic shortages of skilled workers. A sharp distinction was drawn between conditions existing before and after February 1945. Prior to the attacks, labor difficulties were not paramount in Kobe, nor, except in certain isolated cases, did they hinder essential production. The mayor conceded that aggregate productive resources in Kobe would not have been sufficient, during 1945, to utilize fully all the manpower potentially available. But he expressed in the strongest terms his conviction that labor difficulties were controlling in the failure of essential industry to revive after urban attacks. Absenteeism had its important effect but "listlessness," with a startling drop in labor productivity as a consequence, made collapse inevitable. To quote the mayor's own words:

Did all this mobilization of human resources promote our productive power? The fact is that it did not. * * * In face, it was difficult to maintain one-third of normal labor efficiency on account of decrease of the desire to work.

In particular, the mayor stressed the effect of this drop in labor efficiency on efforts to revive production after attacks.

Though aware of the many technical problems involved in the repair of damaged equipment and resumption of regular output, the mayor insisted that such difficulties could have been overcome if those workers remaining on the job had retained their preattack attitudes toward their work. In connection with his experience in post-attack welfare and emergency rehousing activities, the mayor regarded himself as well qualified to enlarge upon the objective reasons for collapse of worker morale. Even among those who were not air-raid victims,

the continued deterioration of living conditions and the threat of further attacks removed all enthusiasm for effort in a damaged and disorganized factory. Thus, according to the mayor, the collapse of labor efficiency was the determining factor in Kobe's industrial decline during 1945 and "this was entirely due to lack of earnest desire to work, to disorganization of resources and personnel, and to frequency of air-raid alarms."

To a large extent, the chief of police in Hyogo prefecture agreed with the Kobe mayor's critique of the labor mobilization program. But his report was inclined to emphasize the general sense of optimism and complacency which permeated all ranks of Japanese society from Pearl Harbor onward, serving to delay and inhibit the execution of all "total-mobilization" measures. The first awakening in Kobe came in mid-1944 with the invasion of the Marianas. The simultaneous B-29 missions against north Kyushu targets caused a considerable amount of uneasiness in Kobe, which was the westernmost of the big war-production centers. Panic evacuations and general uneasiness at that time were credited by the police chief with undermining the initial enforcement of the labor mobilization program, which depended upon the neighborhood associations and local pressure for the control of malingering.

Management's typical criticism of local labor administration and control, which the mayor had echoed, concerned the poor quality of the labor conscripts and volunteers and delays or inadequacies in assignment. The prefectural police official countered such criticism by emphasizing the poor quality of the material available. Military conscription and lucrative war work had drained away practically all experienced and able hands long before the spring of 1944. The police chief was inclined to point to the pre-attack production levels, achieved in Kobe despite the extensive withdrawal of experienced workers throughout 1944 for military service, as evidence that manpower problems had not constituted any serious obstacle to essential industrial activity. There can be no question that the process of labor mobilization and replacement in Kobe during 1944 operated more easily and effectively than was the case in Osaka. But the very factors contributing to smooth administration—the relatively few large industrial units holding labor priorities—tended to mask basic weaknesses in conscription, assignment and control procedures which became so pain-

fully evident during the attack period.

As in so many other respects, the 17 March raid spelled the doom of effective control over conscript, volunteer and "free" labor. All three categories had to be promptly and intelligently reallocated if industrial recovery were to be achieved. But the last group, which included all construction workers and local draymen, was absolutely essential for industrial repair and dispersal. In almost every respect, they constituted the biggest challenge to efforts for reviving essential output.

Altogether, there were 16,870 of this all-important group on Kobe police records in January 1945—2,670 skilled carpenters and builders and 4,500 general construction workers, 4,200 draymen and 5,500 stevedores and freight handlers. In addition, Kobe normally counted on a large number of construction workers and other day laborers residing in nearby cities and suburbs. The following extracts from the police chief's report outlines the situation existing from the beginning of 1945.

With the intensification of air raids by the AAF against the homeland, the day laborers scattered precipitously to local areas of safety, as a result of which it became ever more difficult to control them and to make them work in essential spheres * * * On the other hand, since many of the various war production factories of the metropolis (Osaka) and other cities had started evacuating, many workers, seeking personal safety and black market wages, avalanched into rural communities where food was plentiful * * * The devastation wrought by air raids, the skyrocketing of wages, and the scarcity of food in the cities all attributed to the above. With all the various factors operating together, their control was acknowledged to have become most difficult.

The initial attacks of 19 January on Akashi and 4 February on Kobe served at first to enhance hostility toward the enemy and to counteract these tendencies according to the police report. In fact, attendance of free labor actually jumped 10 to 20 percent in response to official appeals for aid in dispersing equipment from the Akashi aircraft works and speeding repairs on the priority Kobe plants. But the overwhelming urban attack of 17 March brought a complete and devastating change in the situation. In addition to the direct loss of houses, workshops, tools and vehicles sustained by those free workers still residing in the city, the entire system of control was destroyed. To quote the police chief's report, .

The burning of the work classification control association (shoku shubetsu tosei kumai) which was the organ controlling these laborers and the fleeing of the responsi-

ble members of the association, added further fuel. More than 50 percent of the workers in Kobe and in the area between Kobe and Osaka fled to the "gun"¹; their whereabouts became unknown, as a result of which confusion reigned in the loading, transportation, and construction phases.

While attendance rates among regular factory workers gradually revived after the March attack, construction and other free workers so critical to industrial recuperation continued to drift away. In June, the practice became so widespread as to constitute a serious cause for demoralization among regular industrial workers.

In ever increasing numbers the general populace took to the areas free from air raids, and day laborers, being no exception to the rule, avoided labor in factories where there was danger of air raids; rather, they showed tendencies of engaging in light work such as the transportation of evacuee baggage * * * As a result of enforcing speedily the evacuation of personnel and the demolition of city buildings as a counter-measure against air raids, the demand for workers in transportation had increased; daily wages of about 15 yen showed a trend toward steep soaring. Subsequently, in line with the intensification of air warfare, not only the large cities but even the medium and smaller cities were placed in danger of the perils of air raids, so the laborers, seeking safety of life and limb, fled.

With several subsequent small raids, the attitude of these workers became more and more negative and with the great air raid on Kobe of 5 June, they decided that our Army was totally unworthy of their reliance and completely deserted their posts, each man seeking the safety of his own person * * * By July conditions were such that they just wandered hither and thither aimlessly, practically unwilling to lay their hands on any particular task. Consequently, many were absentees and the real attendance rate took a precipitous downward course—especially since those engaged in the local transportation field contributed toward making this attitude widespread.

To prefectural authorities the conditions prevailing among the special labor gangs mobilized after April to prepare shelters and defense installations were even more appalling. Recruited on a neighborhood basis, these groups were intended to gather up "refugee" workers and others who were able but not contributing to essential activity. Morale was generally so poor among these groups that, from June on, it was considered unwise to risk contamination of industrial workers by using them near factory sites. The same problems of rumor-mongering and passive disaffection arose as with craft workers.

Difficulties with craft and temporary workers were serious in themselves but the police chief

naturally devotes most of his attention to developments among regular factory employees during the attack period. It had been anticipated that arrangements for distributing rice and clothing rations to industrial workers at the plant site would not only provide a real supplement to existing wages but also prove to be an effective sanction against post-raid absenteeism. The destruction of emergency food stocks and disruption of normal supply channels gravely undermined this program. The scheduled allocations of work clothes was also in large part impossible after the March attack. Rice deliveries to the plants were frequently interrupted or inadequate, so that individuals often received less than the promised amounts. With the breakdown of communications and so much labor turnover, it became very difficult for prefectural authorities to maintain effective control over actual distribution. Padding of payroll and attendance figures and black market diversion of factory rice allocations were extremely difficult to detect, and in the interest of maximum production, could not be severely dealt with.

The Survey obtained considerable evidence suggesting that, instead of reinforcing labor discipline, the factory ration program frequently was responsible for serious dissension and did much to encourage the practice of informal absence. Members of a particular shop unit would take turns slipping away during work hours to obtain ration supplements. Plant officials were in no position to deal severely with such "recesses" and they were, of course, not indicated in official attendance records. The failure of the factory rationing system in its essential objective was generally recognized. The consequences for labor discipline were regarded with the utmost concern by the police chief, as the following extracts from his report indicate:

The scarcity of rationed goods—especially food—caused a tendency on the part of the workers to sneak out * * * Basically, this food problem was the gravest concern of the workers, greatly contributing to the rise of petty problems of discrimination in food rationing and distribution within the factories * * * Meanwhile (in June) conditions had become such that it finally was impossible to restrict unofficial absenteeism for the purpose of food purchasing tours, even into the farming communities, and for personal errands or evacuation of relatives and personal belongings.

After 17 March the main pillar of local manpower control—the system of labor registration and assignment—was virtually inoperative. With

¹ Literally the rural counties; i.e. "took to the hills."

all central labor records destroyed and the responsible personnel scattered, with the telephone system paralyzed and other forms of communication seriously crippled, with the neighborhood associations disorganized, and with a large part of the population relocating in undamaged sections or fleeing, there was no possibility of using direct means for recruiting and reallocating all available labor in terms of the most pressing repair and production requirements. To add further administrative confusion, over-all priorities for labor assignment were drastically altered by Tokyo in April.

The nearby suburbs to which so many local factory employees migrated were also flooded with refugees from Osaka, introducing jurisdictional complications which would have been overwhelming if communications difficulties had not ruled out any serious official efforts at reorganization of controls. Thus the prefectural police, accustomed to exercising the strictest direct control over the working population, were forced to depend on indirect measures and individual initiative. But, as we have seen, the factory ration program, which had been counted upon as the principal indirect bulwark of labor discipline, had developed highly disruptive tendencies. Although more necessary than ever as the air attacks continued, this rationing program could no longer be regarded as the hoped-for insurance against labor difficulties in Kobe. In the absence of effective sanctions—whether in the nature of rewards or punishments—worker morale became the critical factor in recuperation. The report of the police chief gave considerable attention to the problem of industrial absenteeism during the raid period and to the equally critical decline in productivity among those who did continue to appear for work.

Before reviewing his discussion of trends in absenteeism among regular production workers, it will be helpful to outline the police chief's conclusions as to the factors responsible for the decline. In addition to the points already discussed, he placed particular stress on the demoralizing effect of factory disruption damage and on frequent air alerts.

Interruptions of production, whether due to factory damage or to lack of materials and components, had the direct effect of reducing labor productivity. The "slow-down" as a means of avoiding military conscription or assignment to repair and clean-up gangs, was a continuing problem

after the March attack. Difficulties encountered in damaged plants were heightened by the repair labor problem previously discussed but even undamaged plants saw productivity sag whenever there was prospect of an interruption in activity. To quote the report on this point:

Production operations in the factories were prone to come to a standstill from intermittent deliveries of particular raw materials; as a result, those workers who regularly were appearing but finding time on their hands, gradually became conspicuous, thus creating a situation whereby they might be used elsewhere in work totally unrelated to direct production—such as the cleanup of burned-out areas, reconstruction operations, and even agricultural cultivation—as a result of which they further lost all incentive to work.

Another factor which enormously reduced labor efficiency and actual attendance was the frequency of air alerts and alarms. The phenomenon—especially after May—of workers streaming out of the large waterfront factories and hurrying toward the hills a mile away, was described by many informants. Despite a strict reduction in air-raid warnings in Kobe, knowledge of an "alert" in the region quickly penetrated the factories and was sufficient to initiate an exodus. The frequency and durations of alerts in the district—especially after May—is discussed in detail in the Osaka report. At Kobe, it was very difficult to recall workers and resume production once the exodus was under way. Thus, although Kobe itself was never a target after 5 June, production was frequently at a standstill. Thereafter, as the police report puts it in discussing this period,

The daily sounding of the alarms and the seeking of shelter from air raids greatly hindered the attendance rate each and every time. The feeling of fear of bombings was thus continuously intensified, causing workers to completely lose interest in production. They were interested only in the preservation of life and limb.

The foregoing discussion serves to fill out earlier comments on lowered productivity and attendance as a critical factor in delaying repair and recuperation. The police chief's report also points to an element of unreality in the factory attendance records compiled by his own office. Like the labor force and man-hour data compiled independently by the Survey, such figures record the official factory payroll and attendance statistics. In many cases during the last two or three months of the war, actual attendance and productive man-hours were considerably lower than indicated. There was frequently a serious lag in removing deserters from factory lists.

In concluding this general discussion of labor difficulties during the attack period, there is no occasion for attempting any final assessment of their consequences. The subsequent analysis of production trends within each major industry will include a more precise determination of the part played by reduced labor efficiency, desertion and absenteeism. To give general perspective to that analysis, this section will turn once more to the police report for a summary of the Kobe industrial labor picture in terms of the growth of absenteeism. In the following extracts, the police chief traces the growth of the labor problem through successive attacks, as measured by the depth and duration of abnormal absenteeism.

Attendance had remained well above 85 percent in Kobe factories through 1944.

Upon hearing news of the bombings of factories in the Tokyo and Nagoya areas, workers in the large factories feared the danger of bombings, and even though they had in mind the essential nature of wartime production, they gradually began to show signs of wavering * * * The bombings on 4 February of the Kobe and other Hyogo areas caused a precipitous drop in the attendance rate of the workers of damaged factories. Immediately after the bombings, the attendance rate had dropped 30 to 50 percent. However, the area of the bomb damage was limited and the factory officials took every possible means of relief and aid for the workers. Consequently, with the passing of the days, the rate of attendance climbed gradually, and from the general point of view of the entire labor force, no great effects were felt in the attendance rate and the production esprit de corps was in good condition.

Reactions to the March attack present a tremendous contrast, however, as the indirect consequences of widespread urban damage were felt by factories not otherwise affected.

As a result of the first great air raid on western Kobe on 17 March, not only were the factories themselves destroyed, but the number of workers who were burned out of their homes amounted to an enormous total. Those who were spared the burning of their homes were busily occupied in evacuating their relatives and saving their family fortunes, all of which further disrupted transportation, in turn, affecting the attendance rate, owing to jammed traffic conditions. In the city of Kobe, the attendance rate declined in the afflicted factories to 30 percent (the especially hard hit to 5 percent) while attendance in undamaged factories dropped to between 40 and 50 percent.

The suburban factories, which depended to a considerable extent on Kobe labor, also felt the attack.

In the essential factories in the various cities surrounding Kobe, such as Amagasaki, Nishinomiya, and Akashi,

the attendance rate of workers commuting from Kobe dropped to approximately 10 to 20 percent, due in part to fear of air raids and to the workers themselves becoming victimized, evacuating their families and personal property, and also on account of the disrupted and destroyed transportation facilities.

Likewise, those commuting to Kobe from nearby suburbs were seriously reduced in number. The factor was of importance out of all proportion to the numbers involved, since many factory executives resided in these outside districts.

After the March attack, attendance rates soon began to recover despite the heavy urban damage and the disruption of public services.

With the passage of time, reconstruction operations and normal production activities were again resumed. As soon as the individual workers had disposed of their personal businesses, the rate of attendance climbed gradually, so that two weeks later, on 2 April, the actual rate of attendance recovery for afflicted factories in the city of Kobe was roughly 50 to 55 percent, and for undamaged factories, roughly 60 to 70 percent. In the essential factories of the Kobe suburbs, the attendance rate had practically returned to normalcy. At the end of April, for afflicted factories within the city, it was from 60 to 70 percent, and about 70 percent for undamaged factories; while in the Kobe suburban factories attendance rates had gone back to pre-raid days.

It was after the June attack that an almost new phenomenon asserted itself in Kobe. This time there was little evidence of resilience.

In Kobe proper and in other afflicted areas, despite the fact that the prefecture took special measures to encourage attendance, and the factories took measures for the workers' aid and relief, the attendance of the workers dropped extremely, to from 30 to 60 percent and recovery was not easily effected.

Along with all the factors previously discussed, deterioration in living conditions, heavy plant damage, lack of repair labor, etc., the police chief stresses the cumulative effect of the air offensive—the mounting evidence of American air power in contrast to the puny resources for resistance and industrial rehabilitation.

Moreover, the morale and will to work deteriorated and became stagnant * * * Near and far, cities and metropolitan areas were being incendiary and bombed. Seeing the stark realities with their own eyes, people began to harbor doubts as to whether preparations for a victory were being made. With each passing day, their faith and confidence in final victory faded, and their industriousness in production continually ebbed.

PRODUCTION TRENDS

The analysis of production data in Kobe was carried out in the same manner as previously outlined for Osaka but, for a variety of reasons—principally the more simple and integrated industrial pattern prevailing—statistical information was much more complete. The industrial sample contemplated by the Survey actually approached the ideal—a complete inventory of the city's contribution to essential war production. As measured by labor force, industrial power consumption or value of output, the sample covered by factory questionnaires is believed to cover well over 90 percent of total industrial activity in Kobe.

It was also possible to arrange supplementary interviews with top management and production personnel at all of Kobe's major industrial concerns. Such on-the-spot discussions were of considerable value in clearing up questionnaire discrepancies and developing further information on the precise impact of labor, repair and materials problems.

It is obvious from the discussion in previous chapters that developments in the heavy-industry categories would dominate over-all production trends in Kobe. Thus with such basic activity as steel fabricating, shipbuilding and motive equipment accounting for 70 to 75 percent of the local output of employment and power consumption, it is remarkable that Kobe production rose to top levels at the end of 1944. Despite the over-all shortage of basic materials that had already developed in Japan, deliveries of end-products and even of basic fabrications did not slump until 1945.

Physical damage to plant facilities and components, absenteeism and declining labor productivity were the factors directly limiting output during 1945 in practically every plant. Of the city's 50 largest factory units, only two escaped direct damage and the incidence of complete destruction among small plants and workshops was very high. The very sharp declines in output after the February and March attacks, with new lows after 5 June rendered long-anticipated basic materials problems an academic matter as far as priority end-product was concerned.

Considerable attention is given to the position of the shipbuilding industry in Kobe on account of its predominant position and also because, as a voracious consumer of steel in a period of radical alterations in Japan's strategic and basic materials

position, it was peculiarly subject to production difficulties not ascribable to the urban attacks. The overly ambitious program for this industry was revised downward in February 1945 but activity until that point remained above the base-period average and was scheduled to continue at a substantial level throughout the year. The subsequent collapse was the result of minor plant damage and major labor difficulties. Although considerable ship repair activity was still being attempted at the time of surrender, the industry had little prospect of recovery, even though large stocks of basic materials were on hand and deliveries were continuing at a reduced but steady rate.

Along with production of railway equipment and marine engines, the motive equipment category includes a considerable amount of priority ordnance output and some basic steel fabricating. As with the steel products group, materials shortages had already had considerable effect before the first attack but had been compensated for, in company production and activity figures, by increased output of ordnance and other finished items. Not generally suffering heavy plant damage until the June attack, these groups were seriously handicapped by labor difficulties although shortages of fuel and basic materials were a direct limiting factor in steel fabricating, for two units, at intervals between February and June. Until March, official allocation cutbacks set the activity limit and thereafter one mill was temporarily held up, in May, by lagging coal deliveries. It is interesting to observe, however, that sizable coal stocks—sufficient for 30 days' operation or enough to supply the needs of top priority end-product producers in the city for many months—were always maintained in reserve at this plant. At the end of the war, materials receipts were actually improving from the June low and production was continuing at a much reduced level.

Electric equipment production was highly concentrated in Kobe and—like most other categories outside of the heavy industry group—represented a strategic importance out of all proportion to its relative position in adult employment and other indices. Heavily damaged in February, the industry never recovered, despite well organized repair and dispersal efforts. Repeated damage and labor difficulties were the dominant factors. The basic materials position was favorable in almost every respect.

Aircraft components and rubber-products in-

dustries were also producing at a high rate until they suffered very heavy damage in March and June. Both groups were relatively favored in labor and materials and plant damage was so heavy as to be decisive in most cases. Nevertheless, as with electrical equipment, strenuous repair efforts were attempted in certain key unit. Lack of replacement equipment and labor demoralization prevented any substantial achievement before the surrender and future prospects were dim indeed.

Production changes in the machinery industry were responsible for considerable unevenness before plant damage and components troubles came to the fore in March. Heavy damage to precision equipment and subsequent labor difficulties seemed to be dominant factors in the lack of recovery. Thus, an industry which was supposed to be contributing largely to critical ordnance requirements during 1945, and might have aided in repairing essential machinery for other end-product plants, was largely inoperative after June.

The Industry Survey in Kobe

The Urban Areas Division's analysis of production trends in Kobe followed the same methods outlined in the Osaka report and described, in more detail, in the Division's general report. However, in several respects, the Kobe investigation was more satisfactory than that carried out in Osaka or Kyoto. Adequately complete questionnaires were returned by all important manufacturing establishments in Kobe. In addition to the usual interviews with public officials and civic leaders, it was possible for members of the Survey to visit all major plants and discuss crucial points with the managers and production men concerned. Statistical data and written reports were supplemented in this way for all Kawasaki and Mitsubishi plant units, for Kobe Steel, Chuo Rubber, Nippon Airbrake, Kawanishi Aircraft affiliates and the Takatori Railway Shops. Factory units, thus covered, employed over 70 percent of the city's total pre-attack industrial labor force.

In Kobe and its suburbs, the Survey submitted detailed questionnaires to all industrial establishments which had more than 50 adult production workers employed at one site prior to the attacks. Returns were received from the majority of the factories. A few of these were incomplete in some respects. Supplementary investigation, however, made it possible to utilize all but a few factory returns. In the case of the other plants carried on

official records, no production records were available, which is not surprising in light of the high incidence of damage. However, in many such cases, units were acting as subcontractors to other local firms, making it possible to assess their contribution to end-product output and the effect of production loss. Such units, as has already been suggested, played a relatively insignificant role in Kobe. Thus, the questionnaire sample in Kobe proved to be of exceptional completeness.

Certain indiscrepancies in official and factory data will be noted in the following sections. In general, the most serious problem, as previously suggested, concerns payroll and attendance figures. Plant records frequently carried employees long after they had deserted their jobs. Especially during the last three months of the war, payroll records were known to include many in this category. A similar problem existed with respect to official data on man-hours devoted to productive work. Again, especially after the June attack, unauthorized absence during work periods became increasingly common in some of the larger plants, but there is no objective measure of the extent to which plant records overstate the amount of work performed.

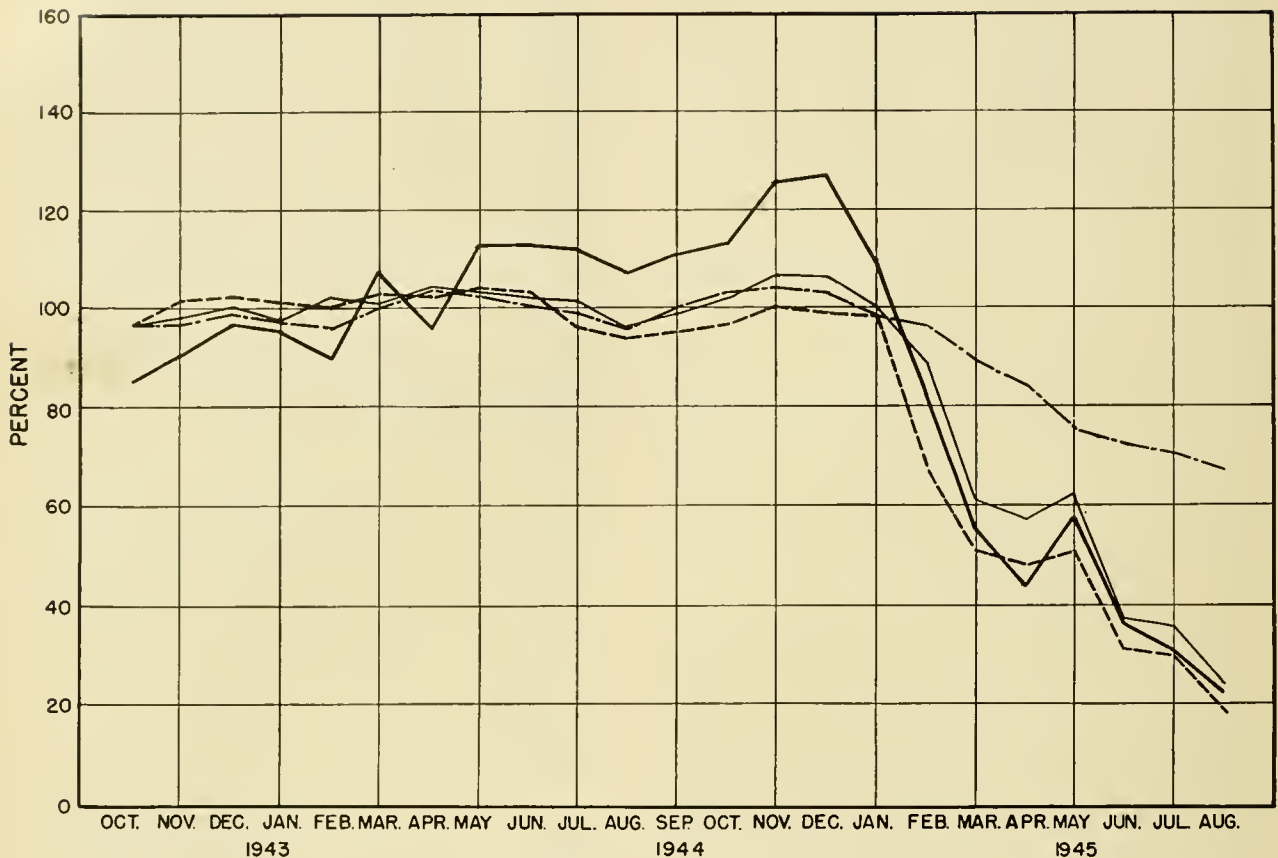
Over-all Production Trends

Exhibit 18 provides graphic illustration of general trends in Kobe production during the 1943-45 period analyzed by the Survey. As with all production data presented in this chapter, each index is based upon the average position of a given factor for the 12-month period, October 1943-September 1944.

Before commenting on this material, it will be helpful to consider the relative position of the various industrial categories in Kobe. In many cases, of course, assignment of factory units to a particular category is somewhat arbitrary and, in the case of major plants, will be discussed in the appropriate sections. The accompanying table summarizes data on the relative position of each industrial category (October 1943-September 1944 average).

Roughly 75 percent of the product value and 70 percent of adult shop labor and electric power consumption are covered by the three heavy industry categories—shipbuilding, motive equipment, and steel products. The various component categories had an importance for military end products out of all proportion to their size and call for careful attention.

ALL INDUSTRY KOBE



LEGEND

- PRODUCTION 66,220,000 = 100%
- ELECTRIC POWER 34,082,000 KWH = 100 %
- LABOR FORCE 95,737 = 100 %
- PRODUCTIVE MAN HOURS 224 MILLION = 100 %

EXHIBIT 18

	Labor force		Production		Power consumption	
	Adult shop workers	Percent	(In 1,000's yen per month)	Percent	(In 1,000 KWH's per month)	Percent
All industry-----	95,737	100	66,220	100	34,082	100
Shipbuilding-----	38,725	40.5	25,595	38.6	5,078	14.8
Motive equipment-----	18,211	18.0	12,794	19.2	9,321	27.2
Steel products-----	10,846	11.3	9,994	15.0	9,408	27.6
Electrical equipment-----	8,537	8.9	5,461	8.3	6,996	20.4
Aircraft components-----	6,794	7.1	5,132	7.6	980	2.9
Rubber products-----	5,414	5.7	2,564	3.9	1,219	3.1
Machinery-----	5,074	5.3	2,915	4.4	521	1.8
Miscellaneous-----	2,136	2.2	1,765	2.7	459	1.3

In examining the abrupt drop registered in Exhibit 18 for the critical January-July period of 1945, it is well to recall the extent of damage to factory installations in Kobe. Among those fifty

plants, each having a total labor force of more than 500 prior to the attacks, only two escaped some measure of direct damage. Among the 50-500 worker group, less than 20 escaped out of 169. By July 1945, 44 of the original 50 in the biggest size group still had a total labor force larger than 500, while 108, as compared with 169, were still employing more than 50. Only 374 of the 627 smaller workshops remained in existence. In general, the heavy losses among smaller plant units was not a determining factor in the severe declines registered by Kobe industry after January 1945.

Ship completions had been the most significant element in building up the production increase during the last two months of 1944. In January, the shipbuilding industry dropped back to within six points of its base-period average, so that other

factors, such as ordnance (found in this report under "motive equipment" and "machinery") and aircraft components took the lead in maintaining Kobe output at 110 percent. The abrupt drop in February—even more noticeable in the relatively stable electric power index—followed relatively heavy damage to a few large plant units and was succeeded in March, by widespread industrial and urban damage.

The February decline was mainly evident in the electrical equipment and motive equipment categories and in rubber products, but a 19 point decline also occurred in steel fabricating where production cutbacks, not damage, was the determinant. Even though the March attack did not come until the 17th, production for the month as a whole was affected seriously in almost every category. The electrical and motive equipment industries, not yet recovered from February damage to key units, fell the most while aircraft components and rubber products output appeared to be least affected.

Some recovery might have been anticipated in Kobe considering the nature of its industries, their priority position and the fact that factories in the eastern part of the city escaped in the March mass attack. Such recovery was witnessed in May, but only after a further drop, in April, affecting every industry but electrical equipment where the principal unit was recovering principally from the February attack. Shipbuilding in particular slumped during April as absenteeism and cumulative damage delayed completions.

May recovery reached 57 percent in production but only 51 percent in power consumption and 62 percent in productive man-hours. The 5 June attack, bringing production down to 36 percent and electric power to 31 percent, also saw a drastic decline in man-hours worked. This time there was no over-all recovery. With productive hours in the 20's and 30's, among the basic industries, there was little prospect for improved output in those plants not seriously damaged or of speedy recuperation in the others. Production fell deeply in the rubber product and aircraft components industries this time, with little prospect of recovery. And the combination of absenteeism and damage placed motive equipment as well as steel fabricating in a very poor position. Except for shipbuilding and electrical equipment, the over-all production and activity record for Kobe would

have been even less hopeful during the last two months of the war.

The analysis of critical factors limiting output in each industry during the raid period calls for separate examination. The following sections will consider each industry, and within these categories each major plant, in light of its production history during the period of analysis and the particular circumstances limiting output after the attacks. Attention will also be given to the production prospects of principal categories during the balance of 1945, under varying assumptions as to the absence of direct factory damage, local urban attacks, urban attacks elsewhere and rail transport interdiction.

This section concludes with a table summarizing data on the decline in output and activity for each category during the critical period from November 1944 through August 1945.

The Shipbuilding Industry (Exhibits 19, 20)

Shipbuilding, Kobe's most important industry, was dominated by two firms. The labor force estimates discussed in the previous chapter indicate that well over a third of all those employed in Kobe manufacturing prior to air attacks worked in shipyards or in firms contributing directly to shipbuilding. Questionnaire figures on adult shop labor place the percentage at 38 percent. Of the total labor force in this industry, almost 50,000 (more than 20 percent students) were employed by the Kawasaki and Mitsubishi yards.

The Kawasaki shipyard, with an adult shop force of more than 20,000 at the beginning of 1945, had been turning out carriers, cruisers, submarines, tankers and standard cargo types as well as supplying marine engines and auxiliary equipment to other yards. This Mitsubishi shipyard, with almost 16,000 adult shop workers, built merchant vessels, submarines, and auxiliary naval craft and also did considerable repair work on both naval and merchant ships. In addition, there were a handful of small firms in Kobe devoted to the repair of lighters and motor schooners used along the Inland Sea. Exhibit 19 summarizes activity data obtained by the Survey from shipbuilding and marine equipment firms in Kobe.

