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. It was established for the
purpose of conducting an impartial and expert study
of the effects of our strategic attack on Ger-
many, to be used in connection with our efforts
in Japan and to establish a basis for evaluating
our 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 135 sup-
porting reports containing the findings of the Sur-
vey in Germany have been published. On 10 Aug-
ust 1945, President Truman requested the Survey
continue a similar study of the effects of all types
of air attack in the war against Japan.

The objectives of the Survey in Japan, who are all
American citizens, were:

Franklin D. Roosevelt, Chairman,
Paul B. Johnson, Jr., Acting Chairman,
Harry C. Alexander, Vice Chairman,
James E. Boren,
John W. Calhoun,
Brooks Ewart,
Frank A. McNamara, Jr.,
Paul B. Johnson, Jr.,
Horace R. Hooper,
Dr. Louis E. Thompson,
Theodore P. Wright, Director.

Walker White, Secretary.

The Survey’s complement provided for 500
civilians, 150 officers, and 500 enlisted men. Sixty
percent of the military segment of the organiza-
tion for the Japanese study was drawn from the
Army, and 40 percent from the Navy. Both the
Army and the Navy gave the Survey all possible
assistance in the form of men, supplies, transport,
and information. The Survey operated from
headquarters in Tokyo, with field units in Kyoto,
Okayama, Hiroshima, and Nagasaki, and
with mobile teams operating in other parts of
Japan, the islands of the Pacific, and the Antarctic.

The Survey accorded the principal ravages
Japanese cities and interrogated key Army and
Navy officials, Government officials, industrialists,
political leaders, and many hundreds of their ad-
mirers throughout Japan. It was thus possible
to reconstruct much of wartime Japanese military
planning and execution, engagement by engage-
ment and campaign by campaign, and to secure
reasonably accurate data on Japan’s economy and
war production, plant by plant, and industry by
industry. In addition, studies were made of
Japan’s overall strategic plan and the back-
ground to her entry into the war, the internal dis-
cussions and negotiations leading to her accept-
ance of unconditional surrender, the course of
attacks and losses among the civilian population,
the effectiveness of the Japanese civilian defense
organization and the effects of the atomic bomb.
Separate reports will be made covering the
future.

In this Summary Report the civilian officials
directors of the Survey have not undertaken
to write a history of the Pacific war, nor to appar-
ect credit for victory among the various com-
ponent Allied forces. They have undertaken, as
civilians, to present an analysis of the factual
material gathered by the Survey and their general
approach toward the future.
UNITED STATES STRATEGIC BOMBING SURVEY
SUMMARY REPORT

The attack on Pearl Harbor was designed around surprise, the use of mortar bomb fleet, and the power of aircraft to sink surface vessels. It was executed with the loss of 98 Japanese planes. Two days later, the Japanese landed the British battleship Prince of Wales, and the battleship Repulse, without air cover off Malaya and sent them to the bottom with the loss of 3 Japanese Navy medium bombers. Allied air power in the Philippines, Malaya, and the Dutch East Indies was virtually eliminated, mostly on the ground, in a matter of days. These losses were, once Allied air power had been eliminated, were held in reserve in occupation in a matter of weeks at a cost of less than 1,000 Japanese lives, and with the loss of all stores in the entire campaign of 98 Japanese planes.

As a result, the Japanese started the war aware of the fact that major effective action could be undertaken without local control of the air. They also anticipated the vulnerability of their air attack of surface objectives, both on land and at sea. The Japanese failed, however, to appreciate the full scope and complexity of the requirements for controlling control of the air. The Japanese aircraft production program at the start of the war was& very limited, at the Japanese start operations were, not only in relation to that of the United States, but even in relation to the capabilities of their own industry. This was to be the real strength of United States air power.

December 7, 1941, Japan attacked the United States and its Allies practically weak in the Pacific, particularly in land and carrier-based air power. The Allied air groups in the Pacific were not only far from home but, in large measure, technologically inferior to that of the Japanese. The Japanese strength had been underestimated. Ninety F-8A and B-24s in the Philippines could not be expected to check the Japanese push southward.

Thus of our seven aircraft carriers were in the Atlantic and one training in the Gulf of Mexico. Even at that time, however, we had begun to work, step by step, the Japanese, the full scope of the basic requirements for air power. Our program for training, production, maintenance, intelligence, and intelligence was limited, not as much by a lack of concept as by the time required for their development and fulfillment.

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THE ORIGINAL STRATEGIC PLAN

Japan's governmental structure provided no effective civilian control of her Army and Navy. In the years between the 1871 invasion of Manchuria and the 1941 attack upon Pearl Harbor, the military clique of Japan wanted a progressively tighter control over the foreign and domestic affairs of the nation. These cliques included groups within both the Army and Navy, but became of the repeated military successor of the Japanese Army in Manchuria and China and the prestige acquired, and became of the more ambitious and aggressive clique of the Japanese Army led by the political position of the Army was already much to that of the Navy. The final decision to enter the war and to advance into the Philippines, the Dutch East Indies, Malaya, Burma, and to the southeast way, however, while the total success and entire control of all of the Japanese Army and Navy leaders and of almost all her important civilian leaders.
This decision to which the Japanese were, in effect, committed by mid-October 1941, was based upon the following conclusions:

1. The threat of Russia on the Manchurian flank had been neutralized by the decisive victory of Germany in Europe which might eventually lead to the complete collapse of the Soviet Union.

2. Great Britain was in such an inevitably defensive position that, even if she survived, her active war-making potential would be spent in a desperate effort to protect her home islands.

3. The forces which the United States and her Allies could immediately deploy in the Pacific, particularly in China, were insufficient to prevent the fully trained and equipped forces of Japan from occupying within three or four months the entire area enclosed within a perimeter consisting of Burma, Sumatra, Java, northern New Guinea, the Bismarck Archipelago, the Gilbert and Marshall Islands, Wake, and some islands north of the Louisiada.

4. China, with the Burma Road severed, would be isolated and forced to negotiate.

5. The United States, committed to aiding Great Britain, and weakened by the attack on Pearl Harbor, would be unable to mobilize sufficient strength to go on the offensive for 10 months to 2 years. During this time, the perimeter could be fortified and the required forward air fields and bases established. So strengthened, this perimeter would be backed by a mobile-carrier striking force based on Truk.

6. While the battle-defence of the exposed perimeter was undertaking American determination to transport the war, the Japanese would quicken their military build-up in the Canal Zone, the Philippines, the Dutch East Indies, and ship these troops to Japan for garrisoning in the north and strengthening its industrial and military factories.