Production Trends

The tempo of launchings at Kobe increased steadily through 1943 and the first half of 1944. An interruption of this trend during the summer months reflected the tapering off of heavier naval building and shifts to other types of construction,

SHIP BUILDING KOBE

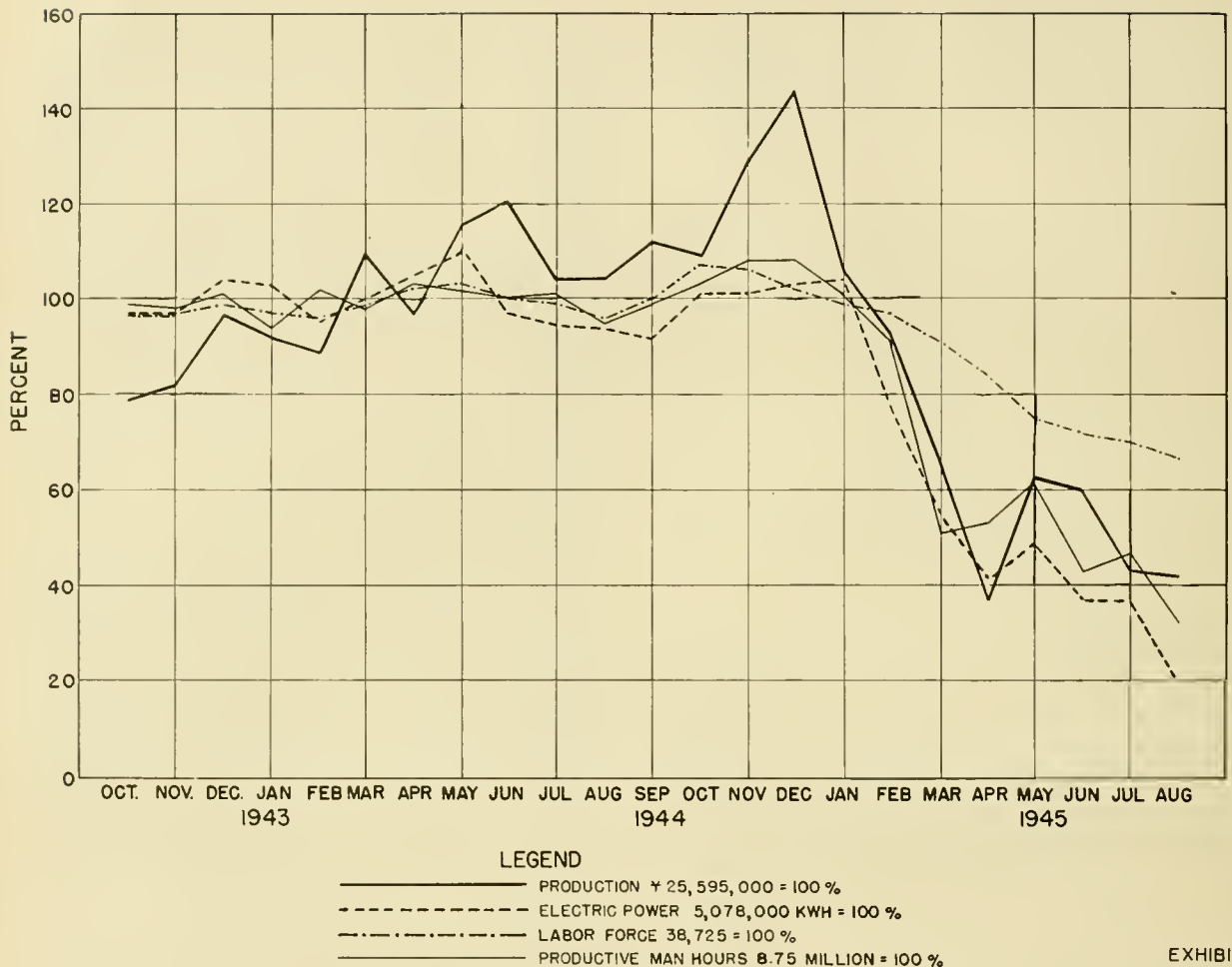


EXHIBIT 19

in line with the changing strategic and economic situation. Shipbuilding retained its high priority, however, as was reflected in all-time peak deliveries from Kobe yards in November and December. After this spurt, output at the 1944 rate was scheduled for 1945 in Kobe. But directly as the result of air attacks, the value of deliveries declined after January to less than 40 percent of schedule in April. The record improves somewhat during the following two months—due to more emphasis on ship repairs and to completion of deferred work. But after April, production figures are increasingly inflated by book credits allowed for work in progress.

Because of bookkeeping problems during the last months of the war and the irregular nature of ship launchings, electric power and man-hour figures provide a more accurate index of activity in

the industry than does money value of deliveries. As compared with the October 1943–September 1944 average, a drop during mid-1944 is clearly indicated in the use of power, followed by a steady increase to 104 percent in January 1945. Beginning in February, when the Mitsubishi yard was hit, there was a sharp and steady fall to 41 percent in April. After a slight revival in May, this index of activity fell to a new low of 37 percent in June and July. The trend in payrolls and productive man-hours also clearly underlines the change-over problems of mid-1944 and the production drive of the last quarter. Despite the New Year holidays, man-hours in January were maintained by heavy overtime at 101 percent. The effect of the March and June attacks on shipyard labor was decisive and will be discussed in greater detail below.

Basic Materials

Fuel and basic materials appear to have been adequate in Kobe shipyards to meet the building and repair program scheduled for the first half of 1945. But components problems arising from attacks on other cities would have begun to hamper second quarter construction even if Kobe had not been a B-29 target. Subsequent shipyard operations, in the absence of local attacks or components problems, would have depended on further allocations of basic materials, however, beyond those actually available as shipyard inventories or in the local fabricating pipeline. Fuel and basic materials continued to move into Kobe at a reduced rate until the surrender and the local fabricating mills were actually increasing output of ship plate and related items during the last weeks of the war.

In fact, inventories of steel products and other materials mounted rapidly during 1945, due to the collapse of shipyard activity following air attacks. This collapse was in the first instance a consequence of plant damage—mainly to machine shops and warehouses, not to shipways and ship repair facilities—but after the heavy area attack of 17 March labor problem became the dominant factor limiting Kobe shipyards. In the 11-week interval between urban attacks there was some recovery, but the failure to complete necessary dispersal and shop repairs and to resume scheduled deliveries was attributed primarily to manpower shortages and "listlessness".

Manpower

Labor problems were thus generally regarded as the most critical result of the air attacks. The industry's manpower position was already vulnerable, however. Employment in shipbuilding remained relatively constant until the first heavy urban attack, although there previously had been a high rate of turn-over. A large number of skilled workers were drafted during the latter part of 1944 so that additional adults as well as many students had to be recruited for the production drive of the last quarter. By this means and with the extension of overtime it was possible to achieve a record level of productive hours for November and December despite some loss of workers during December. With a further net loss of adult workers during January and the extended New Year holiday, productive hours in that month fell back to the base period average and, in February, productive hours dropped again, following damage to

one yard, although net adult employment almost held its own. But with the increasing dilution of the working force, morale and productivity were sagging.

March, the month of the first heavy area attack which dehoused almost 40 percent of Kobe's shipyard workers, saw the beginning of the heavy net decline in adult labor that continued until the end of the war. But there was also a very considerable labor turnover that month which does not appear in monthly pay-roll figures, as efforts were made to replace those workers who were known casualties in the March attack or who deserted the city with their families. Net employment totals continued to fall—due to removal from the payrolls of delinquent absentees as well as to the inability of authorities to replace those who continued to draft away. Overtime work by those remaining made it possible to claim an improvement in total productive hours during April and May but, as previously indicated, there was a growing amount of unofficial absenteeism. After May, even official records show a sharp and continuous decline in payrolls and man-hours. It was with a labor force declining in quality and quantity and in regularity of attendance that Kobe shipyards officials attempted to meet the problems of plant damage, shortages and dispersal during 1945. The indicated primacy of manpower problems must be examined in terms of the differing circumstances which prevailed in each major yard.

Mitsubishi Shipyard

The Mitsubishi yard was the first to suffer damage. After peak acceptances in December, basic activity here continued at almost the same level during January but dropped more than 40 percent as a result of damage in the test incendiary attack of 4 February. Repair efforts were undertaken immediately with the help of outside contractors as well as the firm's own labor force. Nevertheless, work on marine engines and auxiliary equipment was hindered considerably, with consequent delays to new construction. Ship repair work was not as seriously affected, however, and many of the damaged shop facilities were put back into operation during the following 6 weeks.

Heavy damage was again sustained in the 17 March attack, however, and this time it proved very difficult to organize repair activities. The firm continued to get some outside help but, in large part, promised construction workers failed

to materialize. This time the firm's own regular workers and supervisory personnel were forced to undertake most of the cleanup and repair efforts. There was singularly less achievement than in February. Absenteeism, resulting from the widespread delousing and the disruption of public services, became the paramount problem. There was also a marked decline in efficiency. Difficulties also arose in obtaining repair materials and equipment which delayed the process of reconstruction, but lack of manpower was as great an obstacle here as with productive work. Some dispersal of machining operations from heavily damaged shops was attempted, but labor and equipment shortages prevented its successful completion. Emphasis in productive work continued to be placed on the more urgent ship repairs after this attack, but despite official hopes and efforts no more new construction was completed during the course of the war.

Further light damage was sustained in the June urban attack, but the main effect of this raid was to accelerate reduction of the available labor force. The final blow was delivered on 24 July when a handful of B-29s dispatched to Osaka dropped HE on this alternate target, damaging most of the shop facilities still in operation. But by this time the Mitsubishi yard was already stricken. Activity for this last full month of the war was only 25 percent of the base period average as a result of previous unrepaired damage and irregular attendance.

The basic materials position at the Mitsubishi yard was relatively favorable. Deliveries dropped roughly 50 percent by July 1945 from the average rate during 1944, but part of this decline was a result of the scheduled cutback in the 1945 building program at this yard in favor of ship repair work. There was some drop in inventories from the 1944 level but, at the time of surrender, these remained sufficient for several months' operations at scheduled levels. This yard's components position would have been undermined in July—especially affecting completion of submarines—had scheduled operations been maintained through the second quarter, but relatively large and complete stocks had been built up before the attacks and these sustained relatively little damage. Deliveries dropped after the March area attacks on Osaka and Kobe, but were still maintained at fair levels until July. Because of the emphasis on ship repair rather than new construction, this yard was

relatively less vulnerable to components problems.

Coal deliveries fell off slightly after mid-1944 but inventories were permitted to build up through January 1945. After the February damage, deliveries were cut back so that inventories were reduced to a few days' requirements by June. Coal prospects were a matter of concern to the management but, up to the surrender, the general shortage had not been permitted to hinder operations here.

The principal limiting factor on activity prior to bombing had been adequate skilled manpower. The February production drop was the immediate result of plant damage. Subsequent to the March area raid, absenteeism and the over-all decline in labor productivity was the most critical element in delaying completion of necessary repairs and renewed output. If the Mitsubishi yard had not been damaged directly, labor problems still would have placed a ceiling on activity not far above what actually obtained, in the opinion of plant officials. Indirect rather than direct effects of the attacks were thus regarded as controlling. Components shortages would have begun to be serious after June, but basic materials would have been adequate at least through the third quarter, if working activity could have been revived. But after June, there seemed no prospect of overcoming absenteeism and "listlessness."

Kawasaki Shipyard

The Kawasaki yard, which was devoted almost exclusively to new construction, sustained no damage in the February raid. After the production drive in the last quarter of 1944, ship completions there were necessarily lower in January and February, but activity as measured by power consumption remained at top levels until the March attack. Severe damage to fabricating shops and warehouses on 7 March resulted in heavy losses of components and materials but the most critical problem was that of restoring machinery and metal-working equipment. An ambitious dispersal program was undertaken, which involved moving much of the yard's undamaged machine tool equipment into the Kobe subway.

Manpower problems were particularly serious in connection with this repair and dispersal program. Actual work on the shipways revived considerably in May and June, but slight plant damage in the June urban attack and a serious



PHOTO 17.—Looking southeast at part of Kawasaki shipyard, where 36 percent of total floor space was destroyed. Quonset huts have replaced satellite workshops, warehouses, and congested workers' quarters in burned-out area around the plant. Even modern concrete structures along thoroughfare leading out of yard suffered considerable damage.

drop in attendance and productivity brought further declines in July. The production credited to this yard after April represents "value added" rather than completed deliveries, however. Practically all second quarter construction was held up on the ways or in the fitting-out stage until the surrender.

Deliveries of basic materials to the Kawasaki yard were remarkably steady until March 1945 despite over-all downward revision of Japan's 1945 shipbuilding program. Part of the subsequent drop in steel deliveries might have occurred in the absence of air attacks on Kobe, as will be discussed in the section following. But inventories of basic materials were sufficient for three months scheduled operations at the time of surrender, despite the fact that deliveries had almost halted after June. Steel fabricating mills normally supplying the yard were still operating, however, at a reduced tempo, and actually increased their deliveries during the last weeks of the war.

In contrast to the partial interruption of basic material deliveries, coal deliveries continued at adequate levels through August and the yard was even permitted to maintain modest inventories. While future coal allocations were uncertain, Kawasaki could have been provided with sufficient coal requirements through late 1945 for scheduled production at the expense of other lower priority consumers—unless all coal shipments to Kobe had been cut off for an extended period.

Labor Problems

Limiting factors on Kawasaki output prior to bombing were skilled labor and, during late 1944, production problems growing out of the revised 1945 building program. Prospects for the first half of 1945 appeared satisfactory until the 17 March attack, although the anticipated drop in receipts of steel and other materials would have forced use of inventories which might not always meet required specifications and therefore would

KAWASAKI SHIPYARD, KOBE

1945 ABSENTEEISM

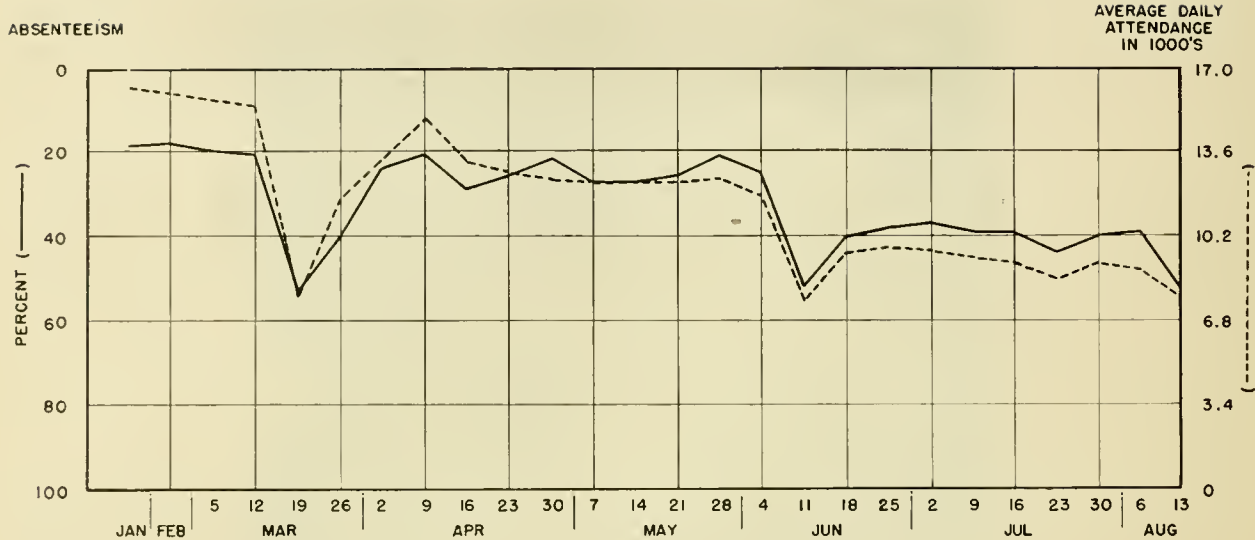


EXHIBIT 20

involve reworking. March damage to the shipways was minor and did not seriously interfere with hull work and actual fitting-out operations, but damage to machine shops called for large-scale diversion of labor in the effort to disperse and repair equipment. Although some outside help was obtained, the decline in attendance and lowered worker efficiency after this area attack was regarded by management as the principal reason for their inability to reorganize production effectively. Dispersed equipment was never restored to operation, although shortage of power-transmitting equipment and fixtures was also an obstacle along with labor problems.

Exhibit 20 presents weekly payroll and attendance data for adult production workers in this Kawasaki yard. Over one-third of the shop employees were dehoused in the March attack and some 3,300 were dropped from the payroll at once because they were known to have been injured or to have left Kobe with their families. Subsequent efforts to persuade such deserters to return were not successful, although the firm lim-

ited itself to published and mailed appeals. The authorities directed sufficient new workers to the yard to make up more than half the loss and some former employees returned after a few weeks.

Many of the new recruits, however, were wholly inexperienced or were casual laborers formerly employed on the wharves or in hauling goods around the city. They did not become satisfactory shipyard workers. The number of student workers was increased considerably but despite better discipline these were not satisfactory for the heavier and more skilled jobs. By extending overtime, the company endeavored to maintain work on the ways and expedite dispersal and repair of shop equipment. But an evident shortage of supervisory personnel and growing absenteeism handicapped these efforts. In addition, air raid discipline broke down seriously after March. At the first alert, workers would drift off to the nearby hills. The labor force continued to dwindle and prefectural authorities were no longer able to supply replacements. The collapse of local transportation forced most of the firm's employees to

reach their work on foot and contributed to food and housing problems. Despite efforts to supply food and clothing at the shipyard, many workers no longer appeared for their full shift.

After the June attack, no serious effort was made to drop chronic absentees from the company's books but the attendance figures make it clear that an additional large number of those dehoused left the city or no longer pretended to work regularly. Some consideration was given in late June to the use of police sanctions against delinquent workers but public and company officials agreed that such measures were neither feasible, or likely to improve conditions in the yards. The increasing tempo of B-29 operations in the region resulted in growing losses of man-hours from air alerts.

Conclusion

It is in these terms that labor problems were regarded as paramount in the shipbuilding industry. The caliber and morale of workers in this industry had been generally lowered prior to air attacks and neither the firms nor public authorities were in a position to cope with the housing, transport and food problems that contributed to the subsequent breakdown. In the absence of plant damage, manpower difficulties would not have been so decisive, but in large measure they formed the barriers to recovery in this industry after air attacks. In any event there would have been some decline in shipbuilding after the mid-year, but sufficient fuel and basic materials were available in Kobe to have completed the scheduled program for the first half year. Components problems—arising after area attacks on Kobe and Osaka—rather than basic materials shortages would apparently have presented the primary obstacles to scheduled third-quarter production. Whether, under more favorable circumstances, this industry might have continued to operate through the last half of 1945, would have depended on further deliveries of basic materials. After the June urban attack, however, there was little reason to believe that shipbuilding in Kobe would recover. The facts were evident to supervisory personnel and workers, further undermining both groups.

Motive Equipment

After shipbuilding, the most important industrial category in Kobe was that covering producers of motive equipment, which included rail-

way locomotives and cars, combat vehicles and internal combustion engines. Here, too, the industry was highly concentrated. Kobe Steel, with 11,000 adult shop workers on its January 1945 payroll, is included in this group because of its production of tanks and heavy diesel engines. This firm also made some steel as well as heavy castings and forgings for other Kobe industries, but by 1945 had shifted almost half its output to ordnance. Kawasaki Rolling Stock, with some 3,700 adult shop workers, was one of the major Japanese producers of locomotives and cars and also made some landing and suicide craft during the war. Also included in this group were two firms with less than 1,000 workers each producing gasoline and diesel engines for stationary power and marine use.

During the course of the war, output in this industry was subject to considerable variation—both as to type and to gross value—but remained relatively stable until February 1945, when the railway equipment plant was heavily damaged. As indicated in Exhibit 21, output actually had risen in terms of yen value after August 1944 to an all-time high in November, but this increase was the result of a shift to arms production at Kobe Steel which obscures the decline during 1944 in the output of railway equipment, basic steel and other heavy items of less monetary value. However, damage to all plants in March extended the February drop and, after slight recovery in May, deliveries almost halted by the end of June, the month when all plants were finally damaged.

Industrial activity as measured by power consumption slumped 15 percent during the third quarter of 1944 but recovered during the autumn and remained at this new level until February. Heavy declines in February and March and in June reflect the attacks of those months. In no case was there a subsequent net recovery.

Beginning in June 1944, the adult labor force in this industry fell steadily, mainly at the expense of railway equipment production. Some workers at Kobe Steel were also shifted to company plants elsewhere. There was a corresponding fall in productive hours with a slight recovery during the late 1944 production drive. From 89 percent of the base year average in February 1945, productive hours fell to 64 percent in March, when all units were hit, and continued to decline thereafter, especially after further damage in June and July. Here, as elsewhere, there is definite evidence that

MOTIVE EQUIPMENT KOBE

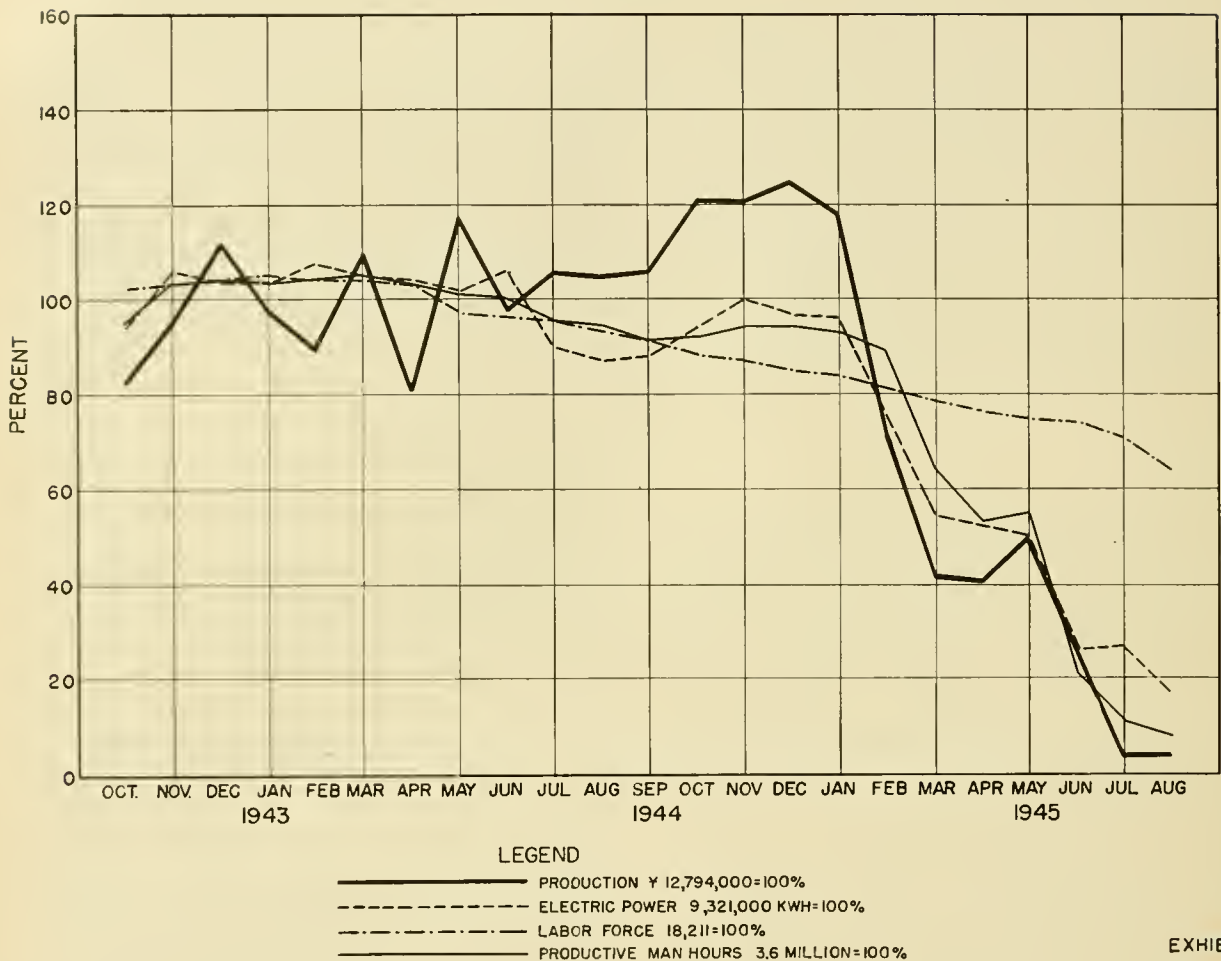


EXHIBIT 21

official payroll and man-hour figures give an exaggerated picture of attendance and productivity during the third quarter.

The factors responsible for this collapse varied considerably between the two chief units. Kobe Steel was accorded a relatively high priority on materials and labor until the attacks, while Kawasaki Rolling Stock was severely restricted from mid-1944 on. Because of their differing priority status and the variety of items produced by plants in this group, it is necessary to examine each in turn.

Kobe Steel

Kobe Steel, which was included in this group because of its tank and heavy marine engine production, reached peak output in January 1945, but tank production had been cut back severely after mid-1944 and main emphasis was then placed on

organizing the production of heavy antiaircraft guns. Marine engine and steel production remained an important part of the firm's output, however, although there was a slight scheduled decline in open-hearth activity. Thus in addition to integrated production of military items, Kobe Steel continued as an important supplier of steel forgings and similar items to the Kobe shipyards and to various ordnance and aircraft engine plants in the region.

Production of steel products was maintained at a high level until February 1945, when fuel and raw materials for this purpose were cut back sharply. Scattered but relatively heavy damage in March seriously reduced other types of production including ordnance, although repairs of essential machining equipment were completed by the end of April. At this point, components prob-

lems and absenteeism both presented serious obstacles to resuming scheduled levels of gun production. The modest amount of recovery achieved during May was not sufficient, however, to strain components supplies. Heavy damage to foundry and machine shops and warehouses in June brought ordnance output to a complete halt. Thereafter, productive activity was limited to forgings and other steel products, which continued at reduced tempo until the surrender.

Manpower Problems

Among the various production problems facing the management of Kobe Steel during the critical months of 1945, labor difficulties were given the first position. Previous to bombing, the plant had lost about 35 percent of its prewar skilled labor, although deferments were obtained for several hundred technicians and foremen in 1943 and almost 3,500 employees in 1944. Nevertheless, the adult shop forces was cut down from some 14,000 in December 1943 to 11,000 by the beginning of 1945. Assignment of student and conscripted labor was never adequate, primarily because the firm principally needed either skilled labor or workers with considerable physical stamina and few of those assigned could meet these requirements. There was considerable friction with local authorities over the firm's rejection of unsatisfactory labor.

Labor shortages began to place a positive limit on steel output in July 1944 (although the decline in raw materials receipts would have forced reduction in any event, especially after January 1945), and delayed the expansion of ordnance output during the winter. But the urban attacks created labor problems of a new magnitude that were never overcome. Attendance had averaged 80 percent prior to the March bombing and dropped to 60 percent thereafter even though the eastern part of the city, where this plant was located, was least affected. Seventeen percent of the adult shop force was dehoused in the March urban attack but about a third of this group was rehoused in factory dormitories. Nevertheless, lack of labor was the main limit on production during April and May. Time lost in air alerts also became serious.

Heavy damage to the surrounding residential area as well as to the plant in the June attack caused an almost total collapse of production. With over half the production workers losing their homes, attendance dropped to 30 percent for 2

weeks after the attack and rose only to 40 percent by mid-August. Aside from some production of finished steel, available labor was diverted after 5 June to repair of machine shops. While shortages of repair materials were critical at this time and the firm got no outside help in the organization of repair activities, absenteeism and war weariness among laborers and supervisors resulted in almost total failure to complete even those repairs that were feasible.

Materials Position

Deliveries of fuel and basic materials to Kobe Steel were relatively well maintained through January 1945, although the firm's inventories had been reduced steadily throughout 1944. Beginning in February, production of forgings and other steel products fell more than 75 percent due to allocation cutbacks but remained sufficient to meet the firm's own scheduled requirements for ordnance and other items. Coal deliveries were cut proportionately with those of pig iron and ingot steel. Because of production delays following the attacks, inventories of materials accrued and it was thus possible to increase output slightly in late July and early August. The effect of decline in the output of steel products was felt by shipyards and other firms supplied by Kobe Steel rather than by the firm's own ordnance and marine engine departments, but these too would have begun to experience some components shortages in April and May if desertions and absenteeism had not cut output in March. The decline in receipts of components after March were mainly the result of the area attacks on Osaka and Tokyo, although some local suppliers were also affected by the Kobe attacks of February and March. In general, however, the firm was relatively well protected against disruptions of components deliveries.

Thus while manpower problems were the immediate obstacle to end-product completions after the March attack, the indirect consequences of urban damage elsewhere would have limited output—at least temporarily—in another 30 days. By June, component shortages would probably have become as completely restrictive upon ordnance output as were the existing damage and labor problems. Although severely reduced as part of the effort to centralize steel making elsewhere, the firm's output of finished steel items for others was not far below schedule for the period after February 1945.

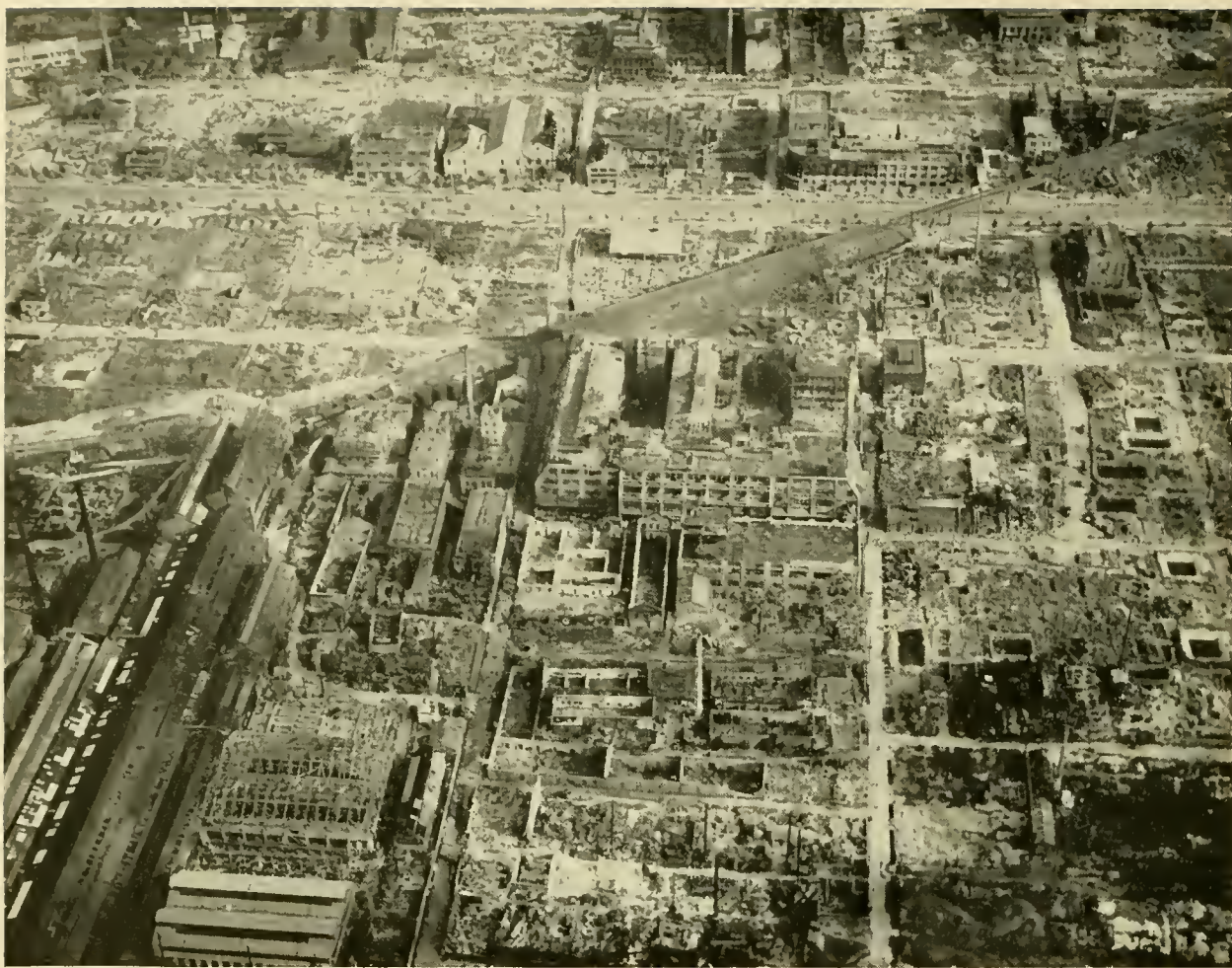


PHOTO 18.—Industrial damage in eastern Kobe. Part of the industrial complex seen in Photo 2 after incendiary damage sustained in the June attack. Although carefully firebreaked and protected, all units in this complex sustained very heavy damage. The Chuo Rubber Works, the four-story structure in the center of the photo, was completely destroyed, as were precision machining and heat-treating plants surrounding it and in the foreground. Only superficial repairs were completed on Kobe Steel Company fabricating units at left.

Kawasaki Rolling Stock

Kawasaki Rolling Stock provides a striking example of an industry discriminated against throughout most of the war but belatedly recognized as essential. About 5 percent of this plant's effort went into heavy AA components for the Kure Naval Arsenal. Also, minor production of motor boats and landing barges was undertaken, with final assembly handled elsewhere. Otherwise, this firm concentrated during the war on its traditional business of locomotive and car building. Repair work was not started until May 1945. Allocations of materials were first reduced in the second quarter of 1943. Deliveries were frequently delayed and shortages began to affect production plans seriously at the end of that year, although the management continued to maintain large in-

ventories built up previously. Peak output of rail equipment was attained in May 1944 and gradually declined some 30 percent by January 1945. Conscription made heavy inroads on the firm's skilled labor but replacements were supplied in sufficient number to bring the number of adults shop workers to a November 1944 peak of 5,000. Labor productivity had fallen drastically, however, and attendance rates of only 75-80 percent prevailed before the attacks—almost 10 percent below other factories in Kobe.

This plant was hit on four occasions—three times by incendiaries and once by HE. Heavy damage was sustained in the February test incendiary raid and the June urban attack, and slight damage occurred on 17 March and again on 24 July, when a handful of planes dispatched to



PHOTO 19.—In main assembly section of Kawasaki Rolling Stock Company. An anticlimax to the heavy incendiary damage visible in the background were several high-explosive hits sustained here in July 1945.

Osaka dropped HE here and on the nearby Mitsubishi Shipyard. No official outside help was provided after the February and March attacks to meet repair problems. Only when it was too late to be effective did the plant get official recognition. The nature of the equipment here did not lend itself to dispersal. Damage to auxiliary equipment and warehouses was very extensive although most of the essential machinery could have been operated in short order if electrical equipment, steam lines, and other such items had been restored. Output dropped 60 percent in February and another 20 percent in March.

After a very slight recovery between the heavy urban attacks, production practically ceased in June. Attempts to undertake large-scale railway repair operations were thus frustrated at the moment when the Takatori railway shops, which were also located in Kobe and normally handled over 75 percent of the region's rolling stock maintenance, also sustained heavy damage.

Except for steel and wood, no basic materials were received after February 1945 at the Kawasaki plant and components deliveries essential to new locomotive construction became increasingly spotty. The firm had managed to maintain substantial inventories of materials until 1945, however, but coal deliveries were on a hand-to-mouth

basis even earlier. Heavy damage to stocks of materials and components in February seriously undermined production prospects even if plant repairs could be completed, and this undoubtedly had its effect on plant managers and workers. Although few workers were dehoused in February, average attendance fell from 80 to 68 percent. The problem of "target-consciousness" was very serious. After the March urban attack, the plant was practically idle for a week and with almost 40 percent of the workers dehoused, attendance averaged 25 percent for the last half of the month.

Recovery during April and May was tardy but plans were under way to reorganize and restock the plant on a priority basis as part of the railway equipment maintenance program. The results of this improved priority position did not begin to affect output before the June attack eliminated the plant as a producer of new equipment. Subsequent efforts to clean up a few shops for use in locomotives and car repair were not successful. Throughout this period, shortages of repair materials were secondary to labor problems, however. Attendance rates fell to 40 percent after the June attack and did not recover. Labor discipline continued to decline. Thus this plant never played a significant part in the rolling stock repair program initiated in May. This large and well-equipped

works could have been of crucial importance after heavy damage was sustained by the near-by government railway shops in the June incendiary attack. Thereafter, central Japan was left with no significant railway repair facilities, as auxiliary shops on the outskirts of Osaka were also damaged in a June area raid.

Two Small Plants

Two producers of gasoline and diesel engines, with roughly 750 adult shop workers each and, in addition, almost half as many students, were also included in this industrial category. Output in each case dropped slightly from November 1944 peaks before the March attack but deliveries of basic materials and components were maintained and both had excellent inventory positions. One plant was very heavily damaged in March and never recovered, although about 30 percent of the staff stayed on to repair a few machine shops and turn out components for Mitsubishi Electric. The other plant sustained minor damage in March and production continued at about 70 percent of the previous level until June and 40 percent thereafter. Absenteeism was then the limiting factor, as stocks of materials and components were adequate to cover the reduction in current receipts. Coal deliveries were adequately maintained although no large inventories were permitted.

The experience of these smaller units on deliveries of materials is thus comparable to that of the large high-priority plant, Kobe Steel, although it would have been vulnerable to components shortages had plant output been maintained at scheduled levels. But the larger plants, whatever their priority, had manpower problems as a direct result of area attacks which they were unable to overcome. Kawasaki Rolling Stock was more drastically affected, but even Kobe Steel was unable to complete feasible plant repairs that would have permitted sustained end-product output. The data presented above on absenteeism and productivity are eloquent, especially in view of the fact that official man-hour and attendance data are known to understate the decline after March 1945.

Steel Fabricating

In addition to Kobe Steel, which was previously analyzed as a part of the motive equipment industry, there were two other large steel fabricating units in Kobe affiliated with the Kawasaki interests. Along with a few small foundries, these two

units accounted for about 12,800 adult shop workers at the beginning of 1945. The primary function of these mills was the supply of steel plate, castings and forgings for shipbuilding, marine engine production and related heavy equipment. Like Kobe Steel, one mill also had roughly three percent of Japan's open-hearth steel capacity. Their activity during the raid period must be examined in light of the over-all drop in coke, iron and steel output.

After mid-1944, the authorities were forced to reduce shipping requirements by concentrating remaining steel production at large integrated mills closer to sources of coal and iron ore. This decision led to a steady reduction in receipts of coal and pig iron at Kobe and curtailment of steel production. To a considerable extent, this planned decline was to be met by larger deliveries of ingot steel and basic shapes from outside mills. Local output of castings and forgings was to be maintained until April 1945 and then likewise reduced in favor of larger integrated mills elsewhere. In fact, both yen value and power consumption figures remained relatively high at local mills during late 1944, although local steel production had been dropping steadily during the last half of 1944.

As planned, the decrease in pig iron receipts was compensated for by larger steel ingot deliveries until mid-January 1945. Activity at these fabricating mills, as measured by power consumption, was maintained through that month but dropped more than 25 percent in February despite only slight damage, and almost as much more in March. As Exhibit 22 indicates, there was no net recovery during the interval between urban attacks and activity slumped heavily again in June. The factors responsible for the decline differed somewhat at the two mills, although they were functionally related.

Of the two Kobe fabricating mills operated by Kawasaki, the smaller Hyogo plant had some rolling facilities but the main emphasis there was on cast and forged steel items and some machining operations. Peak output was reached in November 1944. Operations were curtailed by 20 percent, however, before the unit sustained minor damage in the February raid and more serious damage in March. Productive labor was diverted to repair work and operations were cut to 50 percent of the pre-attack level before the plant received heavy damage in the June attack. Deliveries of raw materials were maintained during February but were

STEEL PRODUCTS KOBE

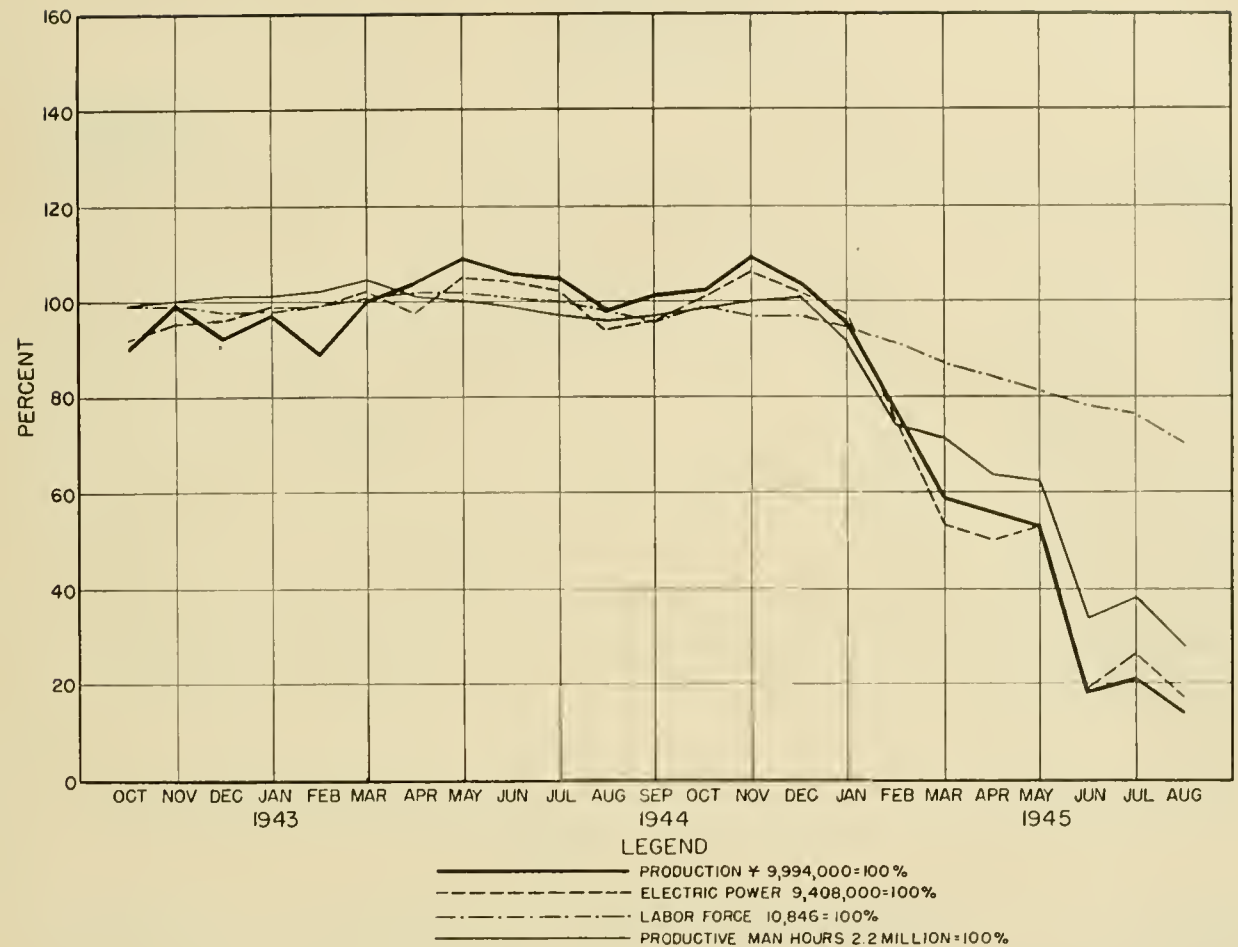


EXHIBIT 22

cut to 30 percent of the previous level in March and inventories dwindled steadily as plant activity was resumed beyond the level of materials receipts. Coal allocations were cut in accordance with activity.

Activity at the larger Fukiai works, which had open hearth capacity and sizeable facilities for rolling ship plate, reached a November 1944 peak as measured by power consumption, although its steel production had been severely curtailed here beginning in July 1944. But the main slump in production of steel plate started late in January 1945 as ingot deliveries dropped. Although plant damage was widespread in March and June, its effect on essential rolling equipment was relatively superficial and production facilities were restored during the interval between attacks far beyond the level of operations permitted by available materials.

Deliveries of materials continued to shrink until July, but the plant maintained inventories of pig iron and ingot steel sufficient for more than two months' output by reducing operations in accordance with current receipts. After reaching a low almost 80 percent below peak levels in June 1945, receipts of materials gradually improved to a rate of 35 percent before the surrender. Coal deliveries likewise were cut to 20 percent of pre-attack levels in June but inventories here were maintained consistently at one month's full supply until the war ended.

Both before and after the beginning of air attacks, availability of fuel and materials was the determining factor in output for both mills. But manpower problems would have placed a severe limit on activity in any event after February 1945. The general manpower situation at the Fukiai plate mill was comparable to that prevailing in

KAWASAKI STEEL PLATE MILL, KOBE

1945 ABSENTEEISM

ADULT SHOP FORCE

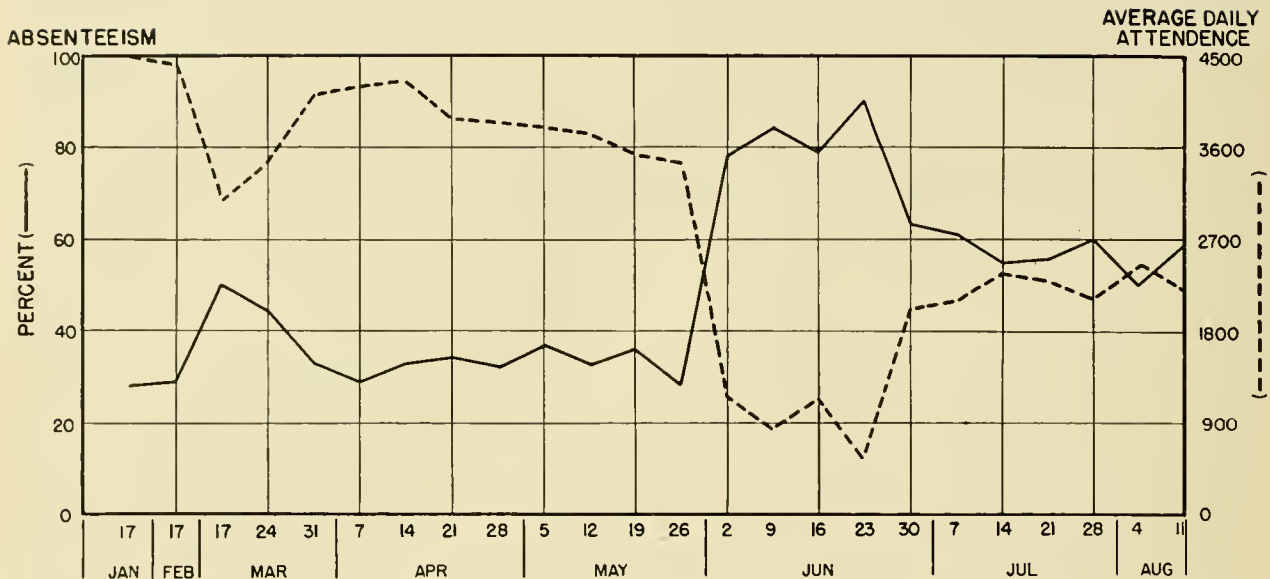


EXHIBIT 23

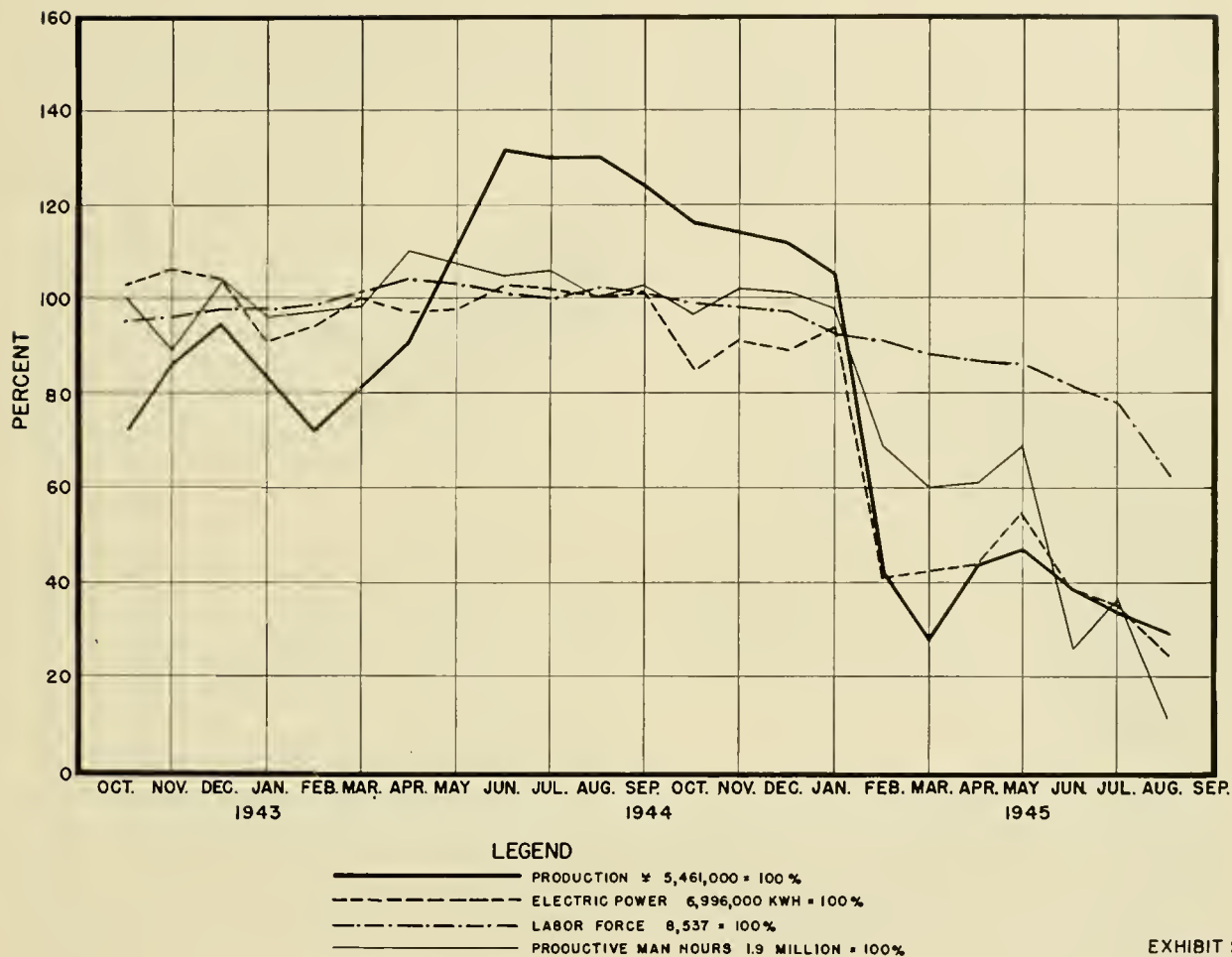
Kobe's other large plants. Dilution of the skilled labor force was more serious than at several key units, however. The total number of adult workers was maintained close to peak levels until 1945, but only by replacement of those drafted with unskilled and physically inadequate material. As a consequence, productivity declined and the attendance rate sagged below 75 percent in January 1945.

Reasons for the subsequent decline in productive hours are to be found in the fall in attendance to 50 percent following the March attack, although only 20 percent of the plant workers were dehousing. June represented the turning point in manpower, however. Attendance of productive workers was only 10 percent following the June attack, when over half the remaining adult labor force was dehousing. Attendance rates had recovered promptly after the March attack but continued to fall steadily for three weeks after the June attack. Exhibit 23 presents official data on attendance for this plate mill. Activity at the

Iyogo mill depended in part on materials supplied from the Fukiai affiliate but manpower problems were almost equally serious there.

The steel fabricating industry in Kobe was by its nature the most sensitive to the general decline in supplies of basic materials and to the related problems of bulk commodity movements. These problems have already been discussed. Allocations of basic materials to the Kobe fabricating mills determined their level of activity until the March 1945 urban attack. After repair of damage, they were again determining in late April and once again in mid-July. During May, a lag in coal deliveries at one mill led to reduction of operations below the level permitted by current receipts of materials, but the firm rigidly adhered to a policy of maintaining one month's inventory of all input items. Except for this one month, coal allocations were always barely sufficient to maintain activity at the rate permitted by other factors. Damage to the plant and equipment, although

ELECTRICAL EQUIPMENT KOBE



widespread, could have been repaired sufficiently but for absenteeism, especially after the June attack, which delayed much of this essential repair work for weeks. Thus manpower problems provided almost as tight a limit on output as did basic materials for the attack period.

Electrical Equipment

The electrical equipment industry accounted for about nine percent of Kobe's industrial labor force and 8 percent of its 1944 industrial output. It is of particular interest because it provides the only example in this city of an elaborate dispersal and subcontracting system and, as was so generally the case in Kobe, activity was highly concentrated. One firm, Mitsubishi Electric, dominated the industry and most of its critical assembly operations were performed at the main plant site even though

it directly operated or drew upon almost 100 other Kobe factories or workshops. Aside from this enterprise, which had 6,300 adult shop workers at its main plant in January 1945, there was only one other important electrical equipment producer in the city—Kawasaki Electric, an affiliate of Kawasaki Aircraft, with less than 800 adult shop workers. In addition, Kawanishi Machinery, the city's largest producer of machine tools and precision machinery, also turned out radio sets and some tubes and other communication components, but this will be discussed in the Machinery Section.

For reasons developed below, neither labor, power consumption nor yen output data provide a fully satisfactory index of activity in the Kobe electric equipment industry. During the period of analysis there was an important shift in the type of equipment produced. Output of heavy items

requiring a long production cycle and much electric power—both in manufacture and testing—was reduced during late 1944. Meanwhile, output of instruments and light electrical apparatus for aircraft and ordnance had been greatly expanded and much of the additional labor used in this program was employed by subcontractors. Product acceptances for the industry as a whole expanded remarkably during 1943 and reached an all-time peak in August 1944, 30 percent above the October 1943–September 1944 average, dropping back to 112 percent in December 1944 and 105 percent in January 1945 as output of heavy equipment was reduced. Attack damage cut this figure to 42 percent in February and 28 percent in March and subsequent recovery efforts were unable to restore production beyond the 50 percent level. Total power consumption dropped at the beginning of 1944 and again in October in response to the progressive shift from heavy equipment to production of instruments and other light electrical items for aircraft and ordnance. Power consumption figures for 1945 confirm the heavy decline in activity after the February and March attacks, with relatively little recovery before the June attack and new lows thereafter.

Kawasaki Electric

As suggested above, two concerns in this group warrant individual attention and, of these, Kawasaki Electric presents much the simpler case history. Altogether this firm had almost 1,200 on its payroll, of which a third were students, and produced electrical engine and airframe accessories, mainly for Kawasaki Aircraft. Value of output reached a peak in December and remained almost at this level until the plant was virtually destroyed in the June area attack. Activity as measured by power consumption continued to increase until the June bombing. The labor force remained practically uniform after reaching a November 1944 maximum. Absenteeism increased, especially after the March and May attacks, although not enough to prevent achievement of monthly quotas through subsequent overtime work. Utility gas consumption was reduced slightly after December but there was no significant interference with production. Deliveries of basic materials were cut after March but receipts of components remained high with very large inventories of both categories. The 5 June incendiary attack hit all 22 storage and shop buildings and there was almost total damage to

equipment and to inventories and semi-finished products. A major part of the labor force was deboused in this attack and, despite urgent efforts, only one shop had been rebuilt prior to the surrender. Without materials or equipment in working order there was no further completed production after 5 June and much of the labor force drifted away.

Because of its particular interest as the only major Kobe firm which had developed an extensive subcontracting and dispersal program, Mitsubishi Electric will be discussed separately as a case study of the general obstacles to industrial recovery in Kobe. This firm suffered its major damage in February and March. Since its activity predominates the production graph, the efforts of this firm to resume high-level output and to cope with indirect effects of the attacks can be clearly gauged.

Aircraft Components

Kobe, like Osaka, had no aircraft assembly operations within its borders at the time of the attacks. But the city had an important indirect part in the activities of both Kawasaki and Kawanishi, aircraft firms ranking among Japan's "big four" producers of combat types. Activities of both concerns were grouped principally in Kobe's suburbs and satellite towns. The city was thus important as a source of labor and the central point of contact with prefectural officials. In addition to electrical accessories and rubber products discussed elsewhere, Kobe firms also supplied components and subassemblies to these and other aircraft companies. A detailed analysis of Kawasaki and Kawanishi final assembly operations is provided in separate company reports prepared by the U. S. Strategic Bombing Survey, Aircraft Division. Except for the brief statement following, attention is here limited to affiliates and suppliers of these firms located within Kobe.

Aircraft Industry

All principal units of Kawanishi Aircraft Company, Japan's fourth largest producer of combat types, were located in the suburban districts east of Kobe and at Himeji to the west. Not only did many Kobe residents work in these plants but some of the larger factories in Kobe proper were among Kawanishi's principal subcontractors and suppliers of components. Additional subcontracting plants located in the eastern suburbs relied heavily on Kobe labor. The original plant of

AIRCRAFT COMPONENTS KOBE

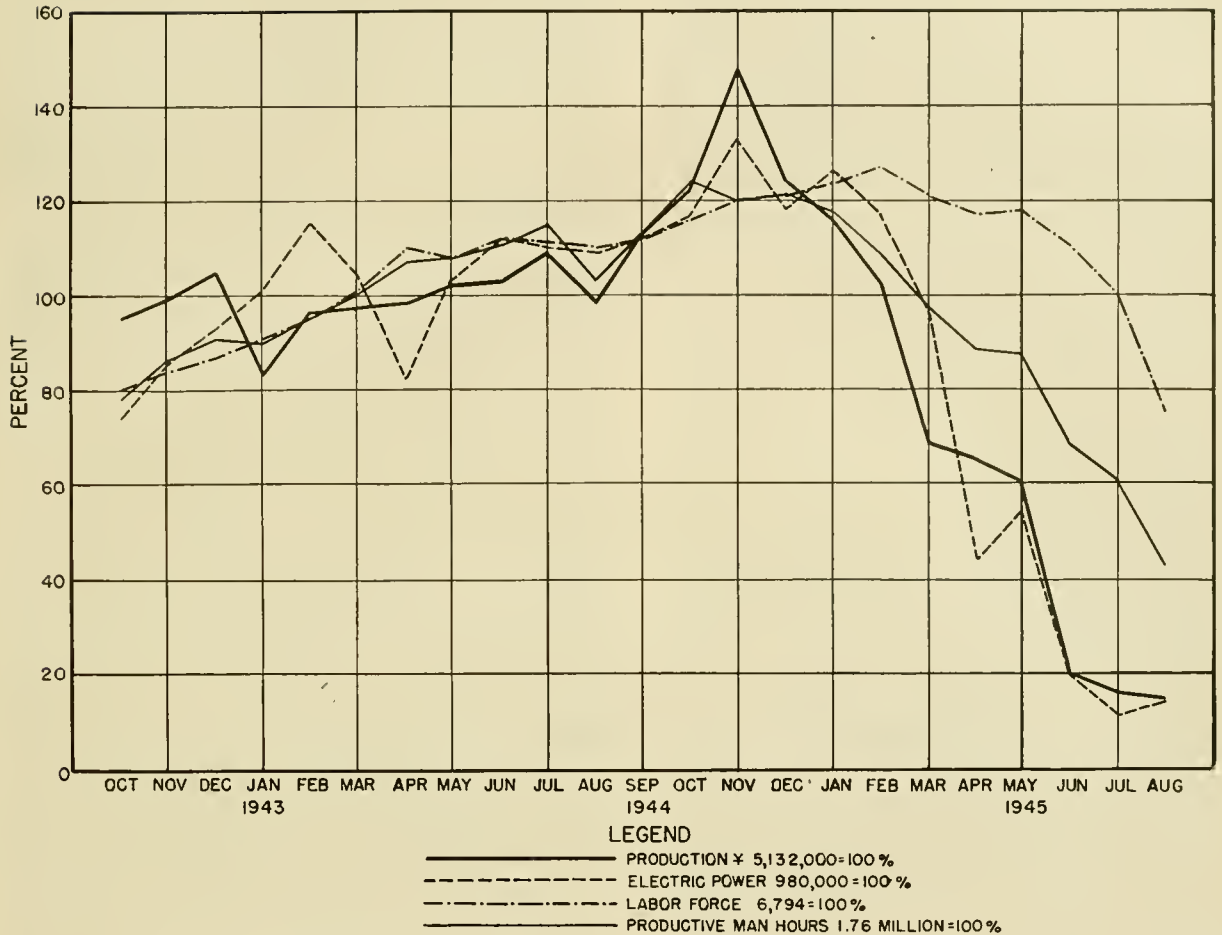


EXHIBIT 25

Kawasaki Aircraft, which ranged third among Japan's combat airframe and engine producers, was at Kobe. Prior to the war all final operations—both of engines and airframes—had been removed from Kobe to new large plants at Akashi, 15 miles west, and to a village midway between the two cities. By 1944, the Kobe works was concentrating on castings and forgings for the two aircraft engine plants west of the city.

In January 1945 the aircraft components industry in Kobe was dominated by three units with more than 1,000 regular adult shop workers each and several units in the 500–1,000 group. In addition, these plants during late 1944 and 1945 employed student labor averaging 20–40 percent of their adult shop force. Except for the Kawasaki plant, most of these units relied considerably on subcontractors located in Kobe, in Osaka, and in the intervening suburbs.

Plants surveyed in this group included a total of roughly 6,800 adult shop workers as of January 1945. This aggregate labor force had increased steadily through 1943–44 and reached peak levels in February 1945. A slight decline occurred in March and April but there was no serious drop until after the June attack. Output and activity as measured by power consumption was somewhat erratic but gradually rose to a peak in November 1944. Deliveries fell off sharply thereafter through March and again in June. Power consumption started on its big decline in February 1945 and, after some revival in May, settled along with deliveries at about 25 percent of the average for the October 1943–September 1944 base period. The principal firms in this top priority industry will be discussed below.

The Kawasaki plant reduced output in February after precision attacks on its principal con-

summer—the final assembly complex at Akashi. Labor was withdrawn to expedite the company's ambitious dispersal program, already discussed in the Osaka report. The plant suffered moderate damage in the March attack and again in June, but loss of materials was light. By the nature of its operations, the plant had no components problems, and inventories of all basic materials were maintained at a very high level. Nevertheless, output and activity fell precipitately after February and never recovered.

Coal deliveries, which had been reduced to a hand-to-mouth basis late in 1944, were now cut drastically, since the plant's output had run far ahead of requirements pending recovery in the firm's pre-attack engine assembly rate. Deliveries of materials continued, however, on a reduced and erratic basis and stocks were permitted to pile up in anticipation of high-level output later in 1945. But after June the remaining labor force began to drift away at an alarming rate and serious problems arose in the effort to repair June damage.

Nitto Aircraft Accessories Company, with over 2,100 adult shop workers and almost half as many students, was the largest firm in this group, specializing in oil coolers for Kawanishi and Kawasaki. Production reached a peak here also in November 1944 but remained at a high level until May. Located on Kobe's eastern outskirts, this plant was heavily damaged in the precision attack on 5 May on the Kawanishi plant closest to Kobe proper, and almost two-thirds of the shops had to be abandoned. There were also heavy losses in material. These inventories were built up again while most of the staff was used for repair work, but these efforts were nullified by further heavy damage in the June urban attack on Kobe. The labor force thereafter fell by 25 percent and absenteeism tripled. Further repair efforts were undertaken and receipts of materials was steadily maintained but little production was completed before further damage occurred in the 6 August urban attack on Nishinomiya. Almost 95 percent of the raw materials on hand and received between May and August as well as 90 percent of the work in progress was rendered unusable in the three attacks.

One of Japan's two major producers of railway airbrakes, the Nippon Air Brake Company, turned largely away from the railroad supply business during the war to production of aircraft propellor components, oil pumps and hydraulic items. From

a peak in November 1944, output dropped back to the previous level by January and remained constant until April. With well equipped shops and favorable labor priorities, this firm met indirect effects of the March attack with considerable success. Components shortages, mainly precision springs and valves obtained from Osaka and Tokyo before the March urban attacks, nevertheless forced a 30 percent reduction in output by June. As a consequence basic materials, which continued to arrive on schedule, piled up to unprecedented levels. The 5 June urban attack burned out over 80 percent of the plant including most of the components and considerable partly finished work. Efforts to salvage equipment and restore production had not progressed very far by August. In addition to its many students, the January 1945 adult shop force of over 1,200 had been increased 10 percent by June, and was still being maintained at the time of surrender.

Two typical medium-sized subcontractors were Oji Seiki and Yamamoto Koku, producing oil pumps for Kawasaki and airframe subassemblies for Kawanishi. Both of these were heavily damaged in the March area attack. Peak output was reached by them in November and December 1944. Oji had large inventories, part of which were lost along with 30 percent of the firm's equipment and two subcontracting plants. Receipts of materials were reduced to the level required for maximum subsequent operations, which averaged only 10 percent of the December peak. Further June damage brought this plant to a complete standstill. Yamamoto operated on a hand-to-mouth basis with respect to materials and when 75 percent of its plant and equipment were destroyed, receipts of material ceased. The labor force was maintained for repair work, however, although it gradually dwindled by 30 percent. Power consumption continued at 30 percent of peak levels, although no official production was accounted for.

There is no evidence that shortages of fuel or basic materials were ever permitted to place a limit on production for the aircraft industry in Kobe. Coal allocations were strictly supervised, however, and were cut back whenever other factors restricted output. Basic materials deliveries were continued for priority plants after damage or production lags due to components shortages and there is no evidence that resulting topheavy inventories of scarce items were ever reallocated.

This industry was highly favored in labor allo-

cation but suffered from absenteeism and desertions much as did other industries in Kobe. In view of the fact that all major units were heavily damaged in the various attacks, and final assembly operations elsewhere disrupted, no serious efforts were made to cope with this problem after May and June.

Rubber Products

The rubber products industry was of considerable importance in Kobe and had a vital role in the Japanese war economy. This industry was highly concentrated in major urban centers. Tokyo, Yokohama, Osaka and Kobe accounted for well over 70 percent of total output and among these Kobe ranked first, although only 31 of the country's 372 rubber-consuming factories were located here. Compared with other Kobe industries, this group was unique in that medium and small factories turned out a large share of the final products. Except for Kanegafuchi and Chuo Rubber, the two producers of rubber stock, key plant units each employed only from 150 to 400. One of Japan's big textile and rayon concerns, Kanegafuchi had undertaken the manufacture of synthetic rubber at its Kobe mill while Chuo Rubber, with 1,600 adult shop workers before the attacks, was one of Japan's three principal natural rubber processing and tire factories. These two plants were the chief source of supply for rubber products firms in Kobe and Osaka.

The Kanegafuchi mill, with almost 3,000 production employees including many students, had continued to produce some tire cord and other heavy textile materials. But synthetic rubber, first turned out on a commercial scale in December 1943, had come to represent 80 percent of output value by January 1945. During 1944, truck and auto tire production at the Chuo Rubber plant had been cut down in favor of airplane tires and various industrial rubber products and relatively more rubber stock was also supplied to other firms for manufacture of small components. Aside from a few minor producers of rubber shoes, all the other Kobe firms in this category specialized during the war in transmission and conveyor belting, in aircraft components such as fuel lines, self-sealing tanks and hydraulic hose, and a wide range of industrial and military products including rubberized uniforms, rubber boats, packing for machinery, and electrical insulating items.

After reaching a peak in April 1944, output in

this industry gradually dropped back to the late 1943 level as the manufacture of motor vehicle tires and fabrics was reduced at the two big units. But the steady increase in production of synthetic rubber, aircraft items and industrial products pushed output value above the base year average during December 1944 and January 1945. Up to this point, activity as measured by power consumption had clearly reflected these shifts from volume production to high-cost specialized items. Almost complete destruction of Kanegafuchi in February brought a sharp drop in both indices. This drop was extended in March, after heavy damage to practically all other units except Chuo Rubber.