7. The decision of the United States as a democracy would make it impossible for her to commit a decisive offensive action in the face of the war which would be imposed by financially securing Japanese assistance, supplies and industry, and the elimination of her Allies. The United States in consequence would compensate and allow Japan to maintain substantial portion of her initial territorial gains.

Certain civil and naval groups were familiar with the United States, its industrial and technological potential, and probable fighting dispositions when armed. They expressed doubts about a strategy which provided no conclusion to the war other than cessation, and which thus might drag on interminably with consequent cost of defeat. The Navy, however, was greatly concerned about the depleting oil supply after the United States and the British economic embargo of July 1941. Such evidence as was available were reviewed and went along with the more dynamic opinion.

None of the responsible Japanese leaders believed that within any reasonable period of time Japan could invade the United States and dictate peace in the White House. Admiral Yamamoto expressed doubt that Japan would do so even if fact were made. Some leaders furthermore felt that Japan's limited shipping would be strained to the utmost in providing logistic support for the peace that would and would be wholly inadequate for any later widening program, within the initial operations went unexpectedly well.

EXECUTION OF THE JAPANESE PLAN

In accordance with the above plan, the Japanese Army was given primary responsibility for conquering Malaya, Borneo and Burma and, because of the limited range of its planes, for establishing initial air support in northern Korea only above 10,000 feet. The Japanese Navy was assigned primary responsibility, in addition to the attack on Pearl Harbor, for initially launching operations in the Philippines, Borneo, Celebes, Java, northern New Guinea, the Bismarck Archipelago, and to the Gilbert Islands and Wake. The Army was to assume control in the Philippines as soon as the landing forces were established ashore. On 1 December 1941 the Japanese Army and Navy forces were accordingly disposed as follows:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Area</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>ARMY</td>
<td></td>
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</tr>
<tr>
<td>1st Flying Division</td>
<td>Malaya</td>
<td>Disarmament</td>
</tr>
<tr>
<td>2nd Flying Division</td>
<td>Philippines</td>
<td>Disarmament</td>
</tr>
<tr>
<td>3rd Flying Division</td>
<td>Bismarck</td>
<td>Disarmament</td>
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<tr>
<td>4th Flying Division</td>
<td>Celebes</td>
<td>Disarmament</td>
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<tr>
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<td>Disarmament</td>
</tr>
<tr>
<td>6th Flying Division</td>
<td>Borneo</td>
<td>Disarmament</td>
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<td>North Korea</td>
<td>Disarmament</td>
</tr>
<tr>
<td>Total Army</td>
<td></td>
<td>6,500,000 soldiers</td>
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The majority of these planes were of obsolete types. The Japanese were not deploying only upon the volume of their air strength in these initial engagements, although they believed they possessed sufficient superiority in numbers over Allied air forces in the Pacific. More that on number, the Japanese relied on surprise and speed of elements, and upon the training and experience of their pilots. In 1933 the average first-line Japanese pilot had about 300-400 flying hours, and about 30 percent of Japanese Army pilots had had actual combat experience in China or in border fighting with the Soviet Union in 1938. The reserve air groups were especially trained in shallow-water tactics for the Pearl Harbor attack, and the Japanese Army air units were trained for support of ground operations in Malaya and the Philippines.

### Chart: Allied and Japanese Air Forces

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and drew the United States major staging areas more advanced than Pearl Harbor.

By stretching and overestimating her line of advance, Japan was undoubtedly seen by events and existing supply systems, she delayed the full mobilization of the fleet. The perimeter originally decided upon, jeopardized her economic program for fulfilling the resources of the area already captured, and halted her plan of early counterattack in the advanced and, as yet, weak positions.

THE UNITED STATES PLAN BEFORE PEARL HARBOR

Prior to Pearl Harbor it had been decided that, if the worst came to the worst, the fleet would have to be eliminated first, and that our initial role in the Solomons would be defensive. But Japan’s effective capabilities were understated; it was thought possible to hold the Midway carriers, successfully engage the Japanese fleet in the Central Pacific, and lay the foundations for an eventual advance against Japan itself. The United States plan held little basis in reality. With the forces that could be assembled to make a defense plan possible. The loss of relatively undisputed territories at Pearl Harbor did not substantially reduce the actual combat capabilities of the Navy at that time as opposed to the Japa-

nese Navy with its superiority in aircraft carriers and battle fleet strength. To have implemented an adequate plan in December 1941 would have re
duced to insignificance regarding Japanese ini-
tiative and capabilities, an actual understanding of the predominant and indispensable role of air strength and full public support for the necessary appropriations, will be the actual outcome of war

As it developed, all that we could do prior to May 1942 apart from the continued training of our isolated forces in the Philippines and specific carrier and land-based air raids was to build up our strength in the Solomons and the islands lying between Pearl Harbor and Australia, while bringing in forces to close the training and production program.

TURNING THE TIDE

United States preparations were still inade-
quately when it became evident that the Japanese intended to advance south from the Bismark Archipelago, and thus threaten our communications with Australia. It was decided nevertheless to attempt to hold Port Moresby and a line north of Bismarck Strait and the Fiji Islands. Exceptional intelligence gave in advance information that a group of transports, protected by the Japa-
nese carrier Shoho and by a covering force including two other carriers, was in the rear to evacuate Port Moresby in May 1942. This information en-
dabled us to concentrate at the appropriate point one of our four carriers that had landed in the Paci-

fic (one had come to the Pacific from the Atlantic, but two were returning from the Dau-

dier raid on Sydney), and to sink the Shoho by torpedo-plane and dive-bomber attack. In the ensuing air engagement with the covering force, we damaged one of the Japanese carriers in that force, but lost the Enterprise. The Japanese force had one carrier left to use one, but their air groups had been badly depleted. The transports turned back from Port Moresby to return to Rab

ua and, for the first time, the Japanese advance had been checked. The result of this battle of the Coral Sea was entirely air action.

Similar intelligence provided advance infor-
mation as to the Japanese move toward Midway is

In this case, the transports were supported by an advance striking force, inflicting the most powerful surface force yet assembled in the en-

and four of Japan’s strongest eight-operation

ation. An additional Japanese carrier was in a

supporting force farther to the north. Again only weaker forces were available to the United States; three carriers, the Enterprise, Yorktown, and Hornet, the only ones available for combat action in the Pacific at that time, were sunk to the attack. One plane located the Japanese fleet

not work them as enemy carriers, and so dam-

eg the fourth that she subsequently did no more

order. In the course of the Japanese Fleet was found to have

despite its power, its superiority in heavy ships, and its strength. The result of the action is described in the Tokyo report that the worst was the service of four enemy carriers. One of the Japanese carriers and one lost by Japanese submarines. None of the Japanese carriers and none of the carrier air groups ever returned to the carrier air groups ever returned to the carrier air groups.
Immediately after Midway, the Japanese had a certain fit for action, shortly to be joined by a fifty-fold increase in their own forces. In addition, they had 9 carriers under repair or construction. In addition, the United States had 2 large carriers operational, in 24 and 13 aircraft, and 13 aircraft carriers, either being repaired for operation, or under construction. The Japanese Navy, therefore, was held by its weakness in the air, and could assign her forces only at night or under cover of small land-based air units until the air strength was rebuilt. A balance of naval air power in the Pacific, and as a consequence a balance of naval power as a whole, was then achieved at Midway.

The sense of imminent conflict shifted back to the island south of Rabaul, as was surrounding them, and the air was used. Rabaul had determined to reorganize their forces to capture Port Moresby, if necessary by the overland route from the northern shore of New Guinea, and under the direction of the Solomon Islands units, the United States Joint Chiefs of Staff ordered a two-pronged attack, one directed toward northern New Guinea from Port Moresby, the other up the chain of the Solomon Islands beginning with Guadalcanal; both with the final objective of capturing Rabaul. General MacArthur and Admiral Akinami considered the forces available to them inadequate, but, in view of the importance of maintaining the line of communications with Australia, they were ordered to go ahead with what they had. A best of the Japanese perimeter thereby developed earlier than the Japanese had expected.

While the Southwest Pacific command was building airfields in northern Australia, Port Moresby and Milne Bay, the Japanese landed, in 21 July 1942, at Buna on the north coast of New Guinea opposite Port Moresby and infiltrated over the Owen Stanley Ranges. Their initial communications were cut at the landing, their advanced columns strung out and their attack held and pushed back by ground forces in the area supplied by air. The Japanese initially that they were unable to reinforce the advance that to a certain extent they had planned behind the beachhead on Guadalcanal.

On 7 August 1942, a desperate landing was made on Hidi airfield. Three United States marine garrisons had air support and the Marines who landed then took control of Budi (later named Henderson Field) which was under construction by the Japanese. The Japanese invasion of the main Japanese command was in the Solomons campaign indicated that they originally stumbled in the strength of our attack and went in only one reinforcement battalion of 3000 men on front support from Truk. After this battalion was virtually destroyed, they sent in 6 more which again were not quite sufficient. Finally, they attempted to end in whole divisions. Thirty thousand troops were landed but, by that time, it was too late. Over-locked by the air provided by planes based on Henderson Field to land at night and then under constant and continuous air attacks. The effects of the Japanese to run in reinforcements at night, and at times to shell our shore installations, yielded in a series of night naval surface engagements which moved heavy losses to both sides.

Our air strength was largely insufficient in the initial period to handle the situation as it was delayed by heavy naval weather conditions and only to a few engagements. The Japanese concentrated a number of naval airfields and airfields in Rabaul and attacked our ships and installations. In the air, however, they suffered increasing losses in the earlier part of the war, and were subjected to continuous harassment from the air. Approximately 10,000 were killed, 20,000 were wounded, and the remaining 10,000 were evacuated in February 1943, in a greatly weakened condition.

By the end of 1942, the good weather of the Japanese attempt to drive us off Guadalcanal had been thrown back and Allied operations were moving back the air bases were drawing to a close. We were severely established in these coastal areas and lost gradually as heavy losses to air, land, and sea. Our losses had been heavy. The Japanese, however, had suffered a cruel strategic defeat. Their advance had been stopped, their strategic plan totally upset, many of their best pilots lost, and Allied forces firmly installed in
positions in the Solomons and New Guinea, which threatened the author of their strategy, Admiral Naka.

In opposing this threat, the Americans continue to plan for the war's conclusion in the South Pacific theater. The United States Navy has strengthened its naval forces in the region, and the Allies have begun to increase their air power over the Solomons and New Guinea areas.

The American strategy relies on the following factors:

1. **Naval superiority**: The American fleet is numerically superior to the Japanese fleet in the South Pacific. This advantage allows the Allies to conduct operations with greater confidence.
2. **Air superiority**: The American air force is also superior in the region, providing superior air support for ground operations.
3. **Logistical support**: The Allies have improved their logistic support, ensuring that supplies can be delivered to troops in the field.
4. **Strategic planning**: The Allies have developed a comprehensive strategic plan for the war in the Pacific, focusing on isolating the Japanese and cutting off their resources.

These factors will be crucial in ensuring the success of the American strategy in the South Pacific theater.
THE ADVANCE ACROSS THE PACIFIC

Such was the situation when the United States began its widespread offensive. While major preparations were still in progress, and the heavy attrition of the Bismarck and eastern New Guinea campaign was slowing up Japan's last air groups and depleting her shipping and supplies, the first landing move in the advance across the Pacific were undertaken. These began simultaneously with the assault against Atu, on the northern flank of the Japanese defense perimeter in May 1943. On the southern flank, the offensive continued with an advance to Munda, in June; to Solomon, Lai, and Elvernafeca on New Georgia in September; and to Bungainville in November 1943. In the Central Pacific it began with the assault on the Gilbert Islands in November 1943.

Therefore, the amphibious advance toward Japan continued even into the autumn. One was the north coast of New Guinea in the Philippines, the other across the Central Pacific through the Marshall in the Marshalls and Palau and then subsequently on to Formosa and New Guinea. To start the advance was for the purpose of completing United States power to points which cut Japan's supply lines in the south and were within striking range of the Japanese home islands. Objectives were set for one or more of four purposes:

- To provide forward airfields so that shore-based aircraft might maintain and project forward United States control of the air; to furnish advance bases for land areas for the staging of troops in succeeding advances; and, in the case of the Marianas, to provide bases for long-range air attacks on the Japanese home islands.

If the New Guinea area was centered in the possible to achieve objectives for air advance where the enemy was weak, to end off three objectives from conquest and occupation of air advance to those with land-based air, and, in certain instances, to employ the operation entirely by air. The Marianas, Nukus and other island bases on New Guinea, which eventually had components as large as Guam, were occupied, supplied, and later moved forward to protect the island bases of lighter aircraft.