Output continued to fall in April and May although power consumption recovered slightly in May as Chuo Rubber endeavored to make up some of the priority production lost in other plants. In the June urban attack, however, this large, well equipped factory was almost completely destroyed and activity fell below 20 percent of the base period average, with no possibility of subsequent recovery. Over-all figures do not give the full significance of the decline in Kobe's rubber products industry which started in February 1945. Output of aircraft accessories and industrial belting were the two most critical elements and maintenance of the latter during 1945 was necessary for completion of the region's repair and dispersal program.

Damage

Plant damage, including destruction of materials and finished goods was extremely heavy in this industry and by all odds the decisive factor in reducing activity. Twenty-nine of the city's 31 factory units suffered damage. Of the eight largest producing units, one was destroyed in the February test raid; six were heavily damaged in the March attack; the one remaining was destroyed in June and there was further damage to facilities that had been restored at the other plants. Damage to equipment was very heavy so that repair problems were in most cases insuperable. The Kanegafuchi mill was almost a complete loss and could not be restored. Nevertheless, because of their importance, outside repair aid was provided in March to several firms hit then, in order to maintain as much output as possible.

Production of industrial belting—so crucial to dispersal and repair efforts—was never restored after the March attack. Readjustment of produc-

RUBBER PRODUCTS KOBE

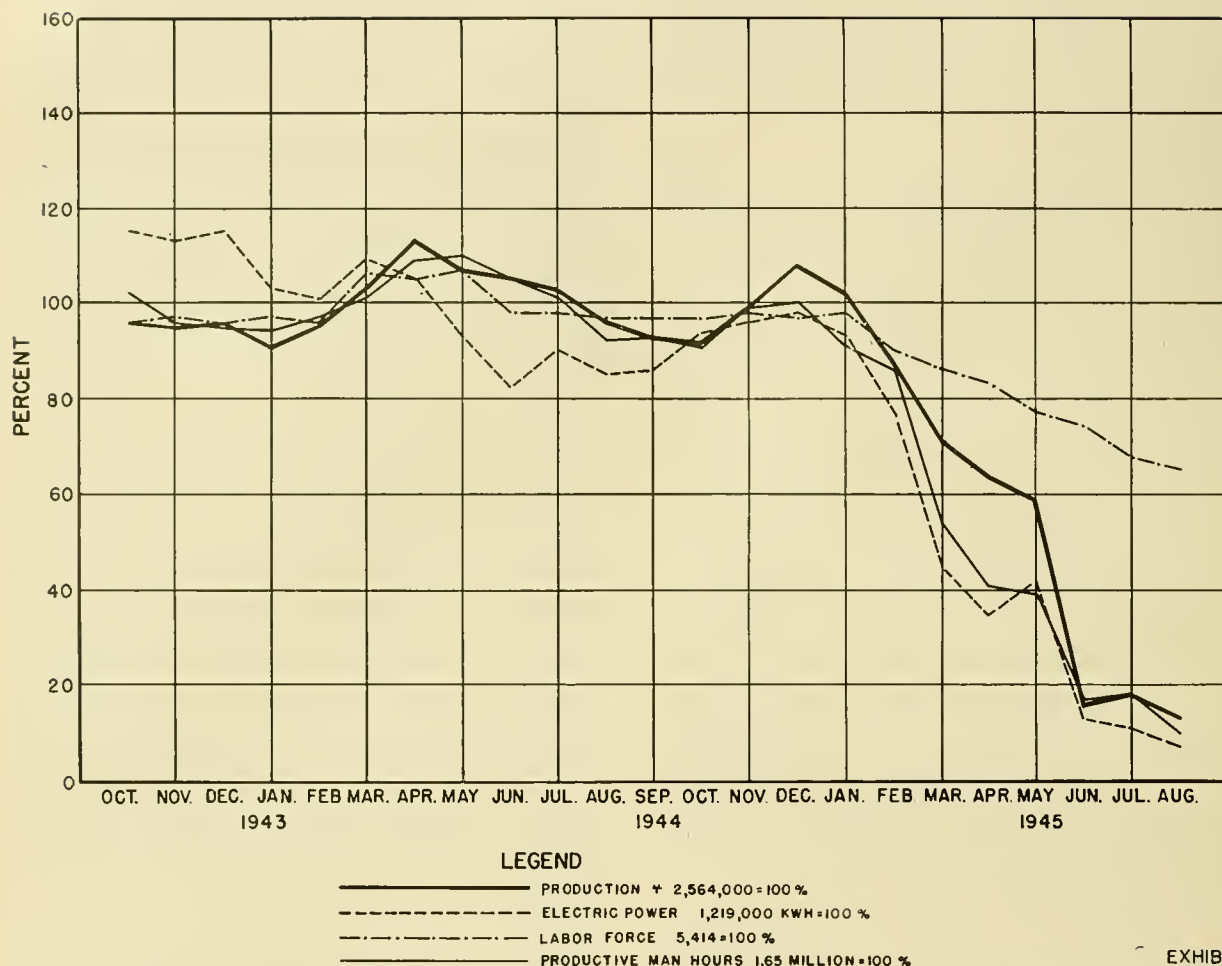


EXHIBIT 26

tion arrangements at Chuo Rubber made it possible to utilize labor and surviving facilities elsewhere in maintaining the supply of certain critical aircraft accessories until the June attack. Destruction of equipment and inventories was so great on 5 June that subsequent absenteeism made no significant difference. At the end of the war only one significant unit in this industry was producing any finished items.

Inventory and Allocations Position

In the absence of local urban attacks, this industry would have continued to operate at a high level on essential products at least through the third quarter of 1945. Plants turning out priority items had experienced no materials problems and generally had very large inventories at the time of the attacks. There had been some concern about future supplies of fabric for belting and deliveries

of sulphur fell off during early 1945 but there was an ample supply of crude rubber and synthetic rubber materials.

The only components problem noted was in connection with aircraft tube valves, where deliveries were cut off as a result of the March urban attacks on Osaka and Tokyo. But with more than three months' stock on hand, there would have been time to organize new sources of supply locally. Plants in this industry were large users of utility gas but none were permitted to experience any shortage of this or other fuel. The industry also received preferential treatment in the supply of labor and repair facilities, although official efforts broke down in June.

Manpower never became a directly limiting factor in this industry except at Chuo Rubber, the one important plant to escape damage in the March attack. Of its 1,600 adult shop workers, 350 were

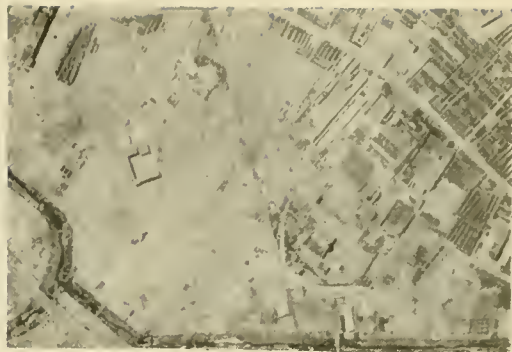


PHOTO 20.—Kanegafuchi Manufacturing Company before and after incendiary attack. Such one-story “saw-toothed” structures proved highly vulnerable. Interior equipment and stocks were totally destroyed. (See Photo 21.)



PHOTO 21.—Ground view typical of many Japanese factory structures. Part of the fire-damaged equipment had been removed before this picture was taken.

dehoused in that raid and absenteeism was a serious problem until dormitories had been set up by the management.

The effects of March damage to this favored industry were felt directly by one aircraft producer and by a large number of top priority plants located elsewhere and caught in the midst of dispersal programs by the lack of belting, hose and electrical items. Kawanishi Aircraft assembly operations were disrupted during April 1945 by lack of components, including some supplied by the Kobe

rubber products industry. The crucial relation of industrial belting production to the 1945 dispersal program has already been discussed in the Osaka report. Heavy damage to all three units of the Bando firm in the March incendiary attack on Kobe not only eliminated this important producer but also destroyed a large stock of finished belts which had been earmarked for specific dispersal sites. This loss was directly responsible for the failure of many dispersed ordnance and aircraft units throughout the region to get into production

before the surrender. It also contributed substantially to the delays in local repair and dispersal programs for priority plants.

Machinery Industry

Along with a number of smaller units producing machine tools and precision machinery in Kobe, there were three important plants. Kawanishi Kikai, with almost 2,300 adult shop workers in January 1945, had developed a large prewar production of lathes, milling machines and shapers. But it also produced a variety of precision machinery products and electronics items. A small but completely integrated radio tube works was located here. During the war, production of communications equipment was particularly expanded, with a branch plant being established at Akashi. And, like many other machine tool producers, Kawanishi Kikai also moved increasingly into production of precision ordnance items.

Activity was maintained here at a high level until March although considerable unevenness in deliveries developed after July 1944 as important production shifts were initiated. After very slight damage in February, the plant sustained heavy warehouse losses in March and some destruction of precision equipment. Components problems were further aggravated by March incendiary damage to suppliers in Osaka and Tokyo, causing a sharp break in communications output. With fairly large stocks of materials, machine tool repair and ordnance component output was maintained until further damage occurred in the March attack. Thereafter absenteeism, plus a July components interruption, brought a further serious decline.

Teikoku Seimitsu, with almost 800 adult shop workers, concentrated on production of new machine tools until 5 June when over 80 percent of the plant and equipment was destroyed. Production of new tools—primarily for the aircraft industry—were cut back in December 1944 and the firm endeavored to develop large-scale production of bomb release mechanism and fuses. Some dispersal was undertaken but had not reached the production stage before the June attack. Large inventories of all basic materials except brass were on hand and the firm's components position was also very good, even though receipts had been reduced after March and certain items, such as bearings, were cut off completely. Not until virtual

destruction of the plant in June were basic materials deliveries cut off. Heavy losses of ordnance components at that time prevented organization of that priority output at dispersal sites prior to the surrender, although repair efforts were underway by the firm's dwindling labor force.

Chiyoda Optical had only 350 adult workers in its Kobe plant but a proportion of these were skilled workers making lens for military instruments and spectacles. Some instrument assembly was also performed. All output went to the Army Air Force and increased steadily to a January 1945 peak but activity, as measured by power consumption, continued to soar until the plant was burned in March with fatal damage to precision equipment. This plant's position with respect to basic materials and components was also favorable, with receipts steadily increasing until the attack, although production demands had seriously eaten into some inventories prior to the March debacle.

It is concluded that the precision machinery industry, although relatively unimportant in Kobe, was accorded very favorable treatment in allocations. Direct plant damage was the determining factor in the collapse of production at the smaller units. A combination of damage, components interruptions and, finally labor difficulties were determining at Kawanishi.

Miscellaneous Industry

Plant questionnaire data was obtained in a number of plants not related to categories previously analyzed. Included were textile and lumber mills, food processing plants and comparable activities, most of them small and concerned with the civilian market. From a military standpoint, the most important unit was Koizumi Hemp Company, a large producer of rope, burlap and canvas materials which was operating at a relatively high level until damaged in June. A sugar refinery, a flour mill and two lumber mills were damaged in the first February attack and many small units were destroyed in the heavy March and June attacks.

Activity for this group first dropped in January 1945, when the New Year's holidays were generally respected. Activity, however, was already declining in the last quarter of 1944 although sales continued at peak levels until January 1945. An exhibit clearly shows the extent of the decline during the attack period, with man-hours being maintained above the other indices as efforts were made

MACHINERY KOBE

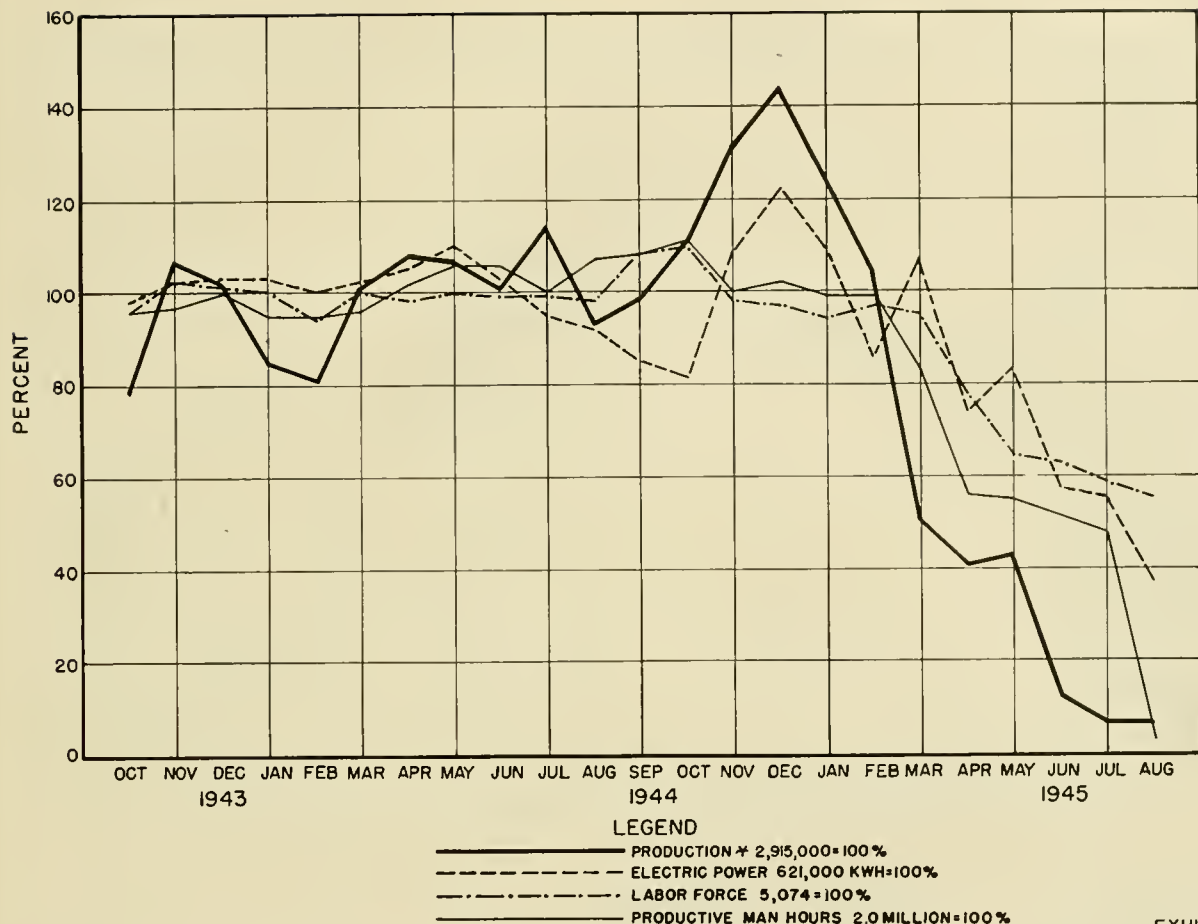


EXHIBIT 27

to continue woodworking and other activities in mills where power equipment had been destroyed.

Among the important plants in this sample, only the hemp mill was capable of large-scale operations after March, but absenteeism and prospective materials shortages were responsible for partial curtailment there in March and April. No effective aid was forthcoming from the authorities for industries in this group during the critical March-August period of 1945.

A CASE STUDY IN PRODUCTION DIFFICULTIES—MITSUBISHI ELECTRIC

Of all Kobe firms, Mitsubishi Electric provides the most interesting case study of urban attack and other effects on priority activity during the critical 1945 period. This company produced a wide range of priority electrical items and came under the jurisdiction of all major planning and production agencies. It required a large variety of basic

materials and components and had organized an extensive subcontracting system. Prior to the attack period, several new plants had been established in outlying cities. In addition, the firm dispersed many operations to sites throughout the city during 1945 and utilized a large amount of student and female labor. Thus, its production achievements and difficulties throw light on practically all aspects of the administrative and economic situation at Kobe during the period of attack.

The firm's main Kobe works, as well as several of its dispersal sites and many of its local subcontractors, suffered damage in one or more of the urban attacks. But both through its Mitsubishi affiliates and its own resources, this concern had unique human and material facilities for coping with such damage and for maintaining output of top priority items, despite shortcomings in the official machinery for aiding essential enterprises.

MISCELLANEOUS KOBE

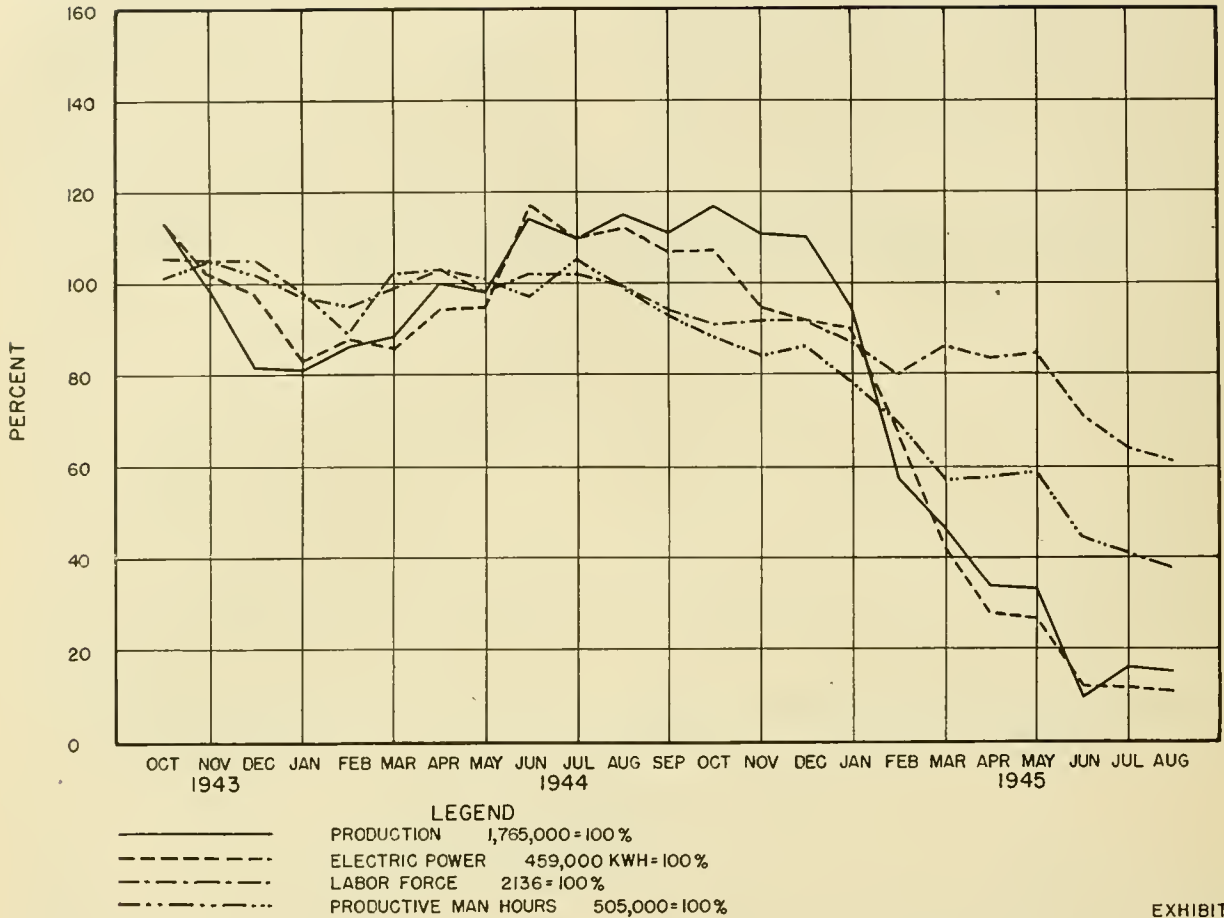


EXHIBIT 28

Mitsubishi Electric had been one of Japan's three chief producers of heavy electrical equipment and also manufactured a wide range of electrical accessories for industrial use. The firm also had a heavy equipment plant connected with the Mitsubishi shipyard in Nagasaki and accessories plants, in Tokyo and Nagoya but the bulk of the operations were centered at Kobe. In 1938 Army and Navy orders suddenly doubled to 30 percent of total business and the company started an expansion program at Kobe which continued into the last year of the war. In 1941 production of certain radio and aircraft items and power distribution equipment was transferred to a new factory at Itami, midway between Kobe and Osaka. Three other large plants were established in nearby towns during 1943 to make bombsights and bomb release mechanisms and various aircraft engine and propeller accessories.

Military orders increasingly encroached on other types of activity after 1938. In 1941, production of public utility and other industrial items tapered off almost completely and direct war items came to represent 80 percent of the firm's business. During the war the Kobe works concentrated on two types of production. Heavy marine equipment, including propulsion and auxiliary gear, was installed in submarines, carriers, and cruisers as well as merchant ships built at local yards. At the same time, the factory steadily increased its output of aircraft and ordnance items.

The Kobe works produced instruments, servomotors and other electrical fixtures for aircraft and for tanks, anti-aircraft guns, and heavy ordnance. This production, which took on even greater importance after mid-1944, was independent of the three branch plants for aircraft accessories established at Wakayama, south of Osaka, and at

Name of agency	Location	Function	Reports submitted		Applications submitted
			Subject	Schedule ¹	
1. Munitions Ministry, Aircraft Bureau	Tokyo-----	A/C instruments production and procurement.	Output; labor; production bottlenecks.	M	Materials for A/C instrument production.
2. Regional Branch	Osaka-----	"Direct support" on supplies—dispersal.	Same; dispersal program--	M	Materials (follow-up); construction, transport and other requirements for dispersal.
3. A/C Industry Control Association	Tokyo-----	Production scheduling and allocation of materials.	Production data and forecasts; material bottlenecks.	Q, M	Material requisitions for A/C electrical equipment.
4. Munitions Ministry, Machinery Bureau	Tokyo-----	Allocation of new machinery and electrical equipment.	Production; labor; dispersal; equipment requirements.	M	New equipment.
5. Regional Branch	Osaka-----	Allocations and repair of equipment.	-----	-----	Repairs; follow-up on new equipment.
6. Navy Technical Department	Yokosuka---	Production and supply for naval shipbuilding.	Output; labor; production problems.	Q	Authorization for materials and emergency allocations.
7. Kobe Office	Kobe-----	Inspection, expediting	Output	W	Requisitions for materials.
8. Maritime Electrical Control Association	Tokyo-----	Supplies for naval electrical equipment.	Output, production schedules and requirements.	M	
9. Regional Branch	Osaka-----	Supplies (follow-up)	-----	-----	Materials allocation for RR electrical equipment output.
10. Communications Ministry, RR Equipment Division	Tokyo-----	Assignment supplies and allocations for electrical equipment for RR commission department.	Production bottlenecks	Q	
11. Electrical Equipment Control Association	Tokyo-----	Assignment of equipment allocation orders.	Production data; bottlenecks.	Q, M	Materials for all other output.
12. Kinki Branch	Osaka-----	Same; emergency reassignments.	do -----	M	Allocations for iron and steel products.
13. Munitions Ministry, Iron and Steel Bureau	Tokyo-----	Allocation of castings and forgings for A/C items.	Requirements, inventories.	M	
14. Kinki Branch	Osaka-----	Iron and steel.	-----	-----	Requisitions for iron and steel products.
15. Iron and Steel Control Association	Tokyo-----	Assignment of orders.	do -----	M	
16. Regional Branch	Osaka-----	-----	-----	-----	Requisitions for light metals fabrications.
17. Light Metals Control Association	Tokyo-----	Assignment of allocation orders.	do -----	M	
18. Regional Branch	Osaka-----	-----	-----	-----	Requisitions for insulating materials.
19. Munitions Ministry, Chemicals Bureau	Tokyo-----	Allocation of insulating materials.	do -----	M	
20. Regional Branch	Osaka-----	-----	-----	-----	RR cars for shipments and dispersal.
21. Communications Ministry, RR Car Control Bureau	Tokyo-----	Allocation of rail transportation.	Requirements	M	
22. Osaka Bureau	Osaka-----	Detailed requests based on Tokyo authorization.	do -----	W	RR cars for shipments and dispersal.
23. Army Air Force Headquarters	Tokyo-----	Inspection, supply, research.	A/C instruments; technical and production problems.	1	Labor requirements.
24. Osaka Office	Osaka-----	Inspection	Output; production problems.	W	
25. Kasai Branch	Takaradzuka-	Technical assistance and special supplies.	-----	-----	Critical supply shortages.
26. Navy Air Force Headquarters	Yokosuka---	Inspection and control; supply expediting.	Output	W	
27. Kobe Office	Kobe-----	Same	do -----	W	Critical supply shortages.
28. Army Arsenal Headquarters	Osaka-----	Inspection, supply expediting.	do -----	W	
29. Hyogo Prefecture	Kobe-----	Labor recruitment; dispersal site; food and clothing ration.	Labor data and problems.	M	Factory rations, dispersal sites, labor.
30. Kobe Labor Office	Kobe-----	Labor assignment and control.	-----	-----	Labor requirements.
31. Kobe Police Bureau	Kobe-----	Factory ration, civil defense, labor discipline.	Pay-roll and attendance data and labor problems.	M	
32. Industrial Service Association	Kobe-----	Housing, food, morale.	Labor data and problems.	M	Housing; employee welfare.
33. Japan Coal Association, Regional Office	Osaka-----	Fuel	Requirements, inventories.	M	Coal, coke.

¹ Schedule for Reports Submitted:

Q = Quarterly.

M = Monthly.

W = Weekly.

1 = Irregular.

Himeeji and Fukuyama, west of Kobe. To simplify operating problems, the Tokyo, Nagoya and Nagasaki electrical equipment plants owned by Mitsubishi were integrated with their local aircraft and shipbuilding affiliates, thus concentrating management of units in the Osaka region through headquarters at the Kobe works.

Basic Materials. Mitsubishi Electric's basic materials position was very favorable although the official allocation system was a source of continual

irritation to management. Through fiscal 1943, 80 to 90 percent of each steel requisition was delivered on schedule and the figure was about 70 percent for copper requisitions and 80 percent for fuel. In fiscal 1944 (i.e. April 1944 to April 1945), copper deliveries actually improved to 84 percent of requests although the score on steel products ranged from 60 down to 40 percent. Fuel deliveries were deliberately reduced in light of plant inventories to only 60 percent of the requisitions

granted for this period, as a result of the plant damage during the last quarter. After March 1945, with plant activity seriously reduced, copper products deliveries still met 60 percent of planned allocation and steel deliveries, like fuel, were cut to 30 percent.

So much for the over-all timing and volume of deliveries, even during the attack period. With the exception of a few specialized items, Mitsubishi Electric held large stocks of materials throughout the war. Very large inventories of all basic requirements were built up prior to Pearl Harbor and, in many cases, were even expanded thereafter despite rapidly increasing consumption. For this latter reason, copper stocks dipped in late 1942 but were restored again by 1944. Steel and aluminum inventories declined during 1945 and there were other specific shortages but, in general, basic inventories were always maintained at levels far above current requirements. As discussed previously, there was no effective means for controlling excess inventories, except in coal, and it behooved management to create maximum reserves of materials, whether for direct use or for unofficial "trading."

Thanks to the priority status which it enjoyed with the Munitions Ministry on aircraft items and with service procurement officials on other output, the company got excellent treatment on emergency allocations. Where necessary informal methods were used to supplement various official requisitions. Thus the firm bought its own vessels to assure exploitation of opportunities to obtain extra basic materials, and "traded" where necessary to insure preferred treatment by suppliers. On balance it appeared to profit through its long-standing business connections with other Mitsubishi affiliates, its wide range of priority output and the complexity of its operations—at the expense of average producers, in the confused scramble for scarce materials. During the attack period, its relative advantages became even more apparent.

In general, then, Mitsubishi Electric had no serious materials problems but the management experienced an enormous amount of frustration in the process of building up and maintaining a favorable inventory position. The following table lists most of the official agencies to which the firm regularly submitted reports and through which it negotiated on production changes, manpower and

materials allocations, and other problems.

Aside from the enormous amount of paper work, there was considerable diversion of management effort for official negotiations in Osaka and Tokyo and unofficial dealings with potential suppliers and brokers. The company did have shortage problems—but not in bulk materials. Special types of silicon steel became unobtainable in 1945 and there was a chronic difficulty with certain gauges of copper wire. Insulating materials, including mica and varnish, various plant maintenance items, and transformer oil also had been hard to keep in stock. Such supply problems were primarily an outgrowth of the "black market" conditions discussed in the Osaka Report. In general, the firm's unofficial endeavors in this respect were highly successful, even during the raid period.

Fuel was never a serious problem, although electric power rationing required night operation of heavy equipment two nights each month, causing inconvenience to part of the staff and lower productivity. Gas supplies were always maintained and coal deliveries were regular although strict inventory limitations were imposed. Like most concerns turning out ordnance and aircraft components, Mitsubishi Electric used a very small amount of coal in its operations. As long as electric power was abundantly available, there was little need to worry about energy requirements—especially when thousands of tons of coal were on hand at nearby heavy industry plants.

Components

Mitsubishi Electric operations were highly integrated so that it was relatively insulated from the production difficulties of independent suppliers. With a wide range of directly controlled production facilities, the firm itself was in position to cope with components' interruptions of most types. But receipts of certain items for which it was dependent on outside sources did become erratic after January 1945. These included high-speed bearings for small motors, insulation blanks, and various frames and fittings. In general, interruptions were due to temporary transport delays following initial attacks on the Nagoya and Tokyo regions and also to damage in the urban attacks. Due to production losses imposed upon the concern, such interruptions did not directly affect output and, in most cases, substitute produc-

tion arrangements could have been worked out in the absence of local attacks.

Dispersal

The earlier dispersed-expansion program of Mitsubishi Electric has already been described. This establishment of new, integrated production units at Itami, east of Kobe, and at former textile mills in three other cities in the region, provided management personnel with invaluable experience for the 1945 dispersal program. Now the object was one of protecting essential operations at Kobe from interruption due to plant damage at the main works. Altogether, eleven sites were established within the city and three outside.

The firm had a high priority for its dispersal program and took the initiative in implementing official authorizations. In effect, dispersal had been started with the decision in mid-1944 to use student labor in the local schools. Thus, a basic plan for decentralized operations only had to be extended to meet governmental dispersal orders.

Altogether, 15 functional units were moved out of the main works and established in and near Kobe. Despite tremendous difficulties growing out of the urban disorganization in Kobe, and the heavy plant damage, much of the program was completed before the surrender. Four office and design sections, eight production units, and two training shops were set up at a distance of one to three miles from the plant. With two exceptions, functions dispersed to school sites were fully operative before January 1945. One school was burned out in the urban attacks but only one other was badly damaged. Despite readjustments thus required, the school dispersal program was fully completed by July 1945 and 8 other dispersal projects initiated during the attack period were from 10 to 90 percent completed at the time of surrender. Except for one factory conversion on the outskirts of Kyoto and two others in Hyogo prefecture, the whole program was concentrated in Kobe and in the hills directly back of the city.

The most ambitious part of the dispersal program—two underground plants for 600 and 1,000 adult workers each—was not finished when the war ended but, at that time, dispersed sites were employing 1,960 students, 890 adult production workers, and 550 design and administrative personnel. Ultimately it was planned to have 4,930 employes at dispersed sites. Except for labor and equipment difficulties following the urban attacks,

the program should have been completed before September. Four hundred and twenty production machines had actually been transferred and 378 were again in operation. By the end of the war, monthly output at a rate of 1.57 million was currently scheduled at disposal sites. Monthly output in the school sites where dispersal had been completed and 225 power machines were operating actually did reach a 760,000 yen rate by August. If the dispersal program had been fulfilled, an operating level of 3.7 million yen per month, using almost 1,100 machines, would have been possible at such sites.

The local dispersal sites included six schools, one dormitory, two local converted factories and three others outside, one section of the local subway (also occupied by machine shops from Kawasaki Shipyard) and the underground plants already mentioned. Aside from the training shops, these sites were used for design and administrative functions, for machining heavy components, for winding and testing aircraft instruments, for assembling small motors and for making various electrical fittings for aircraft and air ordnance. Although never fully completed, Mitsubishi Electric's dispersal program was well conceived and had every promise of success if it were not for the urban disorganization and manpower difficulties following the incendiary attacks. Even then, the firm expected to succeed and, after March, both the Army and the Navy supplied construction battalions and skilled workers to hurry underground factories and to stiffen the morale of those engaged in current production and movement of equipment.

Subcontracting.—Mitsubishi Electric also had a well-developed subcontracting network of long standing—almost unique among major plants in Kobe. Before the attacks, there were 118 factories and workshops which relied upon the firm for deliveries of materials, technical direction, and current financing. Of this group, 67 were located in Kobe and 20 in Osaka. All but five of the rest were in nearby suburbs. Altogether, these employed 8,840 shop workers and 1,350 clerical and supervisory personnel. This compares with 7,934 production workers and 1,316 on the administrative payroll of the parent factory just before large numbers of students were added in 1944.

Mitsubishi Electric subcontractors had over 6,600 power machines and were capitalized at

more than 28 million yen. They performed a wide range of functions including over 20 percent of all machining operations required by the company and much of the assembly of simple components. Among the 118 units, 64 had less than 50 workers each, 32 had 50-100, 10 had 100-200, 8 had 200-500 and 4 over 500 each. Over forty of these units, including all but three of those with more than 10 employees, regularly devoted over 90 percent of their effort to production for this firm.