Four long-range amphibious attacks against strongly defended positions encountered a typical pattern of development. Japanese bases facing the United States objective were neutralized by a combination of air power. Such bases as were within range, were hampered by shore-based air. Carrier-based and available shore-based air rendered the area to be occupied, and on the amphibious force moved up, fast carriers advancing beyond the objective struck swift blows at all positions which could threaten the objective area. With close air sup-

port from both carrier and fast carrier and a concentration of gunfire from short-range ships of the support force, an amphibious assault over the beach was made. The objective was secured under air support and cover from the carriers, which were not withdrawn until air fields admissible could be prepared and activated. The amphibious steps along the two principal lines of advance toward Japan were well timed and mutually supporting, even though concentration on one line might have been more rapid. The latter inflicted at Solomia, primarily by land-based planes from the Mandarins and New Guinea, forced the Japanese to the decision not to support their garrisons in the Gilberts, and thus to be detached.

The Central Pacific advance into the Gilberts and Marshall Islands in late 1942 and early 1943 and the threat of a fast carrier task force attacks against Truk, which concluded in February 1944, cleared the Japanese out from the Marshalls and New Guinea, forced the Japanese to the decision not to support their garrisons in the Gilberts, and thus to be detached. The Central Pacific advance into the Gilberts and Marshall Islands in late 1942 and early 1943 and the threat of a fast carrier task force attacks against Truk, which concluded in February 1944, cleared the Japanese out from the Marshalls and New Guinea, forced the Japanese to the decision not to support their garrisons in the Gilberts, and thus to be detached. The Central Pacific advance into the Gilberts and Marshall Islands in late 1942 and early 1943 and the threat of a fast carrier task force attacks against Truk, which concluded in February 1944, cleared the Japanese out from the Marshalls and New Guinea, forced the Japanese to the decision not to support their garrisons in the Gilberts, and thus to be detached.
still believe that Japan's forces supported this operation. The landing at Leyte Gulf in the Philippines, however, was not carried out as eagerly by the Japanese as their last offensive, short of a defense of the Japanese home islands, was carried out. In all, all available forces to the United States advance in a decisive engagement.

These days after the landing at Leyte, they continued their actions in a three-pronged attack. The plan contemplated that a carrier force attacking from the south would drive off our main strength, while heavy surface forces approaching through Surigao Strait and the Sulu archipelago were to be followed by Japanese Army and Navy planes from air fields in the Philippines would destroy our transport and supporting strength of the landing forces. The Japanese strategy succeeded in drawing off our main strength to the north. The Southern Japanese forces was destroyed in a night surface engagement at Surigao Strait. Four hundred miles to the north, the Japanese forces were sunk off Luzon. Although all of the super battleships had been sunk by torpedoes planes attack, the central forces protected close to our transport still possessed overwhelming surface strength. The Japanese commander of the central force notified to the Survey that he had at hand of expected enemy forces on the air attack.

CONCLUSIONS

Japan's forces available in the area, and enemy as to his full resources induced him to withdraw. As a result of this decision to withdraw, the Japanese forces failed to secure the objective for which aseptic forces had been sized and suffered by the other two Japanese forces.

In the ensuing actions in the Philippines, the Japanese had all the supplies and supplies deployed from Luzon, Philippines, and the two half-donors sent in from China and Manchuria. In the Philippines campaign as a whole, they committed last 7,000 planes. On 1 March 1945, the Japanese decided to move their other supplies to their ground forces outside of the home islands. Except for delaying actions, they had been forced to evacuate widely on islands against invasion.

While the liberation of the Philippines was being completed, the Central Pacific forces made the difficult move into Iwo Jima and Okinawa.

CHINA-Burma-India

The Allied strategy plan contemplated that the actual defeat of Japan would be accomplished by operations in the Pacific. In the meantime, however, it was essential to defend India and to depict China. We could not afford to make substantial losses in the Burma-Burma-India theater was almost entirely starved and logistic support. The geography of the theater was such that inland transportation was virtually impossible beyond the India base. At this juncture, the air in the Burma-Burma-India theater was called upon, not for offensive operations, but to fight down enemy air and destroy Japanese shipping and rail transportation for the same, and needed for all forces and provide much of the necessary logistic support.

Full superiority over Japanese air forces was gradually attained. British ground forces at Kachin which had been surrounded by attacking Japanese forces were supplied by Allied air. The Japanese forces was in turn halted by air attack and destroyed. The troops that liberated Burma were not only supplied, supplied, and supported by air. Japanese logisitics in Burma and China were disrupted. China was kept in this war.

Over 1,400,000 tons of supplies and equipent and 1,200,000 troops were transported by air. The air movement over the "fog" between India and China attained a peak rate of 75,000 tons in 1 month.

In the fall of 1943 it was decided to attack Japan's industrial targets in Manchuria and Korea with B-29's flying from advanced bases in China. When this decision was reached, Fuku, Nagas, and Tatsun had not yet been adopted, and air strike bases were available sufficiently close for direct strikes at the Japanese "Iron Sink" industries. The principal breakthrough in air operations in China was the transportation from India by air of the necessary supplies, most of which were allocated to supplying Chinese ground forces. As a result, the B-29's had sufficient supplies for only a small number of strikes per month. Data secured by the Survey in Japan established that these strikes caused severe damage to the Manchurian steel plants selected as targets since movement of aerial photography had revealed. With the benefit of hindsight, however, it appears that the overall results achieved did not warrant the diversion of effort and that the solution of airpower and supply used by the B-29 might have been more beneficially allocated to an expansion of the
ELIMINATION OF JAPANESE CONVENTIONAL AIR POWER

Japanese production of aircraft of all types rose from an average of 445 planes per month during the first 3 months of the war to a peak of 2,395 planes per month in September 1944. This rise was particularly great during 1943, after the Japanese had learned the lessons of the 1942 campaigns. Aggregate production during the war was 52,000 planes.

Japanese air and sea plane losses from all causes, both combat and noncombat, rose from an average rate of about 500 planes per month in the early months of the war to over 2,000 per month in the latter months of 1944. Aggregate losses during the course of the war were of the order of magnitude of 39,900 planes, of which something less than 60 percent were combat losses, and something over 30 percent were training, flying, and other noncombat losses. The Japanese were thus able to increase the numerical strength of their air forces in places, in almost every month of the war. Numerical strength increased from 2,033 tactical planes at the outset of the war to 6,000 tactical planes, plus 1,400 transport planes, at the time of surrender.

Aggregate flying personnel increased from approximately 12,000 at the outset of the war to over 230,000 at the time of surrender.

United States aircraft production and pilot training exceeded the Japanese twice by wide margins, but only a portion of this strength could be deployed in the Pacific. United States first line strength in the Pacific west of Pearl Harbor increased from some 300 planes in 1941 to 11,000 planes in August 1943. It was not until late 1943 that the United States achieved numerical superiority over the Japanese air forces in the field. First in 1942, however, the relatively few United States air units in the Pacific were able to inflict greater losses than they sustained in the numerically superior Japanese. Aggregate United States plane losses during the course of the Pacific war, not including training losses in the United States, were approximately 37,000 planes. Of these losses 2,700 were on combat missions; the remainder were training, ferrying and other noncombat losses. Of the combat losses over 80 percent were to antiaircraft fire.

As previously stated, Japanese pilots at the outbreak of the war were well trained. The average Army pilot had some 400 hours before entering combat and Navy pilots 400 hours. These experienced pilots were largely expended during the latter campaigns of the opening year and a half of the war. The Japanese paid far less attention than we did to the protection, housing, and replacement of their trained pilots, and were seriously hampered in their training program by a growing shortage of gasoline. Average flying experience fell off throughout the war, and was just over 100 hours, as contrasted to 400 hours for United States pilots, at the time of surrender. Inadequately trained pilots were no match for the skilled pilots developed by the United States.

At the time of the initial Japanese attack, Japanese fighter planes, although less steadily built, more unreliable and weaker in fire power than the United States fighters, had certain flight characteristics superior to those of United States fighters then available in the Pacific. The Japanese improved the quality of their planes during the war, greatly increased the power of their aircraft engines, ultimately mounting United States fighters in fire power and had flexible aircraft in the design and experimental stage at the end of the war. They lacked, however, the widespread industrial skill and industrial skill to match the United States in quantity production of reliable planes with increased range, performance and durability. After the initial campaigns, the United States always enjoyed superiority in the over-all performance of its planes.

By American standards, the Japanese never
fully appreciated the importance of adequate maintenance, logistic support, communications and control, and air fields and bases adequately prepared to handle large numbers of planes. As a result, they were unable to concentrate any large percentage of their air strength at any one time or place. Neither did they appear to have the ability to control large formations in the air with any degree of efficiency.

Local air control and its tactical exploitation the Japanese understood and achieved in their early offensives. But along with all other military powers prior to the war, the Japanese had failed fully to appreciate the strategic evolution brought about by the increased availability of air power. The ability to achieve general and continuous control of the air was not conceived as a requirement in their basic war strategy, as was the planned destruction of the United States Fleet. Had this basic requirement been well understood it is difficult to conceive that they would have undertaken a war of limited objectives in the first place. Once started in a strategic war which did not provide the means to assure continuous air control, there was no way in which they could revise their strategy to reverse the growing predominance in the air of a basically stronger opponent who came to understand this requirement and whose war was being fought accordingly.

CONVERSION OF JAPANESE AIR FORCES TO KAMIKAZE FORCES

By the summer of 1946, it had become evident to the Japanese air commanders that there was no way in which they could equal the United States air arm in any aspect. While losses were considerable, while the results which they achieved were significant, it was not only that which they still possessed was the willingness of their pilots to face certain death. Under these circumstances, they developed the kamikaze technique. A pilot who was prepared to fly his plane directly into a ship would require but little skill to hit his target, provided he got through the interposing screen of enemy fighters and anti-aircraft fire. With a single plane attacking, it was impossible to prevent a certain proportion from getting through. Even though losses would be 100 per cent of the planes and pilots the converted, results, instead of being negligible, might be sufficient to cause serious damage beyond that which we would be willing to endure.

From October, 1944, to the end of the Okinawa campaign, the Japanese flew 2,500 kamikaze missions, of which 455, or 18.4 per cent were effective in scoring hits or damaging our mines. Warships of all types were damaged, including 21 aircraft carriers, 10 battleships, and 16 light and escort carriers. However, no ship larger than an escort carrier was sunk. Approximately 60 vessels were sunk, the bulk of which were destroyers. The Japanese were aided by their own initial claims of heavy ships sunk, and ignored the advice of their tacticians that a Kosho expeditionary fleet was required to attack our ships. To the United States the loss actually sustained was minor, and caused great concern. Two thousand B-29 sorties were directed from direct attacks on Japanese cities and industries to striking Kobe and airfields in Kyushu. Had the Japanese been able to maintain an attack of greater power and concentration they might have been able to cause us to withdraw or to revise our strategic plan.

At the time of surrender, the Japanese had more than 5000 planes in the home islands available for kamikaze attack, and more than 5,000 had already been specially fitted for suicide attack to repel our planned invasion.

DESTRUCTION OF THE JAPANESE FLEET

As stated earlier in this report Japs started the war with 27 carriers. Six were sunk during the engagement of 1942. The Japanese during the course of the war constructed or converted from other types of ships a total of 17 additional carriers including 3 escort carriers of the converted type. One was a 2,000-ton battleship. All these were lost, and in the end, we are left with the result of scoring the only success of battleships and installing small destroyers and landing craft. Due to the loss of those few kamikaze carrier air groups in 1944-45 and the time required to reconstitute new ones, the Japanese did not commit their carriers again until 1946. In the engagements of that year the Japanese lost 7 carriers without themselves scoring appreciable results. Seven more were lost in large surface units in submarine or air attack.

All Japanese carriers sank were lost either to anti-carrier aircraft or to submarines with the exception of one which was finished off by war.
Japan, fast streams after it had been mortally damaged by carrier aircraft.

The Japanese had two carriers: the *Kaga* and the *Shoho*, each of 40,000 tons, armed with 16-inch guns and capable of carrying a full load of aircraft. These carriers were forward-decked, allowing for maximum flexibility in their operations. The *Kaga* had a shorter flight deck than the *Shoho*, but this did not hinder its effectiveness in aircraft operations.

Japan began the war with 21 warships aggregating approximately 1,275,000 tons. An additional 88 combat ships totaling 1,243,000 tons were constructed during the war. About sixty thousand ships of all types and sizes, totaling 3,069,000 tons, were built. Approximately 1,300,000 tons of Japanese warships in the air, bared to enemy detection tactics, and destroyers; contingents were placed on the deck of the aircraft carriers. Of this total, 4,000,000 tons were sunk by Navy and Marine aircraft, 3,000,000 tons by surface vessels, 50,000 tons by Army aircraft, and 60,000 tons by various agents. Only 190,000 tons in these categories remained after the completion of the war. The tonnage sunk by surface ships was principally in night action. A shortage of Japanese destroyers after 1943 and inadequate Japanese air anti-submarine measures contributed to the success of United States submarine operations against the Japanese fleet.