The Survey's report on the Electrical Equipment Industry in Japan describes in great detail the effect of urban attacks on essential activity in this field, especially through destruction of subcontractors. The urban concentration of Mitsubishi Electric subcontractors and their relative importance—especially for its output of aircraft and ordnance items—has already been indicated. Destruction of subcontracting facilities was as widespread here as with other major electrical equipment concerns. Among the 87 subcontractors in Kobe, incendiaries destroyed 53 of which 50 suffered at least partial damage in the March attack directed against the western part of the city where most of these were clustered. The concern was protected to some extent against the consequences of this blow by the carefully planned dispersal program already partially developed at that time. However, there was no way to rehabilitate these damaged subcontractors or to find new suppliers.

Previous direct damage had seriously reduced activity in the main plant—especially in those sections depending the most on light components, but it was never possible to overcome the effects of this destruction of the subcontracting system. Damage was also heavy to other plants in Kobe and Osaka capable of undertaking such operations, so that Mitsubishi Electric found only a handful of subcontracting replacements after the March attacks. Because of transport and communications difficulties, the firm was reluctant to farm out additional work beyond the boundaries of Kobe during this period. The administrative burden involved in controlling subcontracting operations was serious before 1945. With telephones inoperative and all transportation uncertain, even local coordination was dubious.

With the general deterioration in public services, in living conditions, and in scheduling of deliveries, there would have been very serious diffi-

culties even without direct damage to subcontractors' production facilities. Destruction on 4 February of those offices and warehouses at the main works where subcontracting affairs were handled had caused chaos in the whole subcontracting system that would have proved critical even if such a large part of these production facilities had not been lost in subsequent attacks, along with a considerable amount of material and semi-finished items. Rather than furnish equipment or repair help to damaged independent firms where labor discipline and leakage of materials could not be controlled, the company preferred to extend its own dispersal operations and meanwhile to risk greater concentration of activity at the main works.

If Mitsubishi Electric had not sustained such heavy damage to its main plant at the very beginning of the attack period, urban damage to subcontractors would have been as decisive here as it was in the case of major electrical equipment concerns in other large cities, despite the ambitious and vigorously executed dispersal program which this firm already had undertaken.

Damage and Repair

Almost half of the total floorspace in the Mitsubishi Electric plant was damaged to some extent in the first two incendiary attacks, two-thirds of this on the afternoon of 4 February when approximately 3,000 small incendiaries fell simultaneously within plant boundaries from a formation of only 12 planes in the second group over Kobe. The plant force had ample warning and ARP forces were fully mobilized. With four modern fire trucks, seven trailer pumps, and 245 chemical extinguishers, the plant was exceptionally well prepared to cope with incendiary damage.

Where possible, combustible materials had been removed from buildings and the firebreak program had been completed. Six-inch water mains were laid to all parts of the plant. There were 75 hydrants and ample hose boxes along with wells and booster pumps to assure adequate water pressure. Fifteen large static water ponds and 600 sand boxes had been constructed, and approximately 1,000 fire buckets along with some fire-fighting tools had been distributed. Protective measures were more complete and ARP training more thorough than at any other plants surveyed.

Raid discipline was good at this time and almost the whole working force was on hand as soon as it

was clear that only incendiaries had been dropped. Nevertheless, all but one main warehouse and two assembly shops were completely destroyed and moderate damage occurred to several other sections including the main heavy assembly shop where insulating material, machinery lubricants and timbers used to block up heavy parts provided material for a stubborn blaze that eventually spread to 75 percent of this steel-frame structure—far more extensive than was evident from post-raid reconnaissance.

Prompt efforts at debris clearance and reroofing in essential structures minimized post-attack deterioration of equipment, but only 40 percent of damaged floor space was ever restored. While this work was still in progress, almost half as much further plant damage occurred in the March attack, even though plant ARP officials assert that less than 10 percent as many incendiaries actually fell within the compound. But this attack occurred at night when a smaller night crew was on duty. Because of the duration of the attack and the distractions resulting from the enormous fires in the surrounding area, it was difficult to maintain adequate vigilance and to dispose of the bombs before fires were started. For reasons developed below, no substantial amount of the building area damaged in this attack was ever restored. No damage was sustained here in the June attack on Kobe or any of the minor raid incidents.

On a value basis, 27 percent of the building structures at Mitsubishi Electric were damaged in these two attacks, including 25 percent of all machinery, and 34 percent of all tools and essential production fixtures. Damage to materials was even higher. Forty percent of all raw materials on hand were rendered unusable, including 1,500 tons of steel products—much of it special plate and rod required for electrical equipment—and copper wire and plate valued at 11 million yen. Loss of semi-finished items, including components and work in process, was placed at 36 percent and valued at 11,500,000 yen. Thirty-seven percent of all finished items on hand were destroyed.

Building damage in the two attacks was placed at 6,100,000 yen but only 240,000 yen worth of materials were used on building repairs and that almost entirely during February. Materials were scarce, especially after the March attack, and construction labor became unobtainable. But the pri-

mary emphasis was on salvage, dispersal of equipment and maintenance of current output wherever possible.

Much of the materials and components required in the critical aircraft and air armament items produced by the firm had already been removed to warehouses established at dispersal sites. Thus, the very large receipts of copper wire and other items during the last four months of 1944 brought inventories well above twice the previous generous level. Almost half of these stocks had been removed to dispersal points during January and much of what could be salvaged after the February attack was quickly removed. Damage in this first attack to semifinished parts and to stocks of components returned from subcontractors practically halted operations at dispersal sites until production was reorganized.

The outside labor provided after the February attack made it possible to extend removals of inventories, along with equipment dispersals, and still concentrate most of the regular skilled labor staff on recovery of those functions which were to be continued in the main plant. The March attack and the subsequent manpower crisis drastically altered plans for prompt recovery of top priority output both here and at the new sites.

By the end of the war, an inventory of all machinery in the Kobe plant and at dispersal sites indicated that roughly 35 percent of all units required major repairs. Some of this represented normal deterioration and mishandling by unskilled operators during the raid period. Of considerably more importance was damage which occurred during transfer to dispersal sites, but the most important factor was the backlog of unrepaired units left from the attacks. As stated above, almost one-fourth value of all machines sustained damage in the two attacks but few items were beyond repair. Prompt measures were taken to prevent further deterioration but only half of those damaged in February had been restored by the end of the war and only 2 percent of those damaged in March.

After the February attack, some outside help on machinery repairs was sanctioned by the authorities but the subsequent flood of repair requests from aircraft concerns and the general breakdown of the control scheme forced Mitsubishi Electric back on its own resources. Most of those repairs actually completed were handled in the firm's own shops.

Labor Problems

As we have seen, Mitsubishi Electric's output was severely affected by factory damage in February and March but nevertheless the firm managed to achieve a considerable measure of reorganization. With its generally favorable position and well-organized dispersal plan, there is little reason to doubt that the firm's ambitious program for continued high-level production of priority items could have been fulfilled except for the heavy urban attacks of March and June.

Plant damage was decisive in February but resources were available to insure exceptionally prompt recovery. Indeed, considerable activity was maintained despite subsequent difficulties. But aside from the immediate effect of plant damage, company officials regarded manpower problems arising from the heavy urban attacks as by far the most important obstacle to production in 1945. Mitsubishi Electric had a uniquely favorable manpower position before the attacks and, to an unprecedented degree, received effective assistance thereafter.

This favorable labor position was a result of company policy and official aid. Mitsubishi Electric was one of very few private firms permitted to retain all its most competent employees during the war period. Despite military policy, the firm was able to obtain deferments for 80 percent of its regular male employees. The unprecedented success in maintaining organizational stability applied not merely to engineers and top management. Only 400 were drafted between Pearl Harbor and June 1944 out of a male shop force ranging from 4,400 to 5,400 and only 300 more prior to the attacks.

The firm had been equally favored on allocation of additional labor. Male replacements were provided for those drafted during the war and the payroll came to include over 2,000 women. Twenty-two hundred students were employed in mid-1944 and an additional 800 by the end of the year. Had production expanded as planned during 1945, as many as 5,000 students would have eventually been used at the main works and the various dispersal sites. The company had considerable experience in training and labor dilution programs as part of organizing four branch plants earlier in the war. With a large group of skilled foremen, inspectors and instructors which could be shifted from plant to plant, Mitsubishi Elec-

tric was able to make full use of the types of labor available. The large labor reservoir in the Kobe district provided the opportunity during late 1944 and 1945 for systematic dilution of the existing force. As indicated in Exhibit 29, it was thus possible to expand activity and at the same time steadily transfer experienced workers to branch plants in nearby towns where similar programs of expansion and dispersal were initiated.

Considerable friction developed with prefectoral and local officials, however, over assignment of conscript, volunteer and student labor. Until September 1944, the firm refused to accept male conscript replacements unless they already possessed needed skills and they insisted on rejecting all women and students who did not pass the firm's own minimal health standards and IQ and mechanical aptitude tests. This procedure met with resistance since it required labor mobilization authorities to force Mitsubishi's rejects on other firms or to find other acceptable material. Accordingly, the company had to inflate its manpower estimates and requests and to exert considerable pressure but, as a result, its student production program was highly successful.

An unusually large supervisory staff was maintained by this company. Office workers, administrative and engineering personnel totaled 1,200, including several with British and American training. Through a well-organized system of job analysis, most fabricating and assembly functions for aircraft and ordnance equipment and other electrical components were broken down into simple operations that could be quickly learned and easily controlled. All recruits attended a one-month training school before being assigned to and taught a particular operation. As a consequence, Mitsubishi Electric was able to maintain production schedules on such items with only 20 to 30 percent skilled labor.

Student labor, in particular, proved highly satisfactory during the raid period. By using selected groups of students in school buildings under control of their regular teachers to perform work for which they were well qualified and trained, productivity remained much higher than with adults. And furthermore, absenteeism did not become an overwhelming problem. Food and housing could be handled centrally for this group, and discipline was maintained during and after air-raid warnings.

Prior to the attacks, the adult worker was encouraged to retain management approval because of its influence on deferments and its conspicuous success in obtaining extra food and clothing rations as a bonus for regular attendance and for production records. Turnover had been relatively low, except among women taken on during the war, and both attendance and productivity was considered highly satisfactory, considering the size and dilution of the total force. Attendance averaged above 95 percent until 1940-41 and then gradually declined into the 80-90 percent range. The following table gives official 1945 figures on average attendance for adult workers actually carried on the payroll throughout the indicated month:

1945	Rate of attendance	1945	Rate of attendance
January-----	81	May-----	61
February-----	75	June-----	38
March-----	66	July-----	50
April-----	60	August-----	66

During January 1945, the New Year holidays and some evacuation brought substantial absenteeism in many factories, but appeals to step up production succeeded in keeping adult attendance above 80 percent at Mitsubishi Electric. Despite the damage in February, attendance only slipped to 75 percent and was excellent during the first part of March. In the March attack, the homes of 1,800 adult workers were burned. Although there were many desertions, some victims were transferred to other plants or rehoused in a nearby emergency dormitory. Attendance thus held up remarkably well as compared with many plants in Kobe. Directly after the attack, attendance fell to 36 percent, averaged 45-50 percent for the balance of the month and slowly improved thereafter, but tardiness and lowered productivity were very serious. This company, in contrast to most, continued to drop workers promptly from its Kobe records if they deserted or were transferred. The data on adult employment in Exhibit 29 covers up considerable turnover in the period between March and June. Additional displaced workers were picked up where possible, mainly from burned-out subcontractors. After March, the Navy assigned several hundred skilled machinists to the plant. This latter group not only held up the attendance average, but had a very beneficial

effect on general labor discipline during this period.

In the June attack, over 1,000 more adult workers lost their homes and many previous victims were again forced to find new lodgings. Emergency dormitories accommodating some company workers escaped damage, however. After 5 June very little work was accomplished for more than a week and thereafter conditions were increasingly irregular despite efforts to restore the former level of discipline. According to plant records, average attendance was only 38 percent among those still on hand at the end of the month. Informal absence, tardiness, and long work interruptions after air-raid warnings are not adequately accounted for by the official figures on adult productive hours presented in Exhibit 29.

After March, the management found it extremely difficult to supplement wage payments effectively with extra food and clothing rations. It continued to avoid paying black market wage rates to its regular workers although it had been doing so indirectly through subcontractors for a long time. Since so many of the newer employees had been taught only one specialized operation, they were not able to obtain high wages by accepting work elsewhere so the company was sheltered from most black market competition.

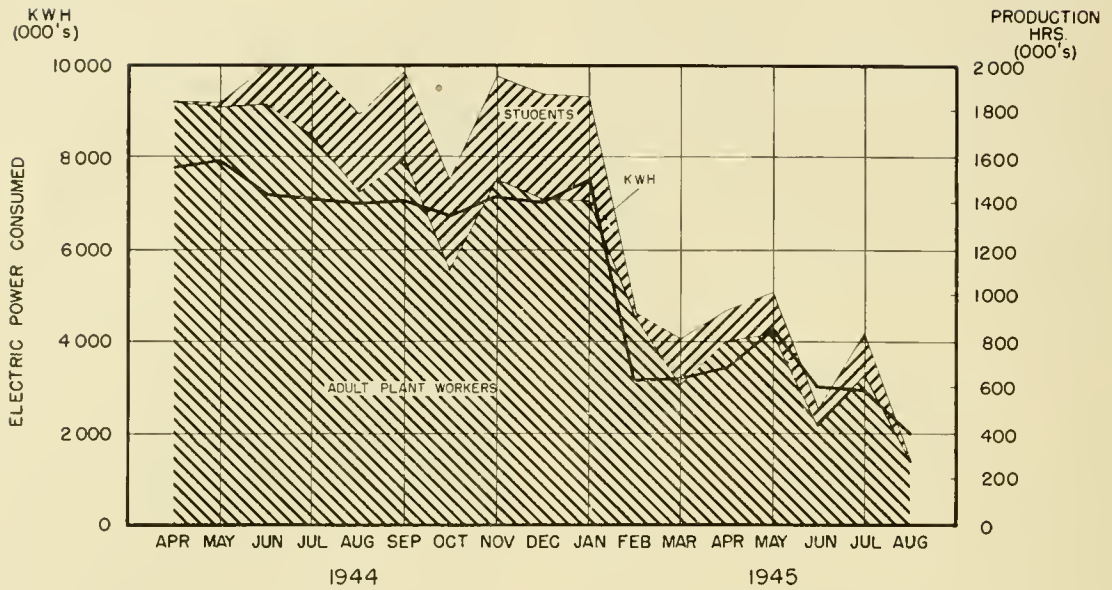
The piece rate system for skilled workers now had to be completely abandoned, however. The company's supplements to the official ration became of increasing importance and its success in combatting absenteeism arose in large part from the energy and money it expended for this purpose, as food conditions generally became more stringent. Nevertheless, loss of time and lowered efficiency became increasingly serious, especially in minor assembly operations where tardiness or absence could disrupt a series of operations. The problem of absenteeism also developed to alarming proportions among supervisory personnel toward the end of the war.

Thus, despite all the initial advantages and by far the best organized program for overcoming indirect effects of the urban attacks, Mitsubishi Electric officials considered that their efforts were mainly frustrated by the human consequences of area damage. While these problems could be met to a considerable degree with students and with those adult workers under Army and Navy discipline, other elements of the labor force suc-

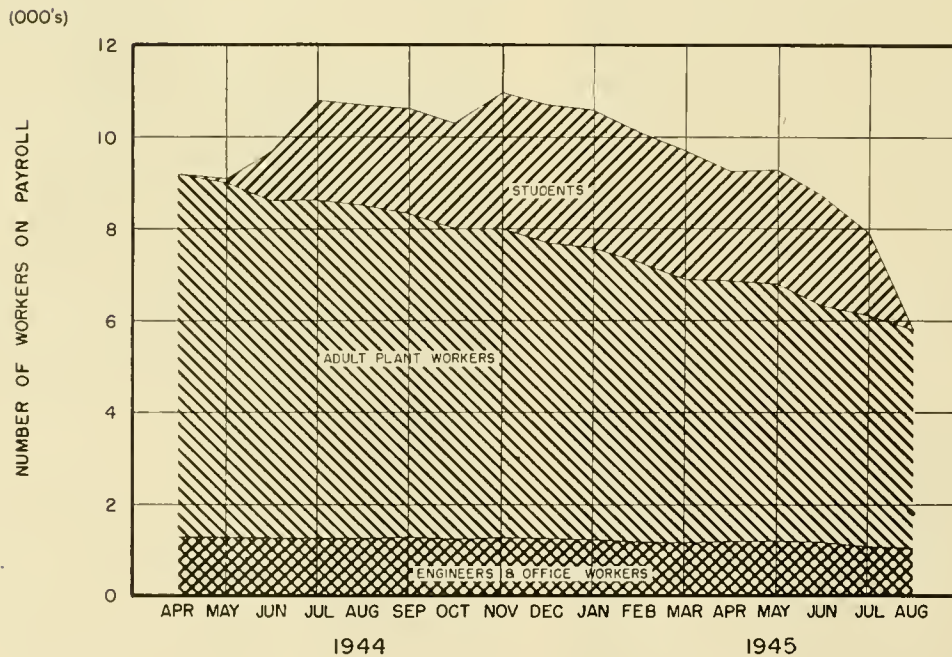
LABOR AND PRODUCTION

mitsubishi electric - kobe

PRODUCTION



LABOR FORCE



cumbed to the general difficulties discussed before. In a report submitted to the Survey, the manager of Mitsubishi Electric stressed four factors other than the initial plant damage as responsible for production loss during the attack period. Among these he ranked worker morale and absenteeism first and related to these transport and communications problems affecting dispersal, deliveries and repairs. In his view, difficult living conditions and destruction of local transportation facilities were mainly responsible for the sweeping change in labor productivity, even among the responsible workers. These factors were not merely reflected in absenteeism and tardiness, but they "destroyed the spirit of cooperation among workers, resulting as a matter of course in the decline of production efficiency," just at a time when repair and dispersal problems demanded the maximum of initiative and effort. By June, the air attacks had "deprived workers of their power of concentration

and prevented them from devoting themselves to their work."

Mitsubishi Electric's decline in activity and output for the period from February through mid-August 1945 was placed at roughly 50 percent of what would have been achieved in the absence of the Kobe attacks. The management of the firm ascribed 20 percent of this loss as the unavoidable consequence of plant damage and related destruction of materials and semifinished items. The other 30 percent was credited to the indirect effects of the urban attacks. The breakdown of local transportation and communications made it "fatally inconvenient to coordinate dispersal and production" and disrupted deliveries. But the dominant element in production loss was the cumulative effect on labor of food and other living problems, lack of transportation to and from work, and the growing fear of renewed attacks.

III. KYOTO REPORT

The City -----	Page 240
Utilities and Transportation-----	246
Fuel and Basic Materials-----	250
Industrial Labor Force-----	254
Production Trends -----	256



PHOTO 1.—Southwest section of Kyoto. Looking south across district of residences and small factories toward large plants on southwest outskirts. Small industry with ARP lookout in left foreground is surrounded by equally combustible shops and houses. Note how few modern concrete structures are visible in this quarter of the city.

THE CITY

Kyoto, the ancient capital and cultural center of Japan, was significant in peacetime for its handicraft industries and textile production. A city with over a million inhabitants, its economic importance derives, in part, from its location on the main Tokaido railroad, midway between the Nagayo region and the large ports and industrial cities on the Inland Sea. It also is the connecting point for rail traffic to points on the Japan Sea. Although the industrial and port cities of Osaka and Kobe were less than 50 miles away, with good rail and road connections, Kyoto succeeded in preserving its cultural heritage and did not, to any appreciable extent, share in the industrial development of prewar years. The city possessed a large reservoir of skilled labor, however, that proved of great advantage for rapid wartime growth in essential activity.

Situated 30 miles northeast of Osaka, the city lies in what is known geologically as the Kyoto basin, a level agricultural plain surrounded on three sides by mountains. The plain is drained by the Yodo river, which provides a rail, road and waterway corridor to Osaka.

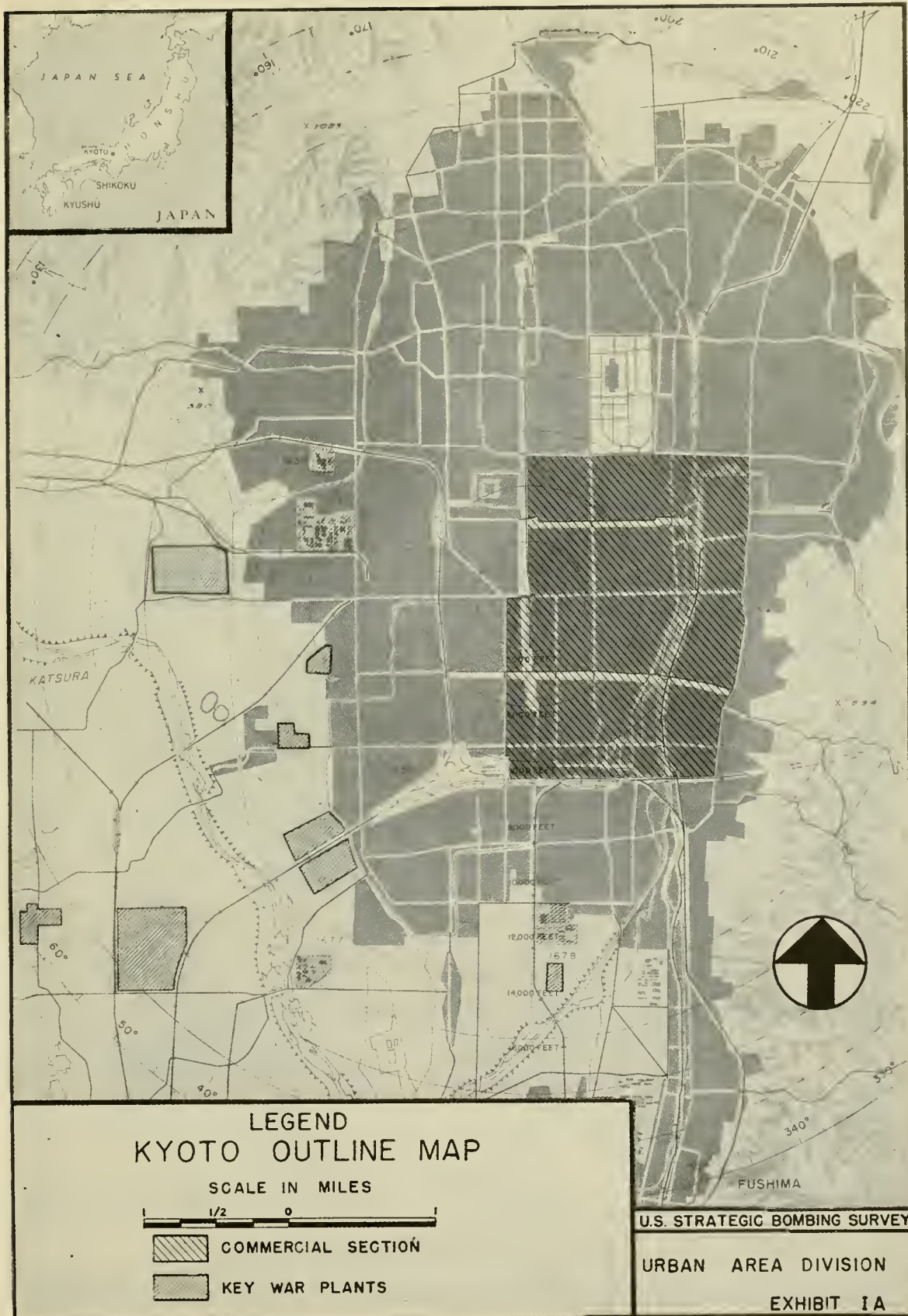
The following table gives the approximate straight-line distances to certain metropolitan centers of Japan from Kyoto:

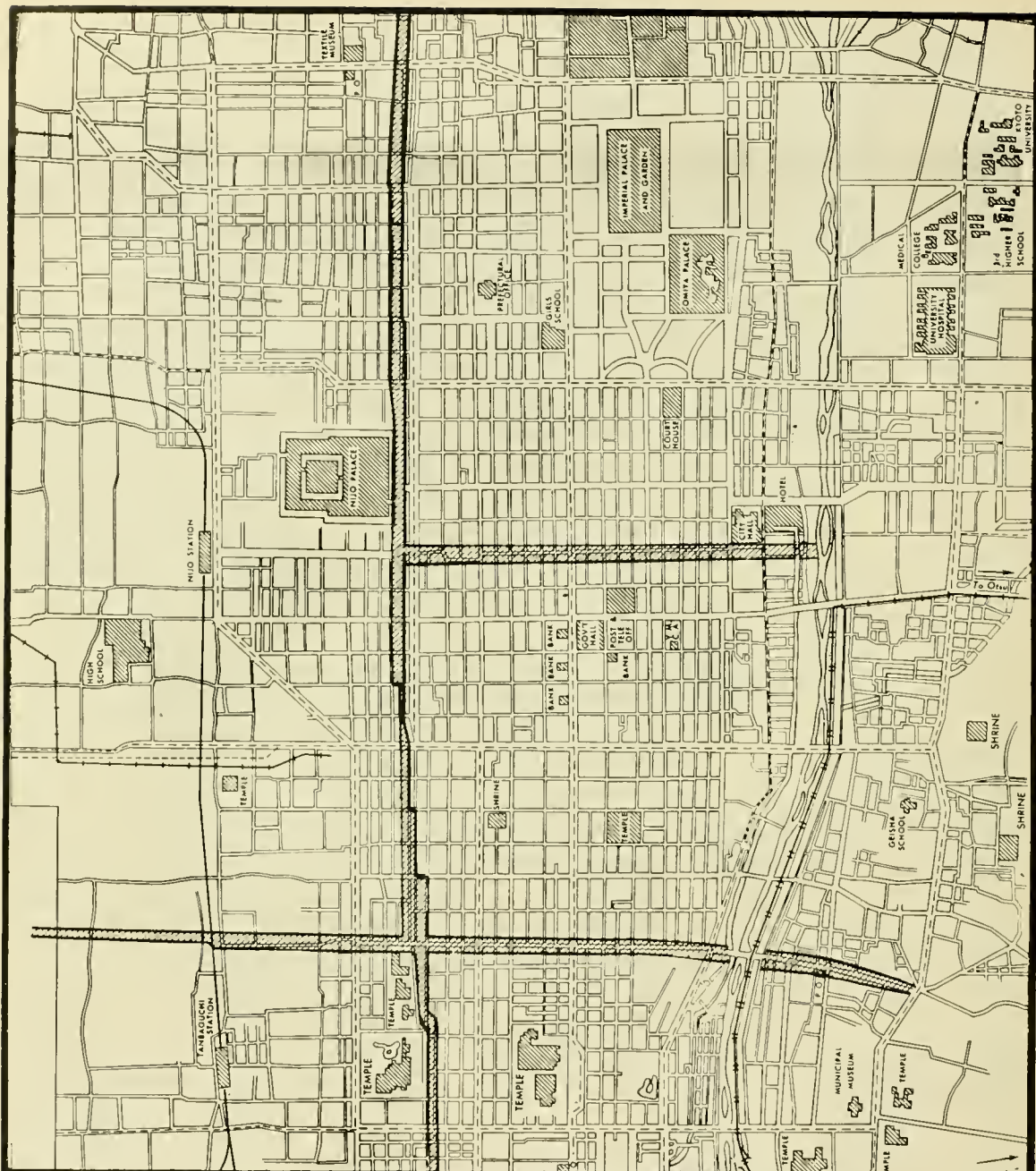
	<i>Miles</i>
Hiroshima	150
Kobe	50
Nagoya	60
Osaka	30
Shimonoseki-Moji	250
Tokyo	200

As the former capital, Kyoto has a few avenues that are much wider than in the usual Japanese city; in addition, the grounds of the universities, temples and former palaces provide extensive open areas in some sections of the city. Most of the city is laid out in rectangular grids, with very narrow interior streets and wider east-west and north-south avenues at intervals. As a whole the city is extremely compact, with only a few streams, the railroad lines, and main streets dividing densely settled areas of extreme susceptibility to incendiary attack.

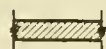
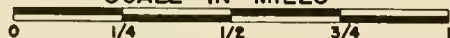
The Tokaido railroad (running from Kobe to Tokyo) and the modern Osaka highway both enter the city from the southwest and cross the central congested area from west to east. Electric inter-urban lines from Osaka enter the city on the east and west sides.

Kyoto is less westernized than the other great cities of Japan and does not have sharply differentiated building zones. As the result of efforts to preserve its ancient character, most large factories have been located in the southwest outskirts, but many residential sections merge with commercial areas and smaller industrial establishments are





LEGEND
KYOTO CONGESTED COMMERCIAL
& RESIDENTIAL DISTRICT
SCALE IN MILES



MAIN
FIREBREAKS

RAILROADS

— (STEAM)



(ELECTRIC INTERURBAN)



U.S. STRATEGIC BOMBING SURVEY

URBAN AREA DIVISION

EXHIBIT 1B

scattered throughout all zones. As indicated in Exhibit 1a, the main commercial zone lies to the north of the railroad station. The district south and west of the commercial area is specified for industry, the area to the north and east of the commercial area being mainly residential. The congested area runs to the edge of the surrounding mountains at many points on the east, north and west.

Kyoto was formerly the fourth largest city in Japan, having in 1940 a population of 1,089,726. The district of light industry and congested slums south and southwest of the station, and the Nishijin textile section in the northwest embrace almost half of the total population, and contain most of the small industry of the city.

Compared with the two other large cities of the region—Osaka and Kobe—there was a consistent, although much less extensive, decline in the population of Kyoto from October 1943 to the end of the war. However, the difference in the rate of decline between Kyoto and the cities of Osaka and Kobe is significant. In Kyoto, the monthly fall in population is relatively constant, whereas in Osaka and Kobe sudden sharp declines record the mass evacuations which resulted from the devastating raids on these cities. The loss in Kyoto's population may be attributed to the planned evacuation of school children, pregnant women, the aged and infirm, and conscription for the armed forces and labor. The evacuation of school children from the ages of 9 to 13 accounted for a total of 19,049. The first such evacuation was in August 1944, the second in July 1945.

The attacks on the cities of Kobe and Osaka, from the month of March 1945 until the end of the war, resulted in an increasing influx of refugees into Kyoto. During the war, Kyoto's population decreased from a prewar figure of about 1,100,000 to a low of approximately 800,000 in August 1945, including some 20,000 refugees from bombed cities.

Housing

In October 1943, Kyoto had about 235,500 residential buildings. The firebreak construction program resulted in a continual decline in this figure until August 1945, when there were approximately 201,750 residential buildings.

In October 1943, with a population figure of 1,008,000, an average of 4.3 persons lived in each

residential building. In August 1945, with a population of 801,000, an average of 4 persons lived in each residential building. This decrease in average occupancy was due to wartime shifting

*Exhibit No. 2
Population in Kyoto City*

<i>Date</i>	<i>Total</i>
1943:	
October _____	1,008,000
November _____	1,000,000
December _____	990,000
1944:	
January _____	975,000
February _____	970,000
March _____	960,000
April _____	950,000
May _____	945,000
June _____	935,000
July _____	925,000
August _____	920,000
September _____	905,000
October _____	900,000
November _____	890,000
December _____	875,000
1945:	
January _____	885,000
February _____	845,000
March _____	825,000
April _____	805,000
May _____	801,000
June _____	801,000
July _____	801,000
August _____	801,000

Sources: Kyoto prefecture, police bureau.

of population, drafting of males, the evacuation of school children and others outside the city, and increased deaths due to wartime diseases.

Between the same dates, October 1943 and August 1945, there was an increase in industrial buildings from about 2,350 to approximately 2,975. This rise in number of buildings was paralleled by the rise in total industrial production: the rise in the spring of 1945 came from the dispersal program under which factories from other cities, particularly aircraft plants from Nagoya, moved to Kyoto. In explanation of the low figure for the total number of industrial buildings, it should be noted that the many small home industries which employed less than 10 employees are classified as residences.

Being less westernized than other cities in Japan, Kyoto had a very high proportion of flimsy wood-frame buildings with tile roofs. Only a few of the newer commercial and industrial buildings were steel-frame or reinforced concrete.

Firebreak and Evacuation Program (Exhibit 3)

Evacuation from this city, which at no time during the war was the target of a planned air attack, presented no critical problems. There was a planned population displacement of approximately 86,000, including a large number of essen-



PHOTO 2.—Typical street in Kyoto. Except for a few main thoroughfares, street widths are like this in commercial as well as residential districts. Operatives of small workshops and stores pictured here customarily live on upper floors. Structures are of wood and stucco construction and are directly joined. This pattern is typical of that which prevailed in large sections of most Japanese cities.

tial workers dehoused by the firebreak program and put up in emergency barracks. Actual planned withdrawal from the city probably totalled 50,000 including pregnant women, the aged, and school children. The organized evacuation of school children was very successful, representing about 60 percent of the entire student population of Kyoto under 14 years of age. Mass evacuation of all those not engaged in essential work was urged by the prefectural authorities toward the end of the war but no such movement ever took place. The three instances of incidental bombing did not cause enough damage to start any concerted exodus, although everyone knew after the March raids on other centers what incendiary attacks would do to the city. Many inhabitants expected that the city would be atom-bombed in the last days of the war, but there seemed to be a general apathy rather than panic.