After the liberation of the Philippines and the capture of Okinawa, oil imports to Japan were completely cut off, fuel oil stocks had been used, and many combat ships had been rendered non-functional due to the absence of fuel. This left Japan with only one combat fleet, the IJN, consisting of only a few ships that remained operational.

DESTRUCTION OF THE JAPANESE MERCHANT FLEET

Japan's merchant shipping fleet was only a small fraction of its armed forces in the field, but it was a vital link in the economic structure. It was the sole element of the fleet structure to be vulnerable to direct attack throughout a major portion of the war. Japan stationed the fleet with some 4,000,000 tons of merchant shipping of over 300 tons gross weight. During the war an additional 4,000,000 tons were constructed, captured, or requisitioned. Sufficient information was secured by the Survey in Japan concerning this 8,000,000 tons to tabulate ship by ship, (a) the names and tonnages, (b) the date, location, and action of sinking or stranding, and (c) the present condition and location of such ships as survived. The course of this work, which was started in 1946, was completed in 1949.

The Japanese government had allocated a third of their shipping fleet to the logistics support of their military forces in the field. They expected that
after their original advance had been completed, they would be able to return increasing numbers of ships to the movement of raw materials for their basic economy. After the beginning of the third invasion, however, they were kept under constant and unexpected military pressure so that the contemplated return after that date was never possible.

Up to the end of 1942, ship sightings exceeded the expectations by a small margin. Therefore, the aggregate tonnage sank far more rapidly than could be matched by the expansion of the Japanese shipbuilding program. The size of the mobile fleet thus declined continuously and at the end of the war accounted for little more than 20 percent of its original tonnage. The Japanese finally attempted to build up a convoy system, to co-ordinate freight movements to rail lines, and to absorb some form of neutral or exchange basis; but these measures acted only as palliative and not as cure. In consequence, convoys and escorting destroyers formed the freight record per ship by a factor amounting in 1944 to as much as 50 percent in the closing months of the war. In 1944 fewer losses became particularly heavy and were thus less the last concern of the Japanese shipping authorities.

The basic economic consequences of ships sinking will be discussed in a later section. From the standpoint of the Japanese armed forces in the field it will be noted that 16 percent of enemy supplies shipped from Japan were sunk in 1942, 30 percent in 1943, and 50 percent in 1944, and 45 percent in 1945. A shortage of fresh water was a continuing limitation on the mobility of the Japanese fleet and contributed to its defeat in the two crucial battles of the Philippine Sea. To a large part lack of shipping, was one of the principal handicaps of the Japanese air force.

Attacks by submarine, long-range search and attack planes, mines, and carrier and land-based planes were cumulative and complicated the Japanese defenses. Long-range search and attack planes threatened the shipping. Without protection against submarines in enemy waters the vulnerability to air attack, ships driven into congested harbors in fear of submarines were easy prey for carrier strikes, and were helped to drive ships out of shallow water into channels where submarines could operate. Had we constructed more submarines, earlier concentrated on tankers and more fully coordinated long-range air search and attack missions with submarine operations, the ship sinking program might have been even more effective.

DESTRUCTION OF JAPANESE GROUND FORCES

The Japanese built up their army ground forces from a strength of approximately 1,200,000 at the outbreak of war, to a peak strength of approximately 3,000,000. Japanese army medical records indicate that the aggregate number deployed in the Solomons, New Guinea, New Hebrides, Solomons, New Caledonia, New Guinea, Bismarck Archipelago, Borneo, Mindanao, Philippines, Korea, and the Aleutians was approximately 500,000, of whom 105,000 were killed in action, and some 220,000 were deployed in Borneo, of whom 45,000 were killed, and 1,060,000 were deployed in China, of whom 105,000 were killed. Most of the remainder were in Manchuria, Korea, or the Home Islands, and did not actively participate in the decisive campaign of the war.

The strategy of our advance and the limitations imposed on Japanese overwater transportation became such that the Japanese could concentrate only a small portion of their available army ground forces strength as of the critical island positions which we disembarked in support. Japanese soldiers were unique in their willingness to face death and endure hardships. At every point where our Army or Marine forces engaged the Japanese on the ground after 1942, we enjoyed full air superiority. In every instance, once I have the campaign, we had eliminated Japanese ability to reinforce the critical areas with other provinces. At Okinawa the Japanese were able to land 30,000 troops, but these reinforcements came realized pleasantries too long a period of time to be effective and many of the transports were sunk prior to unloading heavy equipment.

In every instance where the Japanese had prepared defenses in a landing area these had been refined up by aerial bombardment and usually by naval shelling as well. In this regard, however, it was often proved impossible, however, to destroy more than a small percentage of the defending Japanese soldiers in preliminary shelling up operations of even the greatest intensity. The Japanese were dug in, in tunnels, trenches and caves which were hard to find and often impossible to destroy, either by bombing or by naval shelling. Most of their fixed artillery positions were eliminated, but even some of these survived.
weight of fire on the immediate invasion beaches was generally such that the Japanese retired a short distance inland, but once we advanced beyond the beaches it became necessary to destroy the remaining Japanese in costly close-range fighting. It was determined, however, that Japanese resistance was effectively weakened and our casual-
ity figure when the appropriate weapons were employed with sufficient weight and accuracy to both preclude sufficient casualty figures and subsequent counterattacks.

A Japanese column indicates that in the north-
ern regions, approximately 25 percent of their combat deaths resulted from aerial bombardment, 55 percent from small arms fire, 16 percent from artillery, and the remaining 8 percent from oth-
er causes.

In the places where it was essential to anni-
lolate Japanese ground resistance in close-range fighting, great precision had to be developed in air-support operations in order to be certain not to hit our own troops, and to secure lives on the small target which the limited Japanese positions presented. This required highly specialized train-
ing and the closest coordination between the ground and air forces through an intricate system of ground and air observers and unified control by ground/air radio communications. In the Pacific this system was continuously improved by the Navy and Marines in connection with suc-
cessive amphibious operations against strongly defended positions and reached a high degree of effectiveness. In the Philippine campaign, the Army air forces employed comparable techniques, and General yenning has testified to the feeling of complete helplessness when confronted with this type of opposition.

In the Southwest Pacific, it often proved pos-
sible to effect landings at lightly held positions and thus bypass large bodies of enemy ground forces. In the Central Pacific, many of the islands the Japanese expected us to attack were bypassed, and the garrisons left to withdraw and die. Survey considerations of the bypassed islands in the Pacific and interviews of the Japanese survivors con-
vinced him of the unsoundness of this plan and ground installations were destroyed by air

attack. Out of four major supplies of reinforc-
ments, except occasionally by submarine, their final evacuation. On out of the islands, Japanese
actually saw Japanese. It appears, however, that
our air attacks on these bypassed positions were often conducted longer and in greater weight than was reasonably required or profitable.