In the construction of firebreaks between September 1944 and July 1945, almost 20,000 houses were torn down and more than 85,000 persons displaced. The firebreaks were constructed in the form of a cross, dividing the commercial district

into four sections with subsidiary firebreaks in other areas. The small number of houses destroyed in the first and second firebreak construction periods between September 1944 and March 1945, contrasted to the sharp rise of activity of the third firebreak program in the following month and is indicative of the effect of the March area attacks on the vigor which officials applied to the task. Houses destroyed as a result of the first two firebreak construction programs, which extended over seven months, totalled merely 1,206, whereas during the remaining firebreak construction period of four months, 18,600 buildings were eliminated.

The materials salvaged from firebreak construction were utilized for rehousing in other parts of the city, for a few primitive air-raid shelters, and for fuel. The need for rehousing was intensified by the influx of refugees from Osaka and Kobe in the latter part of March and in June. Damage from the three isolated bombing raids were small. Only 91 houses were completely destroyed and 196 damaged.



PHOTO 3.—Major cross-town firebreak in Kyoto. All structures have been removed except neighborhood warehouses, such as that on extreme left, which are relatively fire-resistant.



PHOTO 4.—Looking across typical Kyoto firebreak into dense residential and light manufacturing district. Wood construction extends to small factories such as those within block to right.

Exhibit No. 3
Firebreaks in the City of Kyoto

Date	Unoccupied zones		Fire-defense streets		Small unoccupied lots		Around important establishments		Total		
Firebreak program starting	Number of locations	Number of houses	Number of locations	Number of houses	Number of locations	Number of houses	Number of locations	Number of houses	Number of locations	Number of houses	Total population displaced
September 1944					20	677		273	22	950	38,000
March 1945			5	256					5	256	1,024
April 1945	4	3,753	17	1,716	119	3,030	2		140	10,500	42,000
July 1945					3	2,361	174	5,311	177	7,672	4,800
Total	4	3,753	22	1,972	142	6,068	176	5,584	344	19,378	85,824

Source: Kyoto police department.

Air Attacks

Aside from photo-reconnaissance missions, there were no planned air operations against Kyoto. However, on three occasions single planes, whether by accident or navigational error, did drop bombs causing some casualties and building destruction. One of these attacks hit the No. 14 Mitsubishi aircraft plant, one of the key units in that industry. On two other dates a total of 23 fighters swept over the city, strafing a few factories on the outskirts, killing 1 person and injuring 13 but destroying no buildings.

Following are results of bombings in Kyoto:

Date	Killed	Injured	Dehoused
6 January	35	133	715
16 April	2	49	
26 June	44	206	1,140
Total	81	388	1,855

UTILITIES AND TRANSPORTATION

Electric Power (Exhibit 4a)

Kyoto was in the same power system as Osaka and Kobe, and therefore was in a position to receive the benefits of the surplus of electric power resulting from the drastic decline in industrial power consumption in those cities subsequent to the March 1945 area attacks. In Kyoto, as in other cities, rationing of power was never officially suspended in order to prevent diversion of labor and materials to nonessential use.

Power consumption remained highly stable in Kyoto, despite the major readjustments that war was forcing on the city's economy. A drop of more than 10 percent in March 1945 reflected a temporary and seasonal decline in domestic and public consumption along with a temporary de-

cline in industrial use. Not until July was there any further drop and consumption increased again during the first part of August. Industrial consumption by larger plants gradually rose from 45 percent to 55 percent of the total during the course of the war, as compared with an average of 80 percent in Kobe. Small industry and commercial users accounted for more than 15 percent of industrial consumption in Kyoto, or roughly twice the amount found in other cities. Their relative importance actually increased in 1945, in part due to the growth of subcontracting and to unauthorized expansion of nonessential activity.

Industrial power consumption registered all-time highs during the flush water season of 1944, due to a temporary relaxation of electricity rationing for certain lower priority industries and the concomitant increase of consumption by war plants. In the fall quarter nonessential consumption was ruthlessly curtailed in order to meet priority requirements here and in nearby industrial centers and thenceforth the industrial consumption curve reflects the level of essential industry. Except for March 1945, power consumption remained relatively constant from October 1944 until July 1945. There was considerable fluctuation among different branches of industry but these tended to cancel one another out. March and July declines reflected temporary reactions to the urban attacks on Osaka and Kobe, especially in the ordnance and electrical equipment industries. Dispersal activities during late April and May did not result in an over-all decline. After the July slump, consumption rose again to previous levels during the last two weeks of the war.

Gas (Exhibit 4b)

Gas production in Kyoto was progressively curtailed, as in Osaka and Kobe, by reduced alloca-

ELECTRIC POWER CONSUMPTION IN KYOTO CITY

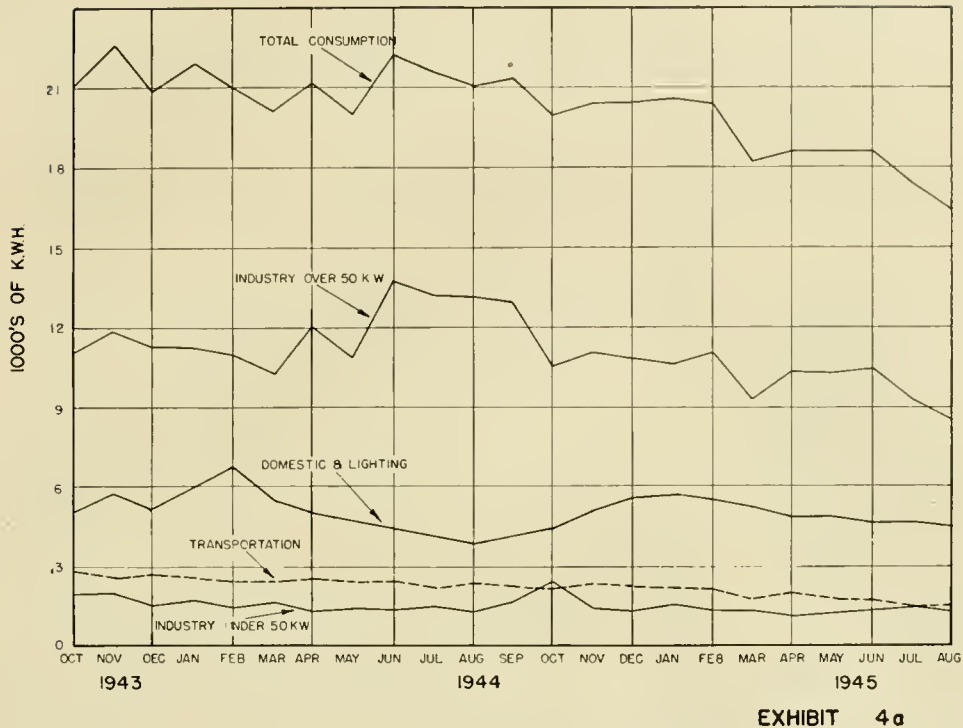


EXHIBIT 4a

tions of coal and deterioration in the quality of coal received. There were slight improvements in coal receipts and gas production at the end of 1944, for the production push of that period, and again in May and June 1945, but the planned increase could not be maintained after July as both mining and transport of coal declined. Thus there was a steady decline except for these two recovery periods, from a rate of 163,000 cubic meters per day in August 1945, most of the cut being absorbed by residential consumers. The coal problem was a result of the general shortage in Japan and the difficulties of transportation, which early in 1944 caused a decided decline in receipts of better quality Hokkaido coal that used to reach Kyoto via the Japan Sea, but the general shortage of coal never began to put limits on essential gas requirements until the last few weeks of the war. At that point, the total breakdown in coal movements through the Inland Sea, which had thrown the whole burden on the railroads, began to have its effects.

To a limited extent the shortage of skilled labor interfered with gas production even beyond the limits of available coal supplies. Much coal was wasted through leakage as a result of delays in

making necessary repairs, especially repairs resulting from damage to mains and outlets in connection with the firebreak program. Leakage never reached anything like the proportions it did in the bombed cities, of course. In May 1945, however, during the period when the firebreak program was pushed at a feverish rate, it reached a high of over 30 percent of total consumption, but through most of 1945 it was well below 10 percent.

In spite of decreased production and increased leakage, industrial use of gas was fairly well sustained until the surrender, although at the expense of domestic use. By that time there was almost no cushion of domestic use left, and further production declines would have begun to affect industrial consumption directly.

Water

The supply of water was never a problem in Kyoto. The supply came from nearby Lake Biwa, which provided unlimited reserves, and electric pumps maintained pressure throughout the city. The firebreak program caused minor leakage which continued due to the shortage of labor but there was never any noticeable shortage or fall in pressure.

GAS PRODUCTION AND CONSUMPTION, KYOTO

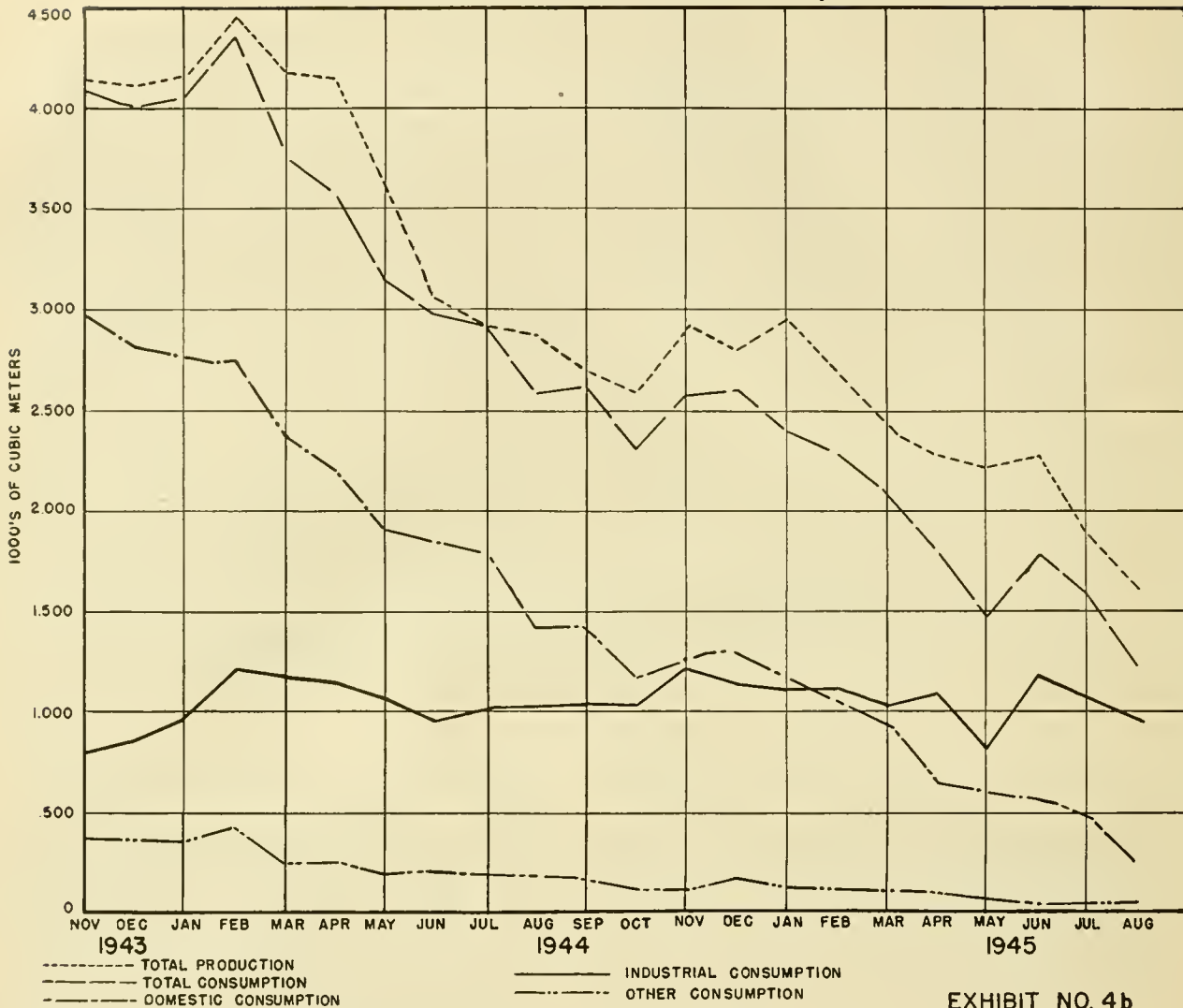


EXHIBIT NO. 4b

Trucking (Exhibit No. 5)

Trucking facilities in Kyoto suffered from the shortages of fuel and of repair labor and parts that were felt in Osaka and Kobe. During 1944 and 1945, only 30 to 50 percent of existing vehicles were operating. Contrary to the situation in Osaka and Kobe, however, freight carried by trucks increased between March and June 1945, when Osaka and Kobe were subjected to attack, as every effort was made to facilitate the dispersal of priority industry and the movement of essential components into Kyoto. In spite of a deteriorating parts supply and the labor situation, trucking facilities were not only maintained but increased until July. The advent of warmer weather made it possible to release more charcoal for truck fuel by cutting allocations for domestic cooking and heating.

Communications

Records of long distance calls and telegrams handled in Kyoto show the indirect effect of air raids on Nagoya, Osaka, Kobe and other cities. Monthly totals in each category fell from an all-time peak in March 1945, when the aircraft dispersal program was getting underway, to a low in July and August. After the March raids on Osaka and Kyoto, telephone cables serving 10,600 of Kyoto's 37,000 subscribers were removed to be used for priority replacements in those damaged areas.

Railroads (Exhibit No. 5)

The railroad section of the Osaka report discusses the situation for the Osaka region as a whole, including Kyoto, and the general conclusions stated there apply equally well to Kyoto.

FREIGHT TRANSPORTATION IN KYOTO

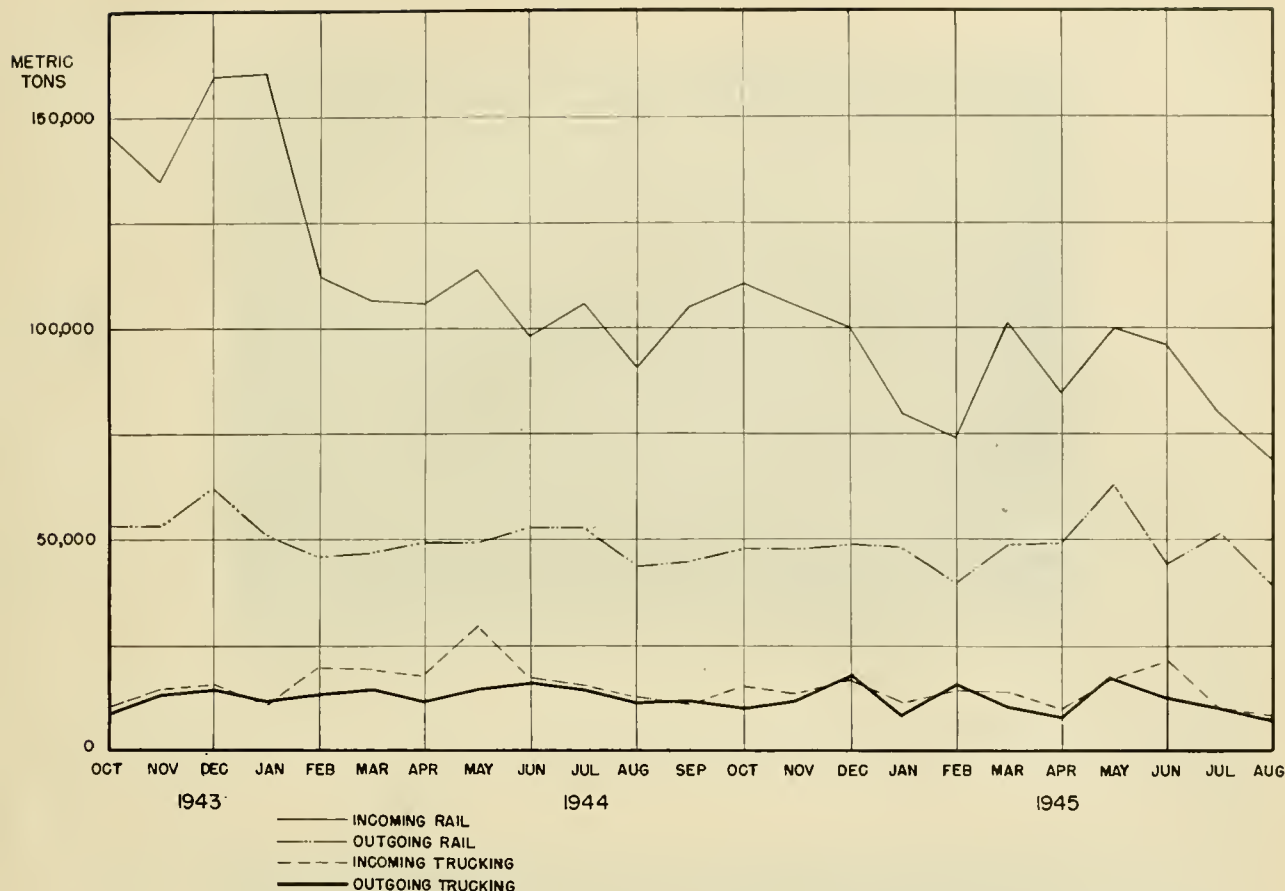


EXHIBIT NO. 5

There was no damage to rail facilities at Kyoto and freight shipments in and out of Kyoto in the first half of 1945 were only 10 to 15 percent below 1944, in contrast to a heavy decline for attacked cities and for the country as a whole. Since, except for coal, most of this decline was at the expense of lower priority movements, it is clear from this data that Kyoto did not experience any serious curtailment of the bulk commodity receipts necessary for maintaining industrial activity had the war lasted longer. Deliveries out of the city, mainly finished war goods, remained until the surrender comparable to the 1944 level.

FUEL AND BASIC MATERIALS (Exhibit 6)

The effects of the general decline in fuel and basic materials were not as direct or as apparent in the case of Kyoto as with Kobe and Osaka. Kyoto's war industry was concentrated almost entirely in final or relatively late stages of fabrica-

tion, whereas industry in Osaka and Kobe ranged from basic processing to end-products, with considerable emphasis on heavy industry. The general shortage of basic materials, such as coal and steel, although finally reflected during 1945 in declining receipts at Kyoto, did not itself cause a decline in priority industrial production. Neither did the general shortage of coal in Japan appear to impose direct restrictions on essential Kyoto production. Kyoto output of war items was occasionally held up, however by delays or failure in receipt of components and other semi-fabricated material from other cities, especially after air attacks. Some production loss was due to air alerts and there were considerable delays in completion of the dispersal program. In general, since a large percentage of Kyoto's production was concentrated in high-priority output for the aircraft and ordnance industries, the city was somewhat insulated from material shortages by preferential allocations.



PHOTO 5.—Northwest Kyoto. Newly developed section on northeast outskirts including a number of multi-story concrete structures. Density is slightly lower than in older sections but interior streets are extremely narrow.



PHOTO 6.—Kyoto railway station. Looking toward factories and warehouses in the southwest section of the city.

COAL DELIVERIES AND INVENTORIES IN KYOTO

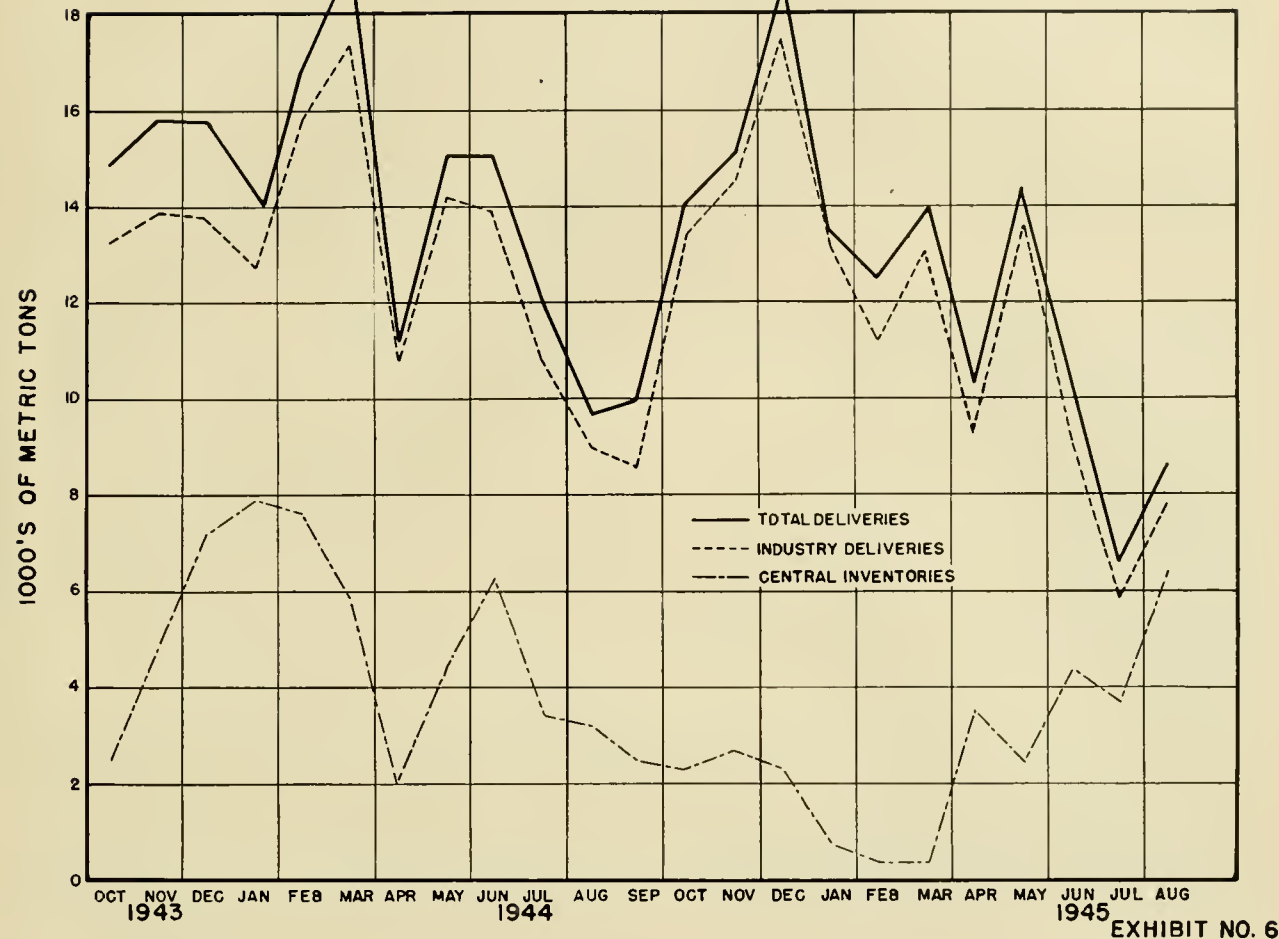


EXHIBIT NO. 6

The case of the Shimazu Engineering Co., a major supplier of special electrical equipment for aircraft and ordnance, is illustrative (Exhibit 7). Officials of the company reported that throughout the war there were occasional delays in basic materials receipts due to allocation tangles and transportation difficulties but these did not curtail output. Their volume needs, however, were relatively small compared with permitted inventories, since the company was principally concerned with fabrication of precision electrical equipment and depended on others for much basic fabrication. Thus, as early as March 1944, delivery uncertainties had delayed receipts of components and threatened production to such an extent that the company sent its own workers to and from Osaka and Nagoya as "couriers" with each individual shipment of finished items and components. The concern's allocations of basic materials were tightened in late 1944 and 1945 but stocks for consider-

able further production were still available in August and scheduled deliveries had been relatively well maintained until the surrender. Component and subcontracting problems, not basic materials, created the actual output delays for this firm as for most others in Kyoto.

The principal basic materials required by Shimazu were iron, steel, copper, brass and aluminum. Iron and steel requirements averaged 250 tons per month. Except for November 1943, receipts were always close to or above allocations until July 1945. The concern was permitted to maintain about 2,500 tons, or 10 month's supply, through most of 1944, but at the end of the year stocks were suddenly built up to 3,800 tons. Inventories gradually dropped to 2,700 tons by August 1945 as consumption moved ahead of allocations but were still sufficient for 8-10 month's operation. Brass deliveries were most erratic but always approached quotas except in mid-1944 and April 1945. Dur-

**SHIMUZU ENGINEERING CO.
MONTHLY VALUE OF OUTPUT**

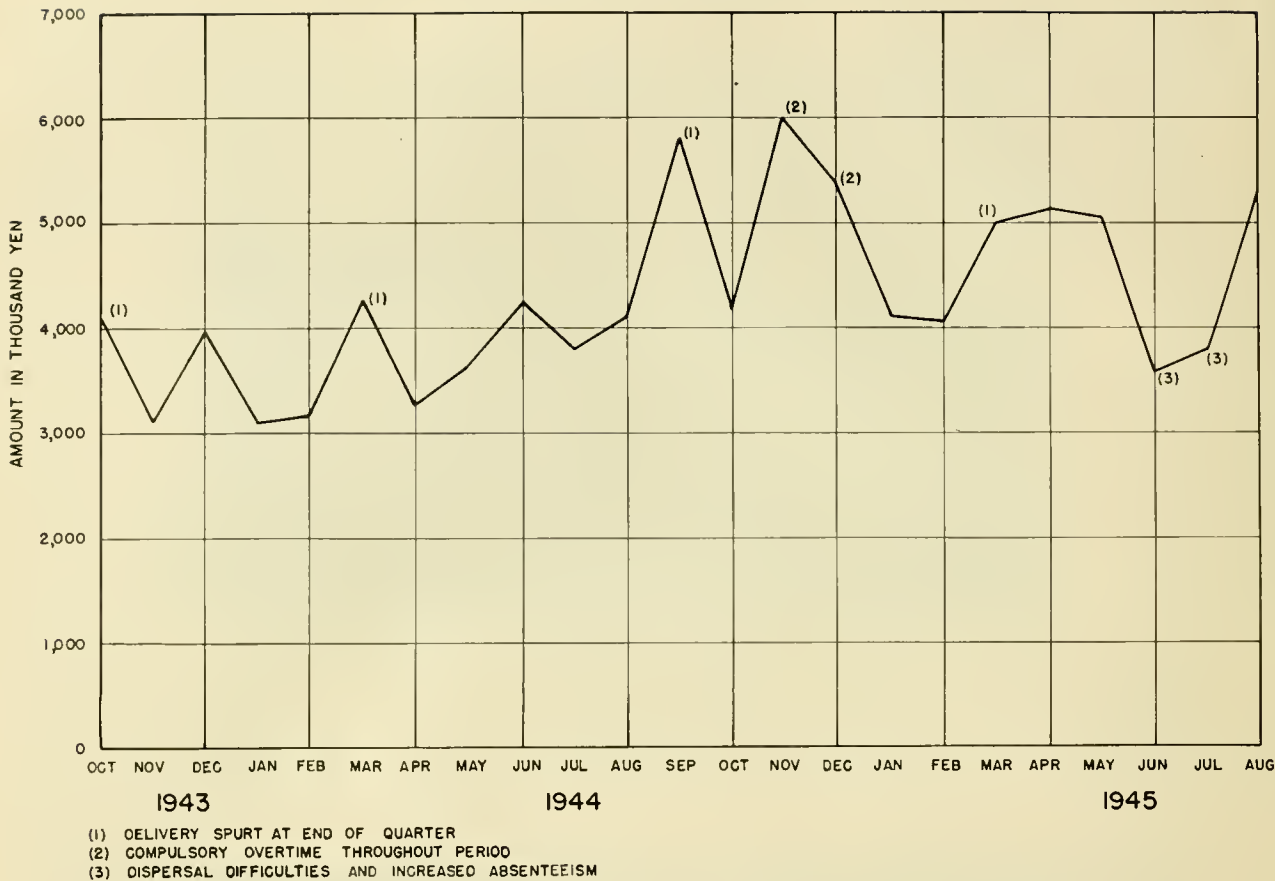


EXHIBIT NO. 7

ing the war, stocks declined from 10 month's to 7 month's requirements. Copper requirements rose gradually from 50 tons per month in 1943 to 200 tons in 1945 and deliveries kept pace except from March-May 1945 when the firm's allocation had to be cut in half. Stocks, however, never fell below the 1943 average of 175 tons and rose to 300 before the surrender. Allocations of aluminum were relatively small since consumption was only about 25 tons per month until late 1945 and were met regularly until October 1944. Deliveries reached an all-time peak in June 1945, however, and were sufficient to raise inventories from a 120-ton average in late 1943 to 225 tons, or 9 month's requirements, in early 1945. Both deliveries and consumption increased thereafter as aluminum was substituted for copper but stocks dropped off only 30 percent by the war's end. Almost every priority firm had a similarly favorable position on inventories and deliveries of fuel and basic materials.

One of Kyoto's largest industrial producers was relatively independent of components' needs and a large consumer of such scarce basic materials as lead, copper, and rubber—the Nippon Storage Battery Company. This firm reported that, although it had difficulties with receipts of basic materials, especially with the tortuous administrative channels through which they were forced to get them, shortages of principal basic items were never a serious problem. Adequate stocks were maintained and deliveries were relatively steady. However, shortages of one minor chemical, insignificant in tonnage, did temporarily restrict operations on two occasions. Company officials spoke vehemently of the inefficiency of military supervisors in failing to obtain "emergency" (i.e., military or black market) supplies, when it became apparent there would be a delay in the regular allocations.

Administration, not transport or actual short-

age, seemed to cover what few basic materials problems did arise in connection with priority output in Kyoto. Inventories were relatively large in proportion to the volume of such materials required for most industrial processes performed there. Some of the failures in component supply which did affect output adversely may have been due to fuel or basic material shortages at plants in other cities, but air attack damage was usually named as the immediate cause. Because of the high priority placed upon aircraft engine production dispersed to Kyoto from Nagoya, and the output of other aircraft and ordnance items, those firms located in other cities which were supplying components and semi-fabricated materials for this Kyoto production seem to have been relatively favored in basic materials allocation. Interruptions in deliveries, therefore, only began to develop after area attacks on the key centers where such components and semi-fabrications originated.

INDUSTRIAL LABOR FORCE

City statistics gathered from Kyoto officials indicate that total employment in Kyoto rose steadily until the end of the war. In October 1943 the total employment figure was about 170,000 and by the end of the war it had reached approximately 225,000. This steady growth from roughly 17 to 28 percent of the population reflected Kyoto's gradual conversion to war industry when air attacks forced essential aircraft and other production out of Nagoya and Osaka.

In the breakdown of total employment, industrial labor moved from 40 to 45 percent during 1943-1945. Within the industrial labor category, there appeared during the war period considerable changes in the ratio of workers in different types of industry as is indicated in Exhibit 12a. Kyoto had never been an important heavy-industry city. Basic metal fabricating employed only 3 percent of workers in October 1943, which indicates Kyoto's concentration on final stages of production, and by August 1945, this minor industry had grown to account for only 6 percent of total industrial employment. All types of metal manufacturing—including aircraft, ordnance, machinery, and electrical equipment—rose from 43 percent in October 1943 to 52 percent in February 1944, to 62 percent in February 1945 and to 69 percent in August 1945.

At the same time, the textile industry, tradi-

tional key industry of the city, showed a marked decrease in percentage of total industrial employment as the city's skilled labor was shifted to war work, dropping steadily from 38 percent in October 1943 to 7 percent at the close of the war. Since textiles were the most important prewar industry in Kyoto, this cut in employment during the war is a significant indication of the extent to which Kyoto had been converted into a war-production center.

Mobilization of Labor (Exhibits 8 and 9)

Mobilization of labor in Kyoto followed the national pattern of conscripting non-essential workers, students and women. However, since there was always a reservoir of persons volunteering for employment, including refugees from bombed cities, relatively less pressure was needed for mobilization in this city. Exhibits 8 and 9 provide detailed information on mobilization of students and others for essential work in Kyoto. Student mobilization started in May 1944 and the available supply was practically exhausted by April 1945. Of the total mobilized, 26,863 (28 percent) were placed in aircraft plants. Mobilization of other labor in Kyoto started in October 1943. Altogether 141,000 were included in this group, of which 43,000 were adults conscripted for indefinite periods and the rest were mainly young people conscripted for temporary service. Here, too, most assignments were made in 1944, although large numbers were conscripted for aircraft and munitions in April and May 1945. Of those assigned directly to aircraft, ordnance and related functions (some 81,000 assignments altogether) half went to aircraft, a third to ordnance plants and the rest to subcontractors.