THE JAPANESE ECONOMY PRIOR TO SUSTAINED DIRECT AIR ATTACK

The reorientation of the Japanese economy toward war began in 1933, and continued with increasing emphasis during the Manchurian and Chinese campaigns. By 1941, total production had risen by more than 50 percent; heavy industry production by almost 200 percent; and 17 percent of Japan's total output was being devoted to direct war purposes and expansion of her munitions in-
dustry, as against 9.6 percent at that time in the United States. Construction of industrial fac-
cilities in these areas amounted—for the Japanese conditions—considerable proportions. Her aircraft, ammunition, machine tool, automotive, and tank industries were erected from almost nothing dur-

ing this period.

The industrial expansion was based and de-
pendent on the availability of raw materials.

These efforts were devoted to the increase of raw
data output in the home islands. In this re-

spects, major results were achieved. Coal produc-
tion in Japan rose from 29,000,000 tons in 1931 to 65,000,000 tons in 1944. Domestic iron output
each considerable progress. Nevertheless, no other country could have been farther from self-suffi-
cency, with respect to raw materials, than Japan.

The development of basic material sources on the continent of Asia constituted almost the central is-

sue of Japan's economic policy during this period.

Although progress in Manchuria and China helped significantly to alleviate Japan's raw ma-

terial shortages in coking coal, iron ore, steel, and foods, insufficiency of raw materials continued to be the most important limiting factor on Japanese

industrial output. Forgetting production of oil and so hundreds mines existed within Japan's "Inner Zone," output of aluminum ingots had risen from 18,000 in 1931 to 37,500 in 1941, 10 percent of which was produced from bauxite imported from the Dutch East Indies. Plans to develop a syn-

thetic oil industry failed to yield significant re-

sults and Japan was almost wholly dependent on oil imports from the United States or the Dutch

East Indies. Japan's dependence on importation

for rubber, zinc alloys such as maganese, etc.,

is considerable.
Pressuring media and economic exploitation of the iron and steel resources of the southern area, stock piling of these vital materials was a necessity. By the end of 1943, annual stocks of 1,000,000 tons, constituting a 7 months' supply, and 43,000,000 barrels of oil and all products were stored in Japan.

Considering the economic performance of the decade, one cannot but be impressed by the tenacity of the effort and the magnitude of the results. Nevertheless, Japan remained an economy having approximately 50 percent of the potential of the United States economy. It was desperately vulnerable to attack on its shipping. Having a comparatively small, newly developed industry, it had to work without enough coal of inferior quality, with less advanced machinery and less advanced training of personnel. This meant that skills, ingenuity and ability to improvise later on, when the economy was under the stress and strain of large-scale warfare.

This economic potential could support a short war or a war of limited duration. The accumulative stocks of munitions, oil, planes and ships could be thrown into action and produce a devastating effect on an unprepared enemy. When this initial blow failed to result in a victory, Japan, without significant help from Germany, was destroyed. Its economy could not support a protracted campaign against an enemy even half as strong as the United States.

In addition, the success of the initial Japanese military occupations delayed total economic mobilization until after the defeat of late 1943. Caught ill and unprepared, the gross national product was reduced to a level of 38 billion yen in the fiscal year ended in March 1944, in 48 billion yen in the fiscal year 1943. Then the war and the abandonment of the Allied forces that had been destroyed.

The production of high-grade materials held production of iron and steel in the home islands to 1,930,000 tons in 1944, to a peak of 2,930,000 tons in 1943, and would it decline to 620,000 tons in 1944. This compared with a 1930 production of 2,030,000 tons and a theoretical capacity of 6,430,000 tons.

The production of high-grade materials, 1,600,000 tons in 1944. By the middle of 1948, the increasing stringency of shipping and the employment of many new industries had reduced this to 1,400,000 tons.

The production of high-grade materials had already been virtually halted, and iron and steel production began to decline rapidly. In March 1945, imports of men's soup and a few imports of foodstuffs were taken over entirely, and the Japanese could not even begin their own production of iron and steel. It is estimated that by the end of the war, Japan's industry had only produced about 40 percent of its normal capacity, and the production of high-grade materials was about 3 percent of its normal capacity.
The decline in Japan's steel production can be attributed to the depression on shipping and the destruction of that shipping. Had this industry not been mortally wounded by shipping shock and had its destruction by bombing been called for, the effectiveness of the few strategic bombing raids directed against the steel industry would have been far greater than it was. The steel shortage constituted an over-all limitation on the war potential of the Japanese economy. Japanese planners were, however, able to score a very substantial increase in the production of those military products which the destruction of the steel had demonstrated to be of outstanding importance. Aircraft production of all types, including training planes, was stepped up from 700 planes per month in the summer of 1943 to 2,872 planes in September 1944. Aircraft engine production was not only increased correspondingly in numbers, but a heavier horsepower was doubled. Aircraft and ammunition, gun and ammunition production was stepped up fifteenfold. Radar and communications equipment was stepped up fivefold. The most important consumer of steel was the shipbuilding industry. The increasingly critical nature of Japan's shipping situation called for the expansion of both naval and merchant shipbuilding programs to a point where 75 percent of all steel consumed was being used in that industry alone. Construction of merchant ships increased from approximately 208,000 tons in 1941 to 6,850,000 tons of steel ships and 264,000 tons of wooden ships in 1944. During 1945, shipyard deliveries included one battleship of 64,000 tons and 24 small carriers totaling 84,000 tons. In 1944, 10 battleships, four aircraft carriers of 114,000 displacement tons and 141,000 tons of escort vessels and submarines were delivered. The increase in high-priority items involved the cutting down of steel availability for lower-priority items, such as tanks, larger naval guns and trucks, and the almost complete elimination of steel for civilian requirements, construction, or export.

During 1944, the effects of the net loss of shipping and slow-down in ship production became such that by the end of the year it no longer was possible to protect even high-priority war production by further shifting of allocations of scarce materials from items of lesser priority. In addition to steel, other basic elements of the economy were involved. Oil, although not as important as steel in the broad impact on the remainder of the economy, was of critical importance to Japan's military mobilization and to her merchant marine. Oil imports from the north began declining in April 1943, and had been eliminated by April 1944. Crude oil stocks were virtually exhausted; refinery operations had to be curtailed; and stocks of aviation gasoline fell to less than 1,000,000 barrels, a point so critical a drastic cut in the pilot-training program and even in combat missions. Japanese imports declined from 319,000 tons in the first quarter of 1944, to 150,000 tons in the third, and stockpiles were only 500,000 tons. Stockpiles and the time delay between the various stages of production explained for a time the inevitable effects of the blockade on refined products, but by November 1944, the over-all level of Japan's war production had begun to turn down, including even the highest priority items, such as aircraft engines.