Labor Problems

Unlike many cities of Japan, the problems of illegal high wages and black market diversion of labor were not of major importance in Kyoto. Nevertheless, since wage controls were in force here as they were elsewhere in Japan, rice and clothing allotments were distributed at the factories to prevent the movement of workers into the labor black market. From the point of view of the efficiency of the labor force, the drafting into the military forces of skilled or essential laborers was the most serious problem. Not only were skilled workers of long experience drafted, but as soon as

Exhibit No. 8
*Labor conscripted in Kyoto City (other than students)*¹

	Conscripted adults						Emergency service					
	Aircraft and parts	Ordnance	Metal	Munitions supply factories	Miscellaneous	Total	Aircraft and parts	Ordnance	Metal	Chemical	Miscellaneous	Total
1943												
October-December		729				729	3,419	2,182	448	303	9,279	15,631
1944												
January												
February	1,881	3,206				5,087						
March	118	861				979	4,075	2,599	534	361	11,047	18,616
April	300	140				440						
May	104	6,560			441	7,105						
June	3,472	711	2		4	4,189	4,564	3,010	589	404	12,373	20,940
July	875	15	1		2	893						
August	339				3	342						
September	396					396	2,376	1,425	299	204	6,186	10,490
October	445	10	3		30	488						
November	548	96	1		4	649						
December	6,416	457	34		123	7,030	3,171	2,026	416	282	7,868	13,763
1945												
January	3,254	4			22	3,280						
February	712	37			4	753						
March	323		7		4	334	1,631	1,039	216	144	4,419	7,449
April	550			4,515	6	5,071						
May	1,468	3		380		1,851						
June	436			134	5	575	1,400	1,495	183	133	4,507	7,718
July												
August							814	519	107	72	2,207	2,719
Total	21,637	12,829	48	5,029	648	40,191	21,450	14,295	2,792	1,903	57,886	98,326

¹ Conscripted adults were normally assigned for indefinite periods. Emergency service assignments were sometimes temporary in nature. Accordingly, totals here refer to number of assignments, and account for successive periods of duty by some individuals.
Source: Labor section, prefectural police.

Exhibit No. 9
*Students conscripted in Kyoto City by date and type of factory to which assigned*¹

Mobilization periods	Beginning	Aircraft	Electrical manufacturing	Ordnance industry	Metal	Others	Total
1st	1944						
2nd	May	2,439	2,717		1,307	170	6,633
3rd	June	3,956	1,457	1,040	920	1,942	9,315
4th	October	1,803	858	78	1,170	1,234	5,143
5th	December	1,388	739	23	1,709	1,373	5,232
6th	1945						
7th	April	94	32		85	329	540
Total		9,680	5,803	1,141	5,191	5,048	26,863

¹ Source: Labor section, prefectural police.

*Exhibit No. 10.—Average percentage of attendance in the 11 largest plants in Kyoto*¹

Type of worker	1944			1945							
	October	November	December	January	February	March	April	May	June	July	August
Conscripted workers	82.3	82.4	81.7	76.4	75.0	72.4	81.2	78.4	79.2	76.5	74.0
Ordinary workers	81.5	82.2	82.2	78.0	77.0	74.1	74.5	79.5	78.8	77.7	76.0
Students	92.2	91.6	89.4	78.7	84.7	80.8	84.7	86.2	85.4	82.3	80.5

¹ Source: Company payroll records.

new workers were trained for their jobs, they too were often forced to leave for military service. A further effect of this problem was the considerable amount of damage and breakdown to machinery caused by the ignorance of new workers, especially those conscripted for war work. The subsequent repair of this machinery consumed valuable time which otherwise might have been devoted to production. Kyoto's experience was very similar to that elsewhere, although not as serious. Similarly, the decline in attendance and labor productivity was less than in bombed cities.

Effect of Air Raids on Kyoto's Labor Force

There was, of course, no appreciable direct effect from air operations, aside from the loss of labor hours caused by the increasing number of air alerts, especially in the last weeks of the war. B-29s were given credit for much of the increased absenteeism, both during and after alerts and due to unauthorized evacuation into the country when reports of incendiary attacks elsewhere had circulated.

The only immediate instance of labor being directly affected by an air attack on another city was in the case of workers that were sent from the Nagoya No. 2 Mitsubishi aircraft plant early in 1945, to Mitsubishi plants in Kyoto, after Nagoya was reportedly bombed. These workers proved quite unsatisfactory. Their rate of absenteeism was excessively high because they frequently left to visit their families in the Nagoya region and their uneasiness was communicated to Kyoto workers. This problem was intensified when the entire labor force of the Nagoya plant was subsequently moved to Kyoto without adequate housing arrangements.

Labor was not regarded as a critical problem in Kyoto but there was a steady decline in labor discipline as is apparent from the rate of attendance at Kyoto's 11 largest plants, as shown in Exhibit 10. These 11 plants reached a total of 39,000 employees, including students, by July 1945, or roughly one-third of total industrial employment in Kyoto and one-fourth of total adult industrial employment. As elsewhere, student labor attendance in Kyoto did not decline as rapidly as adult labor attendance. These figures are generally comparable to those for other unbombed areas.

It is clear that labor was not a limiting factor, with the one possible exception of the high-priority aircraft plant. Although the total labor force

in Kyoto increased steadily throughout the war, productivity decreased in Kyoto as it did throughout Japan. In October 1943, labor hours lost due to absence, air alerts and work stoppage accounted for 28 percent of total labor hours. This rate remained relatively constant until the end of 1944. In January 1945 lost hours accounted for more than 33 percent of total labor hours and by July for more than 40 percent. The increase from 28 percent in 1944 to 40 percent by July 1945 is about the same as the average increase of non-productive labor hours for all Japan in areas which were not subject to bombing, such as Hiroshima and the cities of Hokkaido.

PRODUCTION TRENDS

The decision to conduct a detailed investigation of Kyoto's war economy was based on the assumption that Kyoto had become relatively comparable with other major Japanese cities from an industrial standpoint during the war period. As the only large city not subjected to heavy area attacks, data on production trends and problems in Kyoto might thus provide suggestive "control" data for assessing the impact on essential activity of urban area attacks as against other factors inhibiting the war economy during 1944-1945. Despite secondary prewar importance for types of manufacturing related to essential war production, there had been large-scale conversion of Kyoto's reservoir of skilled labor and manufacturing facilities to the output of priority items. This process had been stepped up considerably after the decision to disperse aircraft production from Nagoya, following the precision attacks of late 1944. With the growing shift to production of items required for defense of the homeland, Kyoto's particular contribution to war production took on an importance not fully revealed in overall data on volume or value of output.

Nevertheless, from the standpoint of war industry Kyoto never became closely comparable to the other principal Japanese urban centers. It differed from the others, lacking port facilities and having little part in the handling, storing and basic processing of bulk commodities and finished items involved in overseas movement. Furthermore, Kyoto did not provide an ideal case study of isolation from air attack effects. In many ways, it was affected by and economically dependent upon Osaka, Kobe and Nagoya—all of which

TOTAL PRODUCTIVE HOURS & HOURS LOST IN KYOTO

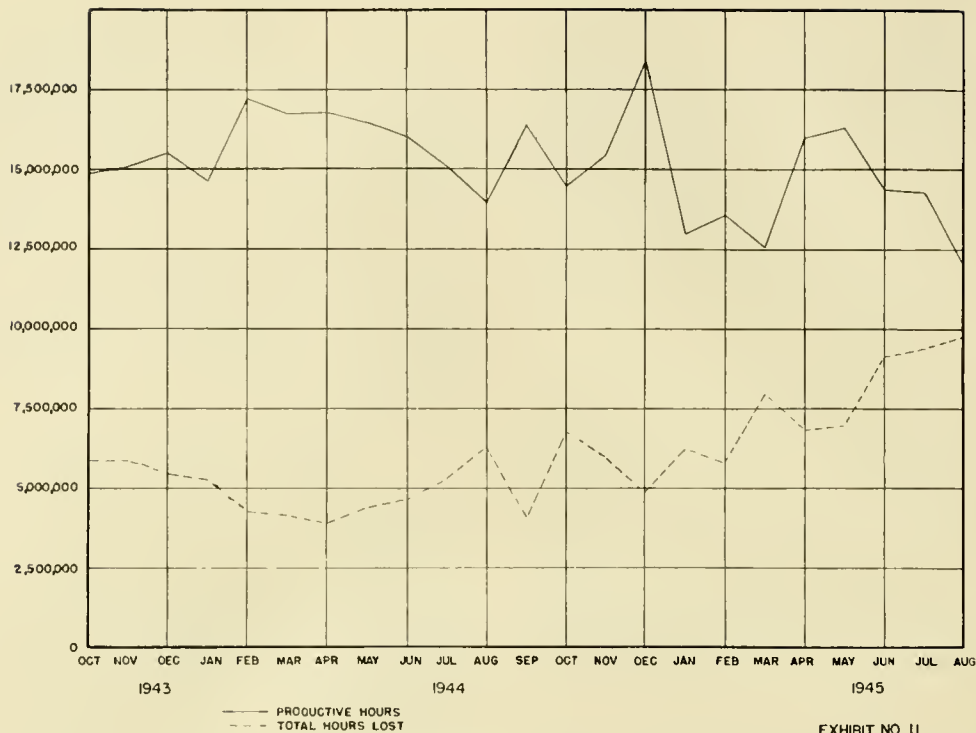


EXHIBIT NO. 11

were heavily attacked. Equally important from the standpoint of analyzing the various causes for production decline, Kyoto was not generally comparable with other major cities in that its factories and workshops were principally engaged in the production of small items and precision machinery for priority end-products. Consequently, it did not begin to feel the basic materials shortages that drastically restricted many types of heavy industry and primary production located in other centers. Such shortages were an important concomitant element in the production declines following urban attacks on the other large cities. The relatively high production levels maintained in Kyoto through August 1945 did not necessarily indicate output rates that could have been equalled by other cities in the absence of air attacks, for Kyoto was an "end-product city". Hiroshima, therefore, presents a more convincing illustration than Kyoto of the extent to which part of the Japanese economy was still able to sustain general priority production in the absence of air attacks. Types of ordnance, machinery and aircraft production requiring large volumes of basic materials were still operating there at high levels in August 1945.

Kyoto production, being concentrated in the last

stages of industry was not yet subject to many of the pressures that began to limit output during late 1944 or 1945 in such cities as Tokyo, Nagoya, Kobe and Osaka. But Kyoto experience does serve to confirm the conclusions reached in surveys of Osaka and Kobe, namely that in the absence of air attacks sufficient basic materials were still available, in various stages of primary or intermediate fabrication, to continue considerably higher output rates for top priority ordnance, aircraft and related items through the summer and early fall of 1945 than would be indicated by actual production rates after the area attacks began.

Industrial Importance of Kyoto (Exhibits No. 12 and 13)

Although Kyoto, with a prewar population of more than one million, was the fourth largest city in Japan, it continued to lag behind the other metropolitan centers from the standpoint of its industrial contribution to the war. In terms of yen value, for example, total industrial production for the last two years of the war was less than twice what it was in Hiroshima, a city about one-fourth as large.

The pattern of industry in Kyoto was in sharp contrast to that of Kobe with its domination by a

PATTERN OF INDUSTRY-KYOTO
ADULT EMPLOYMENT

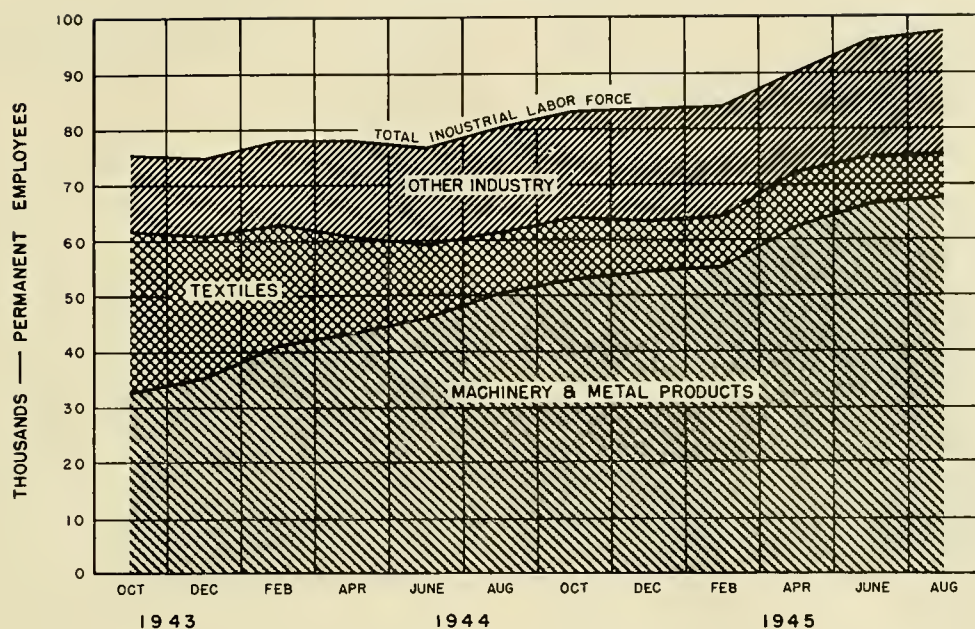


EXHIBIT 12

Exhibit No. 13.—Pattern and Growth of Industry—Kyoto (Industries employing more than 50 workers)

Category	Base period October 1943–September 1944				Period II October 1944–July 1945				Average monthly increase between base period (Oct 43–Sep 44) and Period II (Oct 44–Jul 45)			
	Average monthly value of production	Per- cent total	Average No. of workers	Per- cent total	Average monthly value of production	Per- cent total	Average No. of workers	Per- cent total	Production	Per- cent in- crease	Workers increase	Per- cent in- crease
Aircraft ¹	2,829,688	11.6	6,682	12.1	5,352,141	17.0	14,838	23.7	2,522,453	89.1	8,156	122.1
Electrical equipment ²	4,710,329	19.4	10,495	19.0	5,480,395	17.4	10,613	17.0	770,066	16.3	118	1.1
Ordnance	2,494,290	10.2	4,765	8.6	2,780,230	8.8	4,374	7.0	285,940	11.5	—391	—8.2
Instruments and machinery ²	5,733,861	23.6	11,502	20.8	6,499,371	20.7	10,102	16.2	765,510	13.4	—1,400	—12.2
Machined metal parts	869,918	3.6	1,192	2.2	1,064,634	3.4	1,652	2.6	194,716	22.4	460	38.6
Basic metal-working	1,239,276	5.1	1,960	3.5	1,727,686	5.5	1,965	3.1	488,410	39.4	5	.3
Chemicals	1,479,345	6.1	7,996	14.5	2,078,712	6.6	7,295	11.7	599,367	40.5	—701	—8.8
Petroleum	70,258	.3	118	.2	98,470	.3	90	.1	28,212	40.2	—28	—23.7
Miscellaneous	4,889,986	20.1	10,549	19.1	6,372,089	20.3	11,607	18.6	1,482,103	30.3	1,058	10.0
Total	24,316,951	100.0	55,259	100.0	31,453,728	100.0	62,536	100.0	7,136,777	29.3	7,277	13.2

Source: Industry sample questionnaires.

¹ Three large Mitsubishi aircraft plans which went into production late in the war are not included in these industrial samples. Except for these units, which are discussed separately, the data covers practically all plants employing 50 or more. Only permanent adult shop workers, not supervisory, auxiliary or office personnel, are included in these figures.

² Includes components and many subassemblies for aircraft and ordnance.

few large plant units. It was more comparable with that of Osaka where along with a few large plants, there were many medium-sized factories which played a major role in war production. In June 1945, there were 96,600 permanent adult employees registered in Kyoto factories, of which more than 38,000 worked in 24 plants employing 500 or more. Another 40,600 worked in some 313 plants employing between 50 and 500. About 12,850 were in 780 workshops employing 10 to 50 each. In addition to the 1,100-odd manufacturing units thus accounted for, there were some 1,300 shops employing less than 10 adults which were not included in these calculations. If student labor is taken into consideration, the relative importance of the 24 largest plants is enhanced, for they employed more than 20,000 of the 26,000 employed students.

Despite enormous expansion of three large units, medium-sized plants had absorbed much of the additional employment during the spring of 1945, and small plants had declined in importance. As might be expected, the largest plant units were found in the aircraft industry and included the three large Mitsubishi units established during the war. Among the 12 largest plants, two were devoted to aircraft engines, one to engine valves and bearings and one to airframe subassemblies. Four of these plants turned out batteries and precision electrical equipment, primarily for aircraft and ordnance; two made aircraft armament items and two were devoted to machinery and precision instruments.

The principal industries, in order of their importance, were aircraft engines and parts precision machinery, electrical equipment and ordnance items. Although all these and some other industries expanded during the war, Kyoto never became a major industrial center. During 1945, with declines in production in Nagoya, Osaka and Kobe resulting from air raids, an effort was made to transfer some production from these cities to Kyoto, but except for aircraft, this program did not assume significant proportions.

Exhibit 12 presents data on total industrial employment which suggests the general nature of Kyoto's industrial pattern. Exhibit 13 indicates in more detail the relative importance of various categories of war industry and their growth during the last 22 months of the war, by comparing the average data on deliveries and number of pro-

duction workers for the October 1943–September 1944 period with the average for November 1944–July 1945. Exhibit 13 does not include data on three major aircraft plants that got into production only during the base period used for these calculations. If the three were included, the aircraft industry would have represented about 40 percent of total industrial employment during the last months of the war.

Trends in Industrial Output (Exhibits 14 and 15)

The over-all level of industrial activity in Kyoto remained remarkably stable throughout 1944 and 1945 until August, the month of the surrender. There were considerable shifts in the relative importance of various industrial categories, but these changes in activity tended to cancel out, as is indicated by the total industrial consumption of electric power and utility gas. Indeed, the use of gas for manufacturing purposes reached its highest wartime figure in the month of June 1945. Production data obtained from individual plant questionnaires confirms this picture of sustained activity. As shown in Exhibit 14, actual deliveries of finished items rose to a peak in May 1945, almost 140 percent above the monthly average for October 1943–September 1944, and despite the subsequent decline in June and July remained some 9 percent above the base period average.

A basis for determining the relative level of activity maintained during the last months of the war in different plant size groups is provided by data presented in Exhibit 15 on industrial electric power consumption. Two hundred eighty-eight plant units in Kyoto, out of some 2,400 carried on official records, had electric motors with a total power rating of 50 kilowatts or more. This group includes practically all plants employing more than 100 workers. Together, these plants accounted for more than 90 percent of the electric power consumption, which remained at about 6–8 percent below the January 1945 level from April through July, after a March slump. The 34 largest plants—having aggregate power ratings of more than 500 kilowatts and labor force totals ranging from 500 to 8000—came back to 100 percent in April but declined steadily thereafter to 86 percent in July. It was among this group that dispersal interruptions had the most profound effect on output. Factories of medium size (50–500 kilowatt power rating) numbered 254 and in-

TOTAL KYOTO INDUSTRIAL PRODUCTION, LABOR FORCE, & ELECTRIC POWER CONSUMPTION

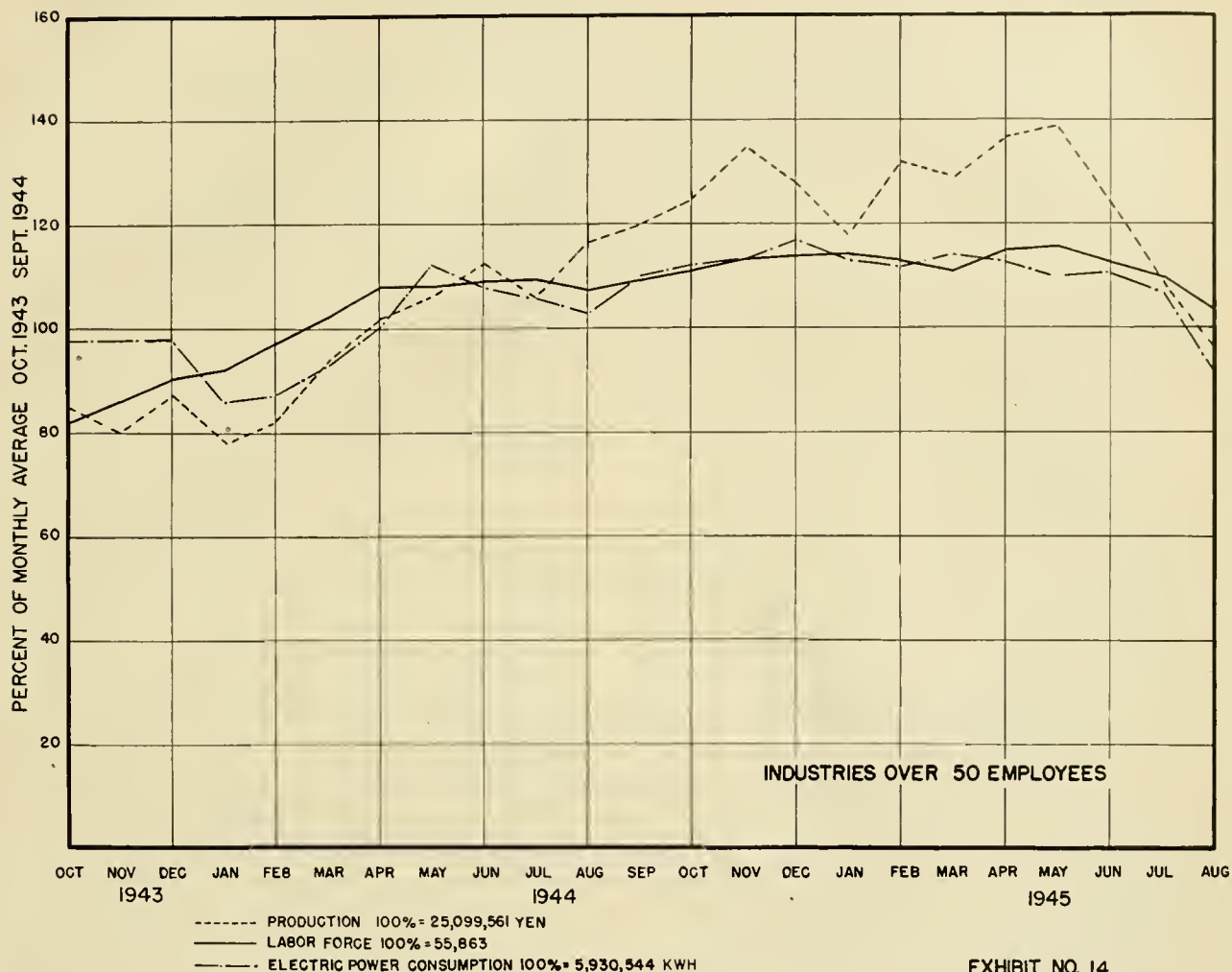


EXHIBIT NO. 14

cluded most of the principal subcontracting units for the larger war plants as well as various low-priority enterprises. Activity in this factory group also declined after January through April but rose to an all-time peak of 110 percent in June. July consumption was still 104 percent of the January level. Electricity consumption by small workshops, numbering over 2,100 but using very little power, likewise rose after an April low, again reaching the January level in July.

The fact that activity in these small and medium-sized plants was on the upgrade during the last three months of the war is of particular interest. It indicates the extent to which the subcontracting program in Kyoto was being successfully expanded, despite general shortages of basic materials and industrial equipment. While deliveries of finished end-products were deferred and curtailed by component bottlenecks and dispersal dur-

ing this period, the groundwork was being laid for an autumn increase in production. Whether such an increase could have been achieved in the absence of air attacks is uncertain, but it is true that the level of industrial activity was moved upward during the last three weeks of the war. Production trends have their real significance when broken down in terms of the various industrial categories most essential for war output.

The Mitsubishi aircraft plants established in Kyoto during 1944 reached peak output levels in April. Their shipments dropped steadily during the following months but were about to turn upward again at the time of surrender. Except for one firm, the rest of the aircraft industry in Kyoto was devoted to components, accessories and sub-assemblies. Activity as measured by power consumption was at a peak in March 1945 and except for a sharp dip in May—the month of greatest dis-

INDUSTRIAL POWER CONSUMPTION IN KYOTO

BREAKDOWN BY PLANT SIZE

(JANUARY 1945 = 100)

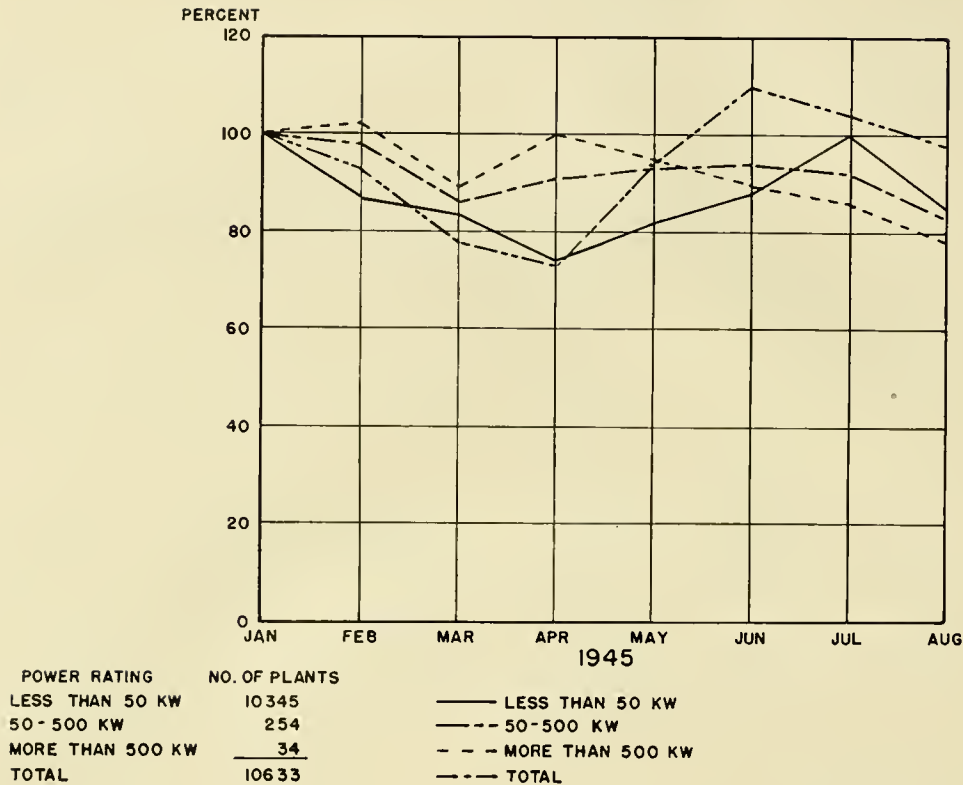


EXHIBIT NO. 15

persal efforts—remained at relatively high levels through June. Deliveries remained at high levels through June but slumped in July.

Activity in the finished machinery and instrument industry was more than 10 percent below the 1943-1944 base period average during most of 1945 and began to slump during June, mainly because of component difficulties following urban attacks on Osaka.

Activity in the electrical equipment industry increased during most of 1944 and remained at high levels until May 1945, but actual deliveries were highly irregular from October 1944 until March 1945. Delays in receipt of materials and production changes seem to be the principal factors. During the second quarter of 1945, however, electrical equipment deliveries were at high levels.

Activity as measured by power commission in the ordnance industry remained relatively stable during the 1943-1945 period. Production reached a peak in September 1944 but remained at irregularly high levels until April 1945, when it was considerably affected by the March attack on Osaka

and never recovered to previous levels.

The variations in activity and output of the various segments of Kyoto war industry tended to compensate each other until June 1945. Thus, in contrast to the enormous industrial declines experienced in the cities that suffered area attacks, Kyoto output as a whole seemed little affected during the crucial winter and spring months. Deliveries of finished machinery and electrical equipment were off from previous levels during January-March 1945 and the ordnance industry was adversely affected by the March urban attack on Osaka. Production of aircraft engines and components reached record levels between February and May, however. During May and June, when the aircraft industry was trying to recover from the effects of hasty dispersal, deliveries of finished machinery and electrical equipment made some compensation for other declines. During June and July further dispersals were carried out, but some firms that moved earlier were beginning to recover and additional small workshops were being converted to production of components for-

merly supplied from Osaka and other centers.

Factors Limiting Production

In appraising the relative importance of various factors limiting essential output in Kyoto, it is necessary to mention the steady decline in labor productivity and the growth of absenteeism. Neither of these problems were as serious as in the cities subjected to attack, but the scarcity of skilled workers was almost as acute, except for the aircraft industry. Labor was plentiful but the policy of conscripting experienced production men made it difficult to utilize the reservoir of semi-skilled and unskilled labor in Kyoto for specialized war production. Labor problems, especially for lower priority plants, were existent but much less controlling than in the case of Osaka and other attacked cities.

As discussed in earlier sections, shortages of fuel and basic materials were not controlling in Kyoto, although their indirect consequences would have been considerable had the war continued. Since Kyoto specialized in the final stages of production, relatively small allocations of basic materials were required directly. Such modest requirements could profitably be maintained, despite over-all shortages, in order to assure current deliveries of urgent end-products. Accordingly, deliveries and inventories were amply maintained in practically all cases. In fact, most factory inventories were permitted to pile up during 1945 to record levels. Raw materials problems that did arise were principally the result of administrative confusion or temporary transport delays.

Direct physical damage to plant was, with one exception, non-existent. But this one "accidental" bombing apparently had much to do with the ensuing dispersal panic. While orderly dispersal plans for many key plants had been under consideration during the early spring of 1945, there was an urgent need for maintaining current production at maximum levels. After slight damage to one Mitsubishi aircraft plant, the official decision was taken to carry out the dispersal program for priority factories with all haste and at whatever expense to current deliveries. Thus the same errors were belatedly repeated in Kyoto as had earlier been inflicted upon the aircraft industry elsewhere. Activity and production suffered accordingly during the last 90 days of the war, but there was considerable evidence that production

in some key units was beginning to recover in August.

Components shortages were repeatedly experienced by various Kyoto war plants. In general, generous inventories were encouraged, especially during 1945, but nevertheless the completion of much essential ordnance, electrical equipment and finished machinery items was deferred for this reason. In many cases—for instance in electrical equipment—much of this deferred production was made up as missing components were received. But elsewhere, especially in ordnance equipment, a permanent ceiling was placed on levels of output. In some few cases these shortages of semi-finished goods and components resulted from reduction of allocations in the light of changes in over-all availabilities and requirements or were related to planned shifts in production. Most component shortages, however, were the result of interrupted deliveries from the main industrial centers, such as Osaka and Tokyo. It was impossible to determine from Kyoto manufacturers the extent to which such supply failures were the result of plant damage or other attack-induced factors. Shortages of basic materials may have played some part in these failures or may have caused delivery delays or cancellations in the absence of area attack damage.

To an increasing extent during 1945, Kyoto firms attempted to expand their own local subcontracting network in order to meet these component problems, but there were strict limits as to the feasibility of this process. In particular, the types of precision machinery required for many operations were unobtainable, as well as such auxiliary equipment as electrical fixtures, motors and transmission belting. Such equipment was often unobtainable after the dispersal program got underway and especially after attacks on the major industrial centers where such equipment was produced or had been obtained second-hand.

Despite its favored position, Kyoto felt to a lesser extent many of the pressures and problems which brought activity almost to a standstill in many other cities. In contrast to many industrial centers, Kyoto had an ample supply of unskilled and semi-skilled labor, but the usual shortage of experienced shop workers and foremen. Despite the absence of attacks, absenteeism increased considerably during the spring of 1945, although not nearly to the extent experienced in attacked cities.

Fuel and basic material shortages were not experienced mainly because of the type of war industry in which Kyoto specialized. The hasty, ill-planned dispersal program had a drastic effect on the output of several of the city's major war-production enterprises. Kyoto never experienced the breakdown of internal transport and communications which contributed so much to industrial stagnation in the damaged cities. Its stock of materials and industrial equipment remained intact. Accordingly Kyoto was able to accomplish much in adjusting its priority activities to the component shortages which were the principal material effect in Kyoto of air attacks on other cities.

The Aircraft Industry

Three large Mitsubishi aircraft plants established in Kyoto during the war are not included in the plant questionnaire data analyzed in this section as they were not operating during the full time used as a base period.

Because of the significance of these plants, periodic information concerning their activity was obtained. If these Mitsubishi plants were included in the statistical data which were derived from the industrial questionnaires, they would substantially alter the 1945 production curves for the Kyoto aircraft industry and for the city as a whole. Altogether aircraft would then have represented more than 40 percent of the total industrial employment and activity for the last months of the war.

Mitsubishi No 2 Engine Works.—Until April 1945 this plant, with a skeleton staff of highly skilled workers, was still producing experimental engines in Nagoya although dispersal to Kyoto and organization for series production was under way. At that time remaining operations were halted and complete dispersal began. The design section had been transferred to a large school in Kyoto while the prototype-engine machine shops and jigs from Nagoya were established in Yamashima, a Kyoto suburb. Other Kyoto intermediate schools were taken over for establishment of more shops. By 15 May, dispersal out of Nagoya was virtually completed and organization for quantity production was begun.

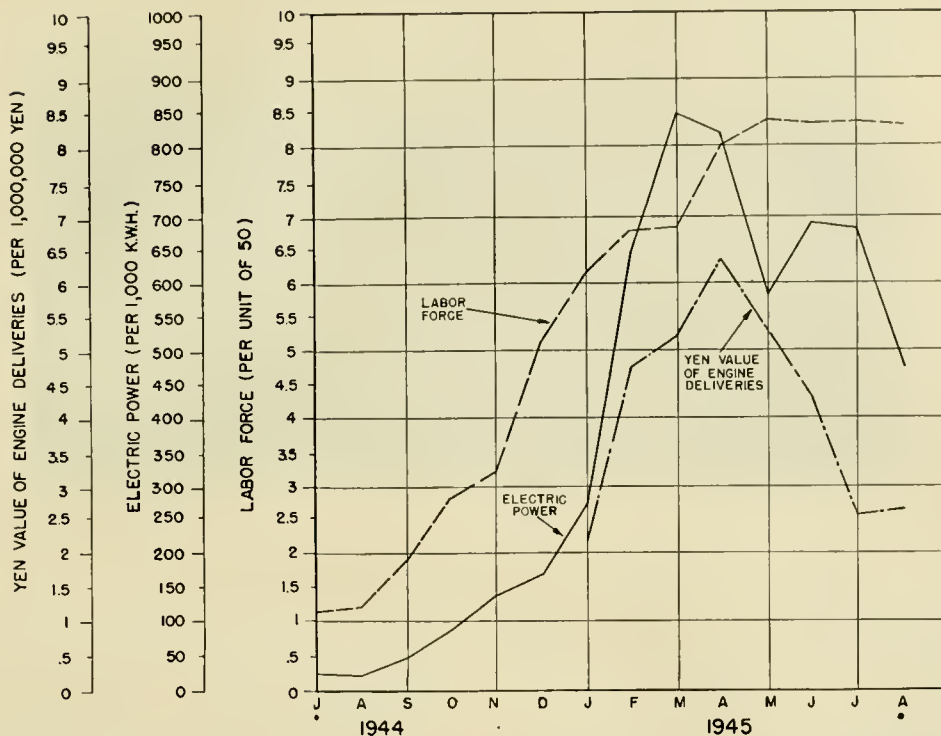
In the early months of 1945 this plant averaged 5 experimental engine deliveries per month from Nagoya as compared to 7 or 8 deliveries per month in 1944. The dispersal caused a complete disruption

in production and also affected worker efficiency adversely. A large number of new workers had to be trained, and jigs and machinery obtained for quantity production. No complete engines were delivered to the military from the Kyoto plant because of the time required to initiate volume production. However, had the war continued, the Kyoto complex would have started deliveries in September on engines that were in various stages of production during the late spring and summer of 1945. The yen value of Kyoto parts production in May, June, July and the first two weeks of August 1945 was ¥201,697, 96,944, 49,218 and 111,292 respectively. Sufficient components were available to support 3 to 4 months' production at the time of surrender. By July 145, this organization employed 3,155 full-time adult shop employees in Kyoto.

Mitsubishi No 8 Engine Works (Exhibit 16).—This organization was established at Kyoto in 1944 and actually began operations in July with production of aircraft engine parts. Production was continually expanded in volume and scope and in January 1945 it began deliveries of completed aircraft engines. Exhibit 14 presents activity data on output and activity.

Engine production rose from a value of ¥ 1,593,384 in January 1944 to a peak in April of ¥ 6,313,884. Total employment reached a peak level in May 1945 and thereafter remained at about 8,250. In late April production began to drop, however, as orders were received to disperse part of the organization into a series of schools and other buildings around the city. The bombing, by one plane, of the Mitsubishi No 14 plant in Kyoto hastened dispersal activities at the No 8 plant. Instead of following a gradual and orderly schedule that would have maintained production, the firm dispersed in one great rush to schools, under railroad viaducts and into a department store. Deliveries naturally suffered as a consequence.

Between 1 January and 15 August 1945, this plant produced 904 engines. During this period plant operations were interrupted by 185 air-raid alarms, including practice drills, which caused a loss in man-hours roughly equivalent to 106 completed engines. Company officials estimated that the dispersal movement in late May and June caused the loss in production of another 129 engines. They also stated that production would have again equalled the April levels within 3 to 4



* JULY 1944 TO AUG 1945

EXHIBIT 16

months if the war had continued. This plant never reached planned capacity operations. In April 1945, the peak month before dispersal, it was running at 72 percent of planned full capacity. There was always a sufficient quantity of all component parts on hand and ample stocks of most types. However, there might have been some component problems if production had not been limited by air-raid alarms and the poorly handled dispersal program. But for these obstacles, deliveries would have moved up to the planned maximum by July or August. In fact, deliveries fell below 30 percent of the plan for those months, but would have recovered again in September as dispersal problems were overcome.

Mitsubishi No 14 Plant.—This firm was particularly important to the whole Japanese aircraft production program as it manufactured, as of December 1944, 90 percent of all aircraft engine exhaust valves and 30 percent of all inlet valves. These operations required special irreplaceable machinery. The Mitsubishi Aircraft Co. had taken over the Kyoto machine tool works in January 1944 and had expanded its production of exhaust and inlet valves under the name of Mit-

subishi No 14 Works.

Production difficulties first arose in mid-1944 when allocations of ferro-alloys—chromium, nickel and cobalt—began to decline. Valve production fell sharply for a time while production techniques were revised to permit the use of special steels which had a lower content of the critical metals, but deliveries of exhaust and inlet valves again rose to previous levels. In December 1944 the firm was producing at 100 percent of capacity and output continued until March 1945 at roughly the same rate.

However, in the spring of 1945, the organization once again faced the problem of modifying its techniques to cope with new alloy shortages. Furthermore, along with the approaching exhaustion of certain critical metals, a lone plane attack on 16 April 1945 led to dispersal of equipment on dispersal schedule and with the need for making a wholesale scale. In the absence of an orderly further production changes, deliveries fell almost to zero in June 1945. Damage to equipment was minor, since the single plane on 16 April dropped only six bombs, three of which penetrated three buildings. Further attacks on this modern and



PHOTO 7.—Kyoto. Looking southwest from central Kyoto toward plant of Mitsubishi Aircraft Company, on southwest outskirts. Along with two business buildings, the Mitsubishi plant was the dominant landmark in its section of Kyoto.

extremely critical plant were expected, however. Practically all irreplaceable equipment was removed during the next six weeks.

The dispersal movement began immediately after the bombing and was a makeshift affair. Equipment and supplies were transferred to caves, tunnels, viaducts and various buildings. The firm never recovered from these three consecutive blows—approaching exhausting of critical supplies, the bombing, and lastly, ill-planned dispersal. Although a large backlog of completed valves had been built up, further production would have continued only at a low level had the war been prolonged.

Labor problems were not serious factors for this plant, although conscription of skilled workers affected training and supervision. The number of workers rose sharply in the early months of 1945, as work began also on the production of bearings at this plant, though only on an experimental basis. In January it had 2,300 employees and in May it reached a peak of 6,850, but 40 percent of this number were conscripted students and were relatively ineffective until the completion of training.

Industrial Analysis (Exhibit No. 15).—The aircraft industry was the fastest growing industrial sector in Kyoto, and it had the highest priority, especially in the later war phases, for obtaining labor and materials. The statistics of the three Mitsubishi aircraft plants, analyzed pre-

viously, were not included in the statistics for the industrial sample which were gathered from industrial questionnaires. The figures of these three Mitsubishi plants were based on different mean factors and therefore are not included in the production, labor force and electric power consumption totals of the statistical sample for the Kyoto aircraft industry. However, in any general analysis of the aircraft industry, all Mitsubishi organizations, because of their preeminence in the industry, must be considered. When these three units are included in the over-all analysis of the Kyoto industrial sample, the aircraft industry becomes by far the largest and most important in Kyoto.

The Munitions Ministry and the military exerted tremendous efforts to increase Japanese aircraft production in 1944–1945 and to restore output after attack damage in late 1944 and subsequent dispersal. In Kyoto, production in the aircraft industry more than trebled in the period from October 1943 through October 1944. Aircraft production in the last two months of 1944 fell sharply, due to model changes in the Okubo plant of the Japan International Aircraft Company, as this secondary firm shifted to combat types. If the output of the Mitsubishi No 14 plant were included in the sample production figures, however, this drop would have been more than compensated for, since output rose to peak levels in December 1944.

THE KYOTO AIRCRAFT INDUSTRY PRODUCTION, LABOR FORCE & ELECTRIC POWER CONSUMPTION

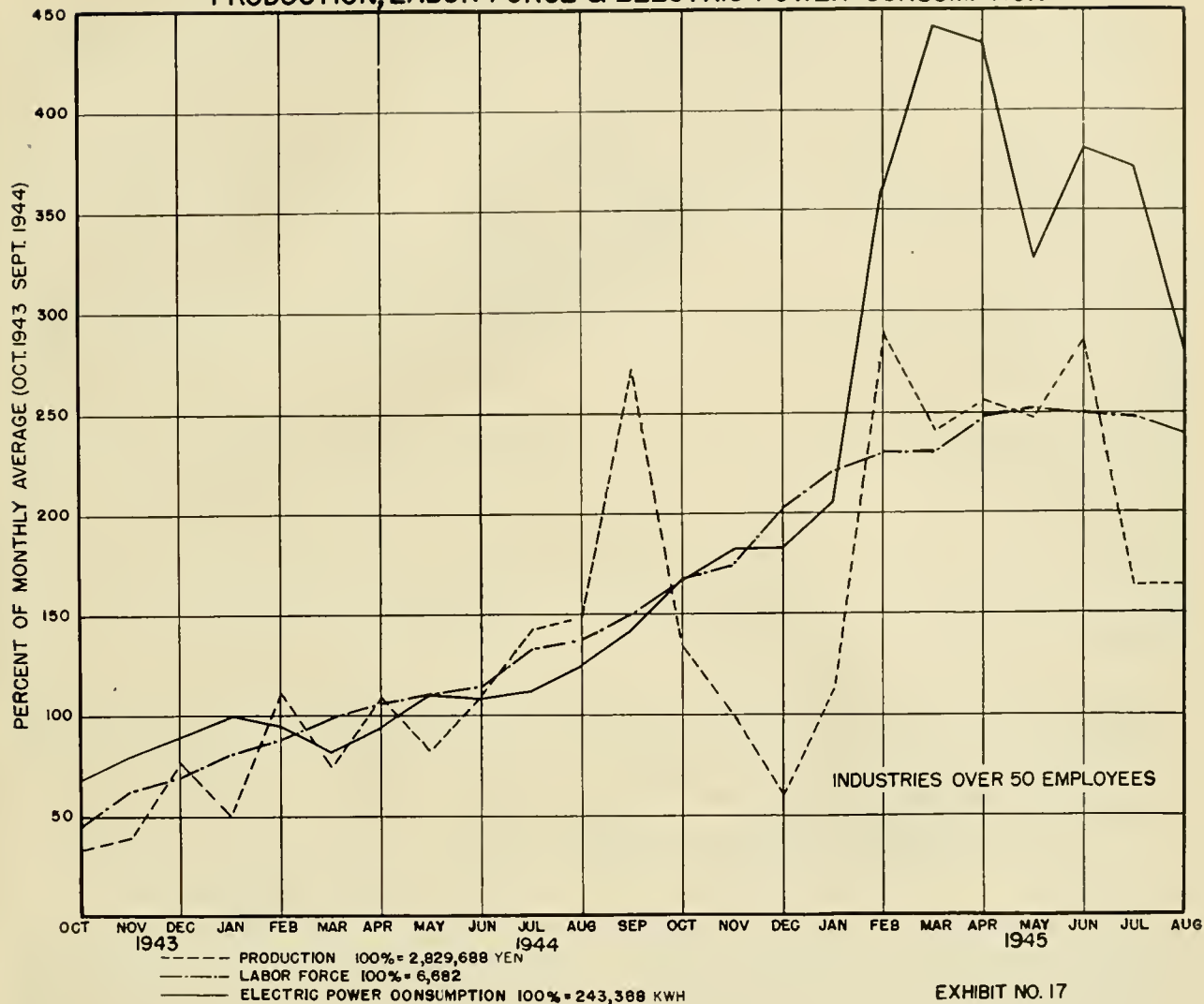


EXHIBIT NO. 17

After January 1945, loss of productive hours caused by air alerts affected the production of all firms and, in April 1945, the important companies began dispersal of at least some operations. Except for lone bombings, Kyoto was never hit, but the saturation raids on neighboring cities prompted immediate action. Japan International, which was beginning to assemble combat types, started its dispersal program at this time. Dispersal eliminated this company's production for the duration, as the parent plants shut down completely long before the dispersal sites were ready for operation. Of far more importance were the Mitsubishi plants. The Mitsubishi No 2 organization was completing its transfer from Nagoya to Kyoto while the No 8 and No 14 plants, which

were already established in Kyoto, began dispersal activities at this time. Dispersal in haste was the primary cause of the industry's production drop. If the three Mitsubishi industries were included, the industrial sample aircraft graph would show a much sharper drop from higher levels than it does after April 1945.

Although dispersal was principally responsible for the collapse in production in the industry, other factors, such as manpower deficiencies and absenteeism, contributed. Workers in increasing numbers were brought into the Kyoto aircraft industry, especially between January and April 1945. At no time did the industry have all the skilled workers needed. Except for engine valve output at Mitsubishi No 14 works, most of the

THE KYOTO FINISHED MACHINERY INDUSTRY PRODUCTION, LABOR FORCE & ELECTRIC POWER CONSUMPTION

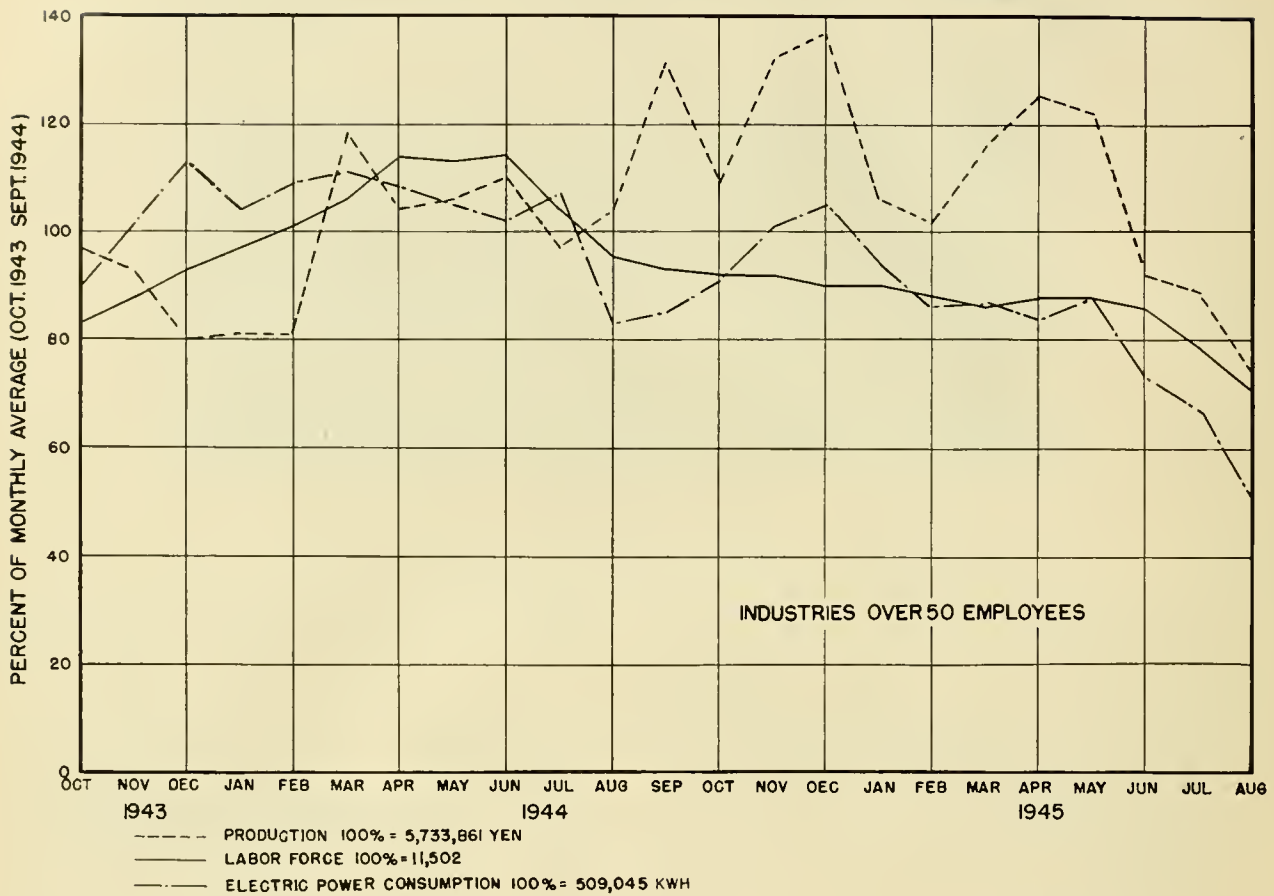


EXHIBIT NO. 18

industry always had a sufficient supply of raw materials and component parts on hand. Certain accessory producers did run out of some parts in July and components problems would have arisen for more firms in July and August if dispersal had not reduced output. In the case of aircraft engines produced in Kyoto, sufficient materials were on hand to insure substantial output during the summer and early fall if production problems at dispersal sites could be mastered.

Finished Machinery (Exhibit No. 18)

The finished machinery industry was the second most important industry in Kyoto and was devoted mainly to fabrication of instruments and precision accessories for aircraft and ordnance. This industry's average monthly production during the period October 1943 through September 1944 was 23.6 percent of the total Kyoto production and during the same period it employed 20.8 percent of the city workers.

In the period October 1944 through July 1945, production in this industry represented 20.6 percent of total Kyoto production and the labor force employed represented 16.2 percent of the total city labor supply.¹

The monthly average (over 50 workers) of production and labor for the two periods is as follows:

October 1943-September 1944			
Production	Percent total	Workers	Percent total
5,733,861	23.6	11,502	20.8
October 1944-July 1945			
Production	Percent total	Workers	Percent total
6,499,371	20.6	10,613	17.0

¹ Statistics exclude 3 Mitsubishi aircraft plants. If these were included, percentages would be slightly less.

THE KYOTO ELECTRICAL EQUIPMENT INDUSTRY

PRODUCTION, LABOR FORCE & ELECTRICAL POWER CONSUMPTION

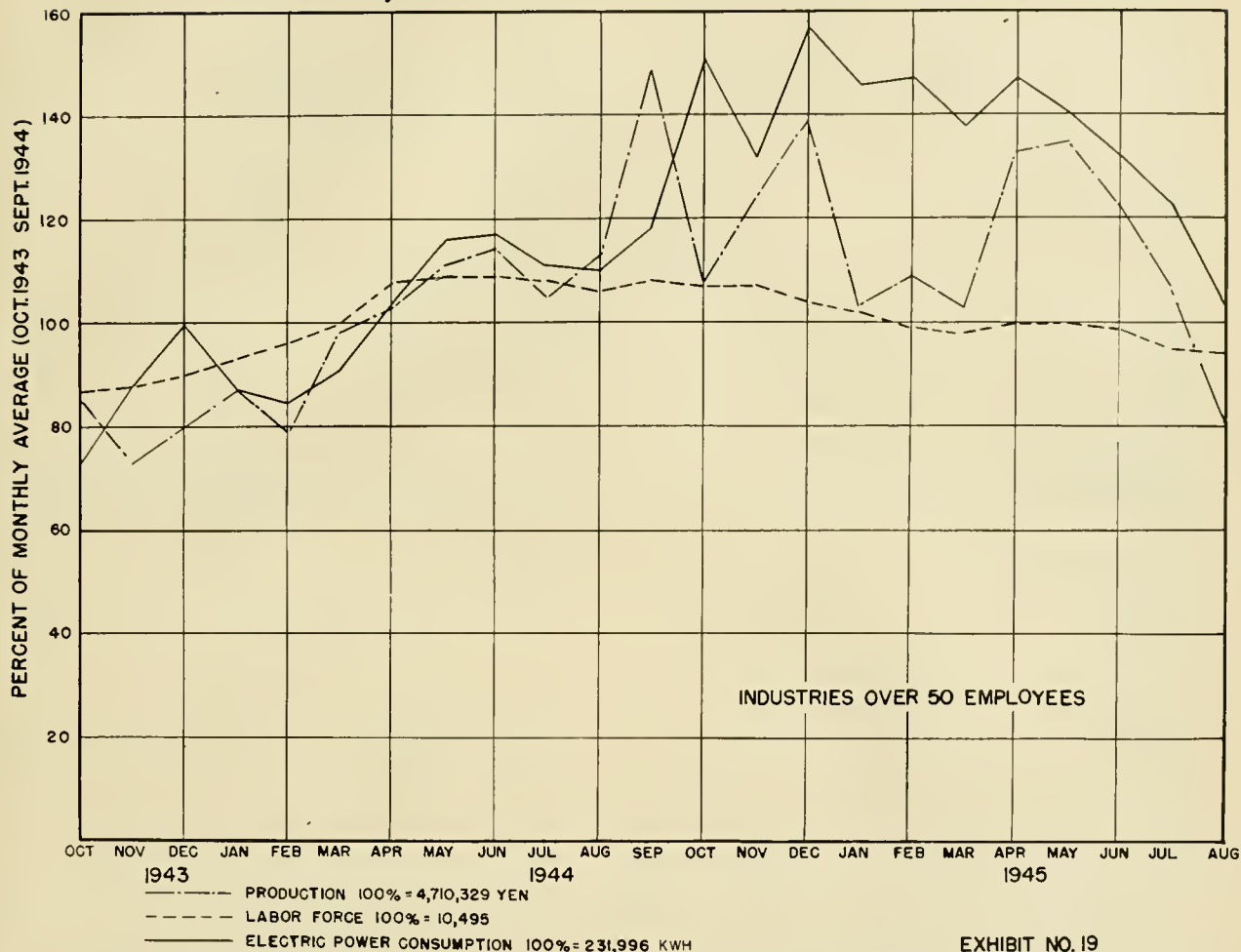


EXHIBIT NO. 19

Production in this industry rose irregularly but extensively through 1944, reaching a peak in December. In January and February of 1945 it fell off considerably owing to production changes and delivery delays following the late 1944 spurt. However, it rose in March and again in April. In succeeding months, until the end of the war, production started down once more with developing momentum in the last weeks.

This industry never obtained all the skilled employees it desired. From July 1944 the total number of employees decreased. In the latter stages of the war many workers were conscripted, many went into the aircraft industry, and after January 1945 general absence increased sharply as some left the city and others searched for food.

It was not until April 1945 that this industry experienced any difficulty in obtaining raw materials as against mere delays in receipts. Heavy

raids on cities which furnished semi-fabricated items for the industry directly affected production. Furthermore, the aircraft industry, which had top priority in allocations, competed for many materials at the expense of this industry. This decline in receipts began to be reflected in June production.

Transportation difficulties by rail and truck increased during the last six months of the war. Transportation problems delayed incoming raw materials and delivery of the industry's finished production, especially after March. Nevertheless, despite the growth of these negative production factors in the early months of 1945, it was not until June 1945 that a consistent downward production trend set in.

Electrical Equipment (Exhibit No. 19)

The electrical equipment industry was the third

THE KYOTO ORDNANCE INDUSTRY PRODUCTION, LABOR FORCE & ELECTRIC POWER CONSUMPTION

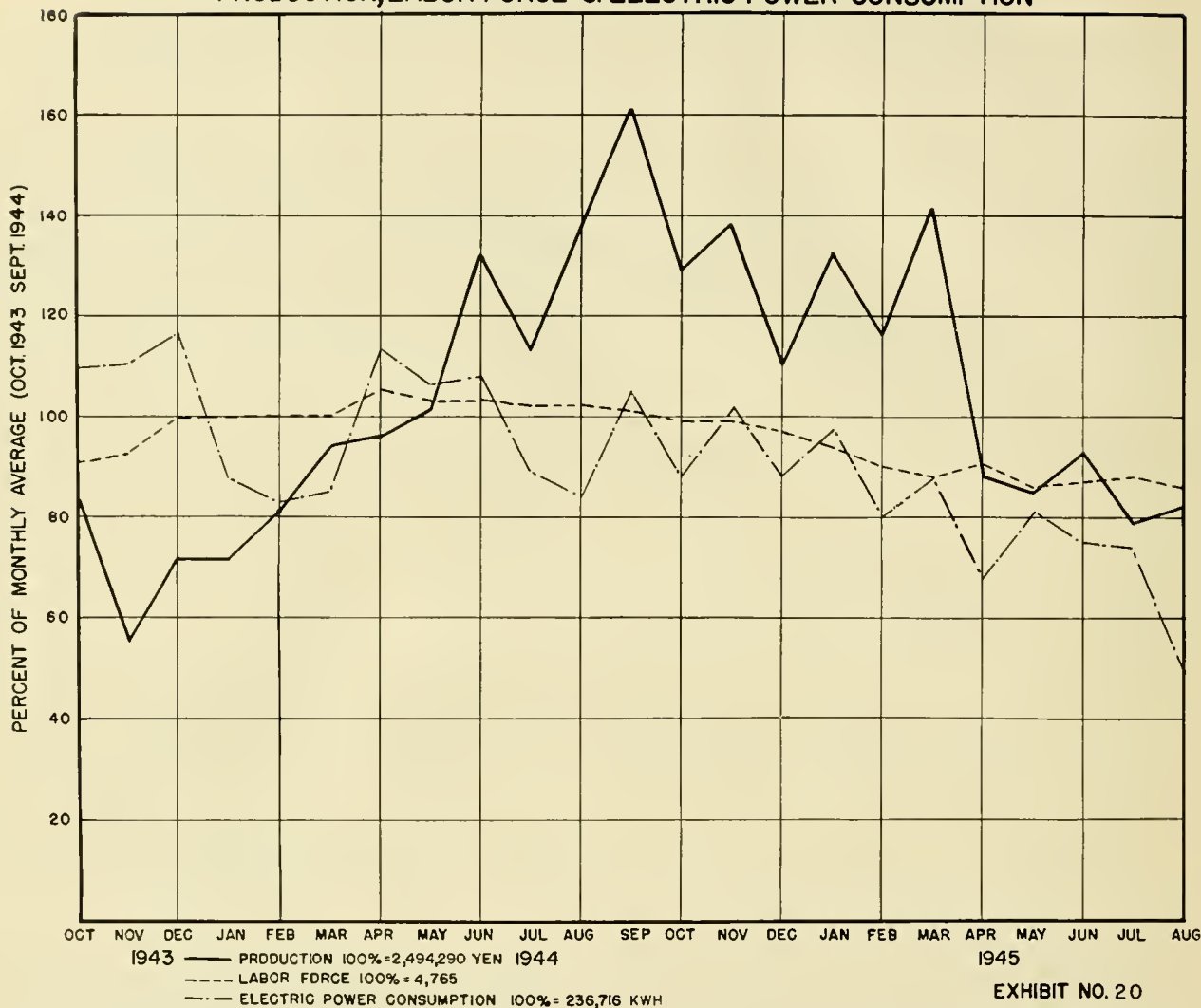


EXHIBIT NO. 20

most important in Kyoto among factories employing more than 50 workers. Storage batteries were a major item, along with the electrical instruments and apparatus for aircraft and ordnance. The average monthly production from October 1943 through September 1944 was 19.4 percent of total city production and this industry hired 19 percent of the city's workers.

During the period October 1944 through July 1945, average monthly production was only 17.5 percent of total Kyoto production, even though the yen value of the industry's production had increased. During this period the number of workers represented 17 percent of the total number of Kyoto workers.

The monthly average for industries employing more than 50 workers in production and the number of employees for the two periods is as follows:

Production in the electrical equipment industry fluctuated considerably between October 1943 and August 1945. Deliveries rose rather steadily throughout 1944 to peaks in November and December 1944, dropped off below the 1944 average during the first quarter of 1945 and then registered an impressive spurt in April and May. Production and deliveries sagged during the last 10 weeks of the war but even in August 1945 it was still at a higher rate than during late 1944 and early 1945.

During 1944-1945, this industry usually operated below its optimum capacity because of the difficulty it experienced in competing for manpower with higher-priority industries such as aircraft, but was able to maintain required output. At times, though sufficient materials had been allocated to the industry for priority items, there were

delays in receipts. This problem increased during the first quarter of 1945 to the point of threatening minimum inventories but the industry was given more favorable attention in the second quarter. Because the industry was highly integrated and had its subcontracting units concentrated in Kyoto there was little evidence of components problems or other repercussions of attacks elsewhere.

Many of the 10,613 workers in the sample plants were young and most of them were unskilled. There was considerable difficulty in obtaining skilled workers and many of the laborers that the company had spent time training were drafted.

Ordinance (Exhibit No. 20)

The ordnance industry was the fourth largest industrial group in Kyoto among factories with 50 or more employees. (Much of Kyoto's total

contribution to the munitions industry was in the nature of machinery and electrical items. From October 1943 to September 1944 it represented a monthly average of 10.2 percent of the city's total yen production and employed 11.6 percent of the total workers. Production of finished ordnance items rose through 1944 and reached its peak in March 1945. From this high mark, output registered a sharp drop in April, primarily as a result of the March attack on Osaka which was the major outside source of components and basic fabrications for the industry. There was a further decline in May and after considerable recovery in June, a new low in July, reflecting further attacks on Osaka. This decline was above average in comparison with the over-all Kyoto industrial picture, as is illustrated by the industry's monthly average of only 8.8 percent of the city's yen production and 7 percent of the city's industrial labor supply for the last ten months of the war.

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, German
- 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
 - } Part I, Aluminum of Germany
 - } 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
- 2* Wieland Werke A G, Ulm, Germany
- 27 Rudolph Rautenbach Leichtmetallgiessereien, Solingen, Germany
- 28 Lippewerke Vereinigte Aluminiumwerke A G, Lunen, Germany
- 29 Vereinigte Deutsche Metallwerke, Hedderheim, Germany
- 30 Duerener Metallwerke A G, Duren Wittenau-Berlin & Waren, Germany

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

CIVILIAN DEFENSE DIVISION

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

EQUIPMENT DIVISION

Electrical Branch

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

Optical and Precision Instrument Branch

- *50 Optical and Precision Instrument Industry Report

Abrasives Branch

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

Anti-Friction Branch

- *53 The German Anti-Friction Bearings Industry

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- *54 Machine Tools & Machinery as Capital Equipment
- *55 Machine Tool Industry in Germany
- 56 Herman Kolb Co., Cologne, Germany
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- 58 Saxos Union, Frankfurt on Main, Germany

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

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

Motor Vehicles and Tanks Branch

- *77 German Motor Vehicles Industry Report
- *78 Tank Industry Report
- 79 Daimler Benz A G, Unterturkheim, Germany
- 80 Renault Motor Vehicles Plant, Billancourt, Paris
- 81 Adam Opel, Russelheim, Germany
- 82 Daimler-Benz-Gaggenau Works, Gaggenau, Germany
- 83 Maschinenfabrik Augsburg-Nurnberg, Nurnberg, Germany
- 84 Auto Union A G, Chemnitz and Zwickau, Germany
- 85 Henschel & Sohn, Kassel, Germany
- 86 Maybach Motor Works, Friedrichshafen, Germany
- 87 Voigtlander, Maschinenfabrik A G, Plauen, Germany
- 88 Volkswagenwerke, Fullersleben, Germany

- 89 Bussing NAG, Brunswick, Germany
- 90 Muehlenbau Industrie A G (MiaG) Brunswick, Germany
- 91 Friedrich Krupp Grusonwerke, Magdeburg, Germany

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- 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
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- 99 Submarine Assembly Shelter, Farge, Germany
- 100 Bremer Vulkan, Vegesack, Germany

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- *101 Ordnance Industry Report
- 102 Friedrich Krupp Grusonwerke A. G Magdeburg, Germany
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- 104 Henschel & Sohn, Kassel, Germany
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- 106 Hermann Goering Werke, Braunschweig, Hallendorf, Germany
- 107 Hannoverische Maschinenbau, Hanover, Germany
- 108 Gusstahlfabrik Friedrich Krupp, Essen, Germany

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- *110 Oil Division, Final Report, Appendix
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- 112 Underground and Dispersal Plants in Greater Germany
- 113 The German Oil Industry, Ministerial Report Team 78
- 114 Ministerial Report on Chemicals

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- 117 Ludwigshafen-Opau 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
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- 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

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- 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, Krailburg, Germany

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- 134a Industrial Sales Output and Productivity

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- 169 Bayerische Motorenwerke, Durrerhof, Germany
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- 173 Continental Gummiwerke, Hanover, Germany
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- 206 1 to 10 in Vol I "Utilities Division Plant Reports"
- 207 11 to 20 in Vol II "Utilities Division Plant Reports"
- 208 21 Rheinische-Westfalische Elektrizitaetswerk A G

Pacific War

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- *2 Japan's Struggle to End The War
- *3 The Effects of Atomic Bombs on Hiroshima and

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- 5 Field Report Covering Air Raid Protection and Allied Subjects, Nagasaki, Japan
- *6 Field Report Covering Air Raid Protection and Allied Subjects, Kyoto, Japan
- 7 Field Report Covering Air Raid Protection and Allied Subjects, Kobe, Japan
- 8 Field Report Covering Air Raid Protection and Allied Subjects, Osaka, Japan
- 9 Field Report Covering Air Raid Protection and Allied Subjects, Hiroshima, Japan—No. 1
- *10 Summary Report Covering Air Raid Protection and Allied Subjects in Japan
- *11 Final Report Covering Air Raid Protection and Allied Subjects in Japan

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- *13 The Effects of Atomic Bombs on Health and Medical Services in Hiroshima and Nagasaki

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- *17 Nakajima Aircraft Company, Ltd.
Corporation Report No. II
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(Airframes & Engines)
- *18 Kawanishi Aircraft Company
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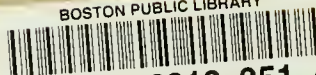
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