The air attack against the Japanese home islands was the centerpiece of the strategy which was designed to destroy Japan. Furthermore, it was the key to the increased and accelerated impact of the blockade on Germany and, with, the loss of the base of operation in the Marianas, could form a similar attack in the Pacific. Their influence, however, was not sufficient to overcome the influence of the Army which was committed of its ability to resist invasion.

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test in which it would weaken enemy capability and will to resist our amphibious forces at the time of landings. This led, originally, in assessment of the situation, to the conclusion that the attack on airfields, warehouses, electronics plants, of production, and assisted military ships destruction of which could be expected to weaken the capabilities of the Japanese armed forces in areas of the Kanto region in November 1943, then the undisputed in the more basic elements of Japan’s social, economic, and political fabric. Certainly of the United States commanders and the representatives of the Survey who were called back from their observations by December in early 1944, the least expected to be a complete surrender, and invasion. The controlling opinion, however, was that the few minutes of the Fukuoka area and on the political desires of those not equipoise of Japan was in part to be a series of actions that target selection could accept.

With the benefit of hindsight, it appears that the main objective of surrender without invasion and reduction of Japan’s economy and will to resist, the first and second, ended for an invasion, should the Japanese not surrender, called for an invasion, should the Japanese not surrender, employed by military defeat, destruction of the bulk of our merchant fleet, and almost complete Black Sea. The proposed targets, after an initial attack on the industrial and transportation system by daylight attacks, coupled with destruction of the airfields on one side by night and bad weather, attacks of this kind would have applied some pressure to support the view was finally adopted. Although urban areas were targeted, the railroad and the rest of the city was under way when the war ended. The impressive numbers of bombs dropped by Allied forces in the Tokyo air raids were 5,200 tons, and the B-24s for 7,000 tons, and the B-29s for 14,000 tons. By contrast, the total bomb tonnage in the European theatre was 2,200,000 tons of which 1,200,000 tons were dropped within Germany’s own borders. Approximately 400 tons of bombs were dropped by China-based B-24s on Japanese bases in Manchuria, Korea, and Formosa. These raids were of insufficient weight and accuracy to produce significant damage.

By the end of November 1944, 4 months after the initial raids, the number of heavy bomb raids on the Shih-nan area was operational. The number of planes originally available was small and opposition was significant. Enemy con-
resolution of the issue. The effort to negotiate a peace settlement continued.

ECONOMIC EFFECTS OF AIR ATTACK AGAINST THE JAPANESE ISLANDS

The physical destruction resulting from the air attacks on Japan was considerable. The attacks on Japan's cities, especially Tokyo, caused significant damage and loss of life. The economic effects of these attacks were far-reaching, affecting various sectors of the Japanese economy. The physical destruction of industrial sites, transportation infrastructure, and other key economic facilities significantly impacted Japan's industrial capacity and ability to produce goods. The disruption of transportation networks and the loss of key economic centers led to a decline in economic output and a reduction in the country's ability to support military operations.

The Japanese government was forced to divert resources from other sectors to repair the damage caused by the air attacks. This diversion of resources further strained the already limited economic capabilities of the Japanese economy. The war effort became more costly, and the economy was pushed closer to the brink of collapse. The economic effects of the air attacks on Japan were severe and had long-lasting consequences for the country's ability to sustain its war effort.

The precision of the air attacks allowed the Allies to target specific industrial sites and transportation hubs, which further disrupted Japan's economic infrastructure. The physical destruction observed in the cities was extensive, with entire sections of the urban landscape flattened. The attacks also had a psychological impact, causing a loss of confidence and morale among the Japanese population.

The economic effects of the air attacks on Japan were profound, leading to a significant decline in industrial production, a reduction in economic output, and a strain on the country's ability to support its war effort. The Japanese economy struggled to recover from the damage inflicted by the air attacks, further exacerbating the challenges faced by the country during the war.
completely the residential and smaller commercial and industrial structures in the affected areas and a significant number of important places, but a portion of the many substantially constructed office buildings and factories in these areas and the underground utilities survived. By 1944 the Japa

nese had built essential home industry in their war economy. They still relied, however, on peace employing less than 200,000 women for sub

contracted parts and equipment. Many of these smaller plants were concentrated in Tokyo and accounted for 19 percent of the total industrial output of the city. Such plants suffered severe damage in urban incendiary attacks.

Even hundred and seventy thousand boarding of oil and oil products, 82,000 tons of foodstuffs and 2 billion square yards of textiles were destroyed by air attacks. Ninety-seven percent of Japan's stocks of guns, shells, explosives, and other military supplies were thoroughly destroyed in dispersed underground storage depots, and were not vulnerable to air attack.

Physical damage in plant installations by either land or aerial attack, plus decreases due to dispersion forced by the threat of further physical damage, reduced physical productivity capacity by roughly the following percentages of preattack plant capacity: all refined, 80 percent; aircraft engine plants, 75 percent; airframe plants, 67 percent; electronic and communications equipment plants, 20 percent; army ordnance plants, 50 per

cent; naval ordnance plants, 20 percent; merchant and naval shipyards, 10 percent; light metals, 77 percent; cast steel, 15 percent; chromiun, 10 per

cent.

The economic consequences of the physical dam age brought by air attack are closely interrelated with the concurrent effects of the suspension of imports, the cumulative effects of under-maintenance of plants, and the declining health, vigor, and determination of the Japanese people.

Let us first consider the level of Japanese indus

trial activity in July 1943, the last full month before surrender. Electric power and coal consumption were both about exactly 50 percent of the peak recorded in 1941. Production efficiency had, however, declined and the overall industrial output was approxi mately 40 percent of the 1944 peak. Output varied considerably as between industries, factories, plants, and by areas. Out

put of air frame was 60 percent of the 1944 peak; aircraft engine, 55 percent; shipbuilding, 55 per

cent; army ordnance, 45 percent; and naval ord

nance, 45 percent. Oil refining had declined to less than 20 percent of the 1943 output. Primary aluminum production was 9 percent of the 1944 peak. Although steel and production had de

clined to about 37 percent of the 1944 peak, exp

losive production was about 40 percent of the 1944 figure.

In each one of these industries, the reasons for the declines appear to be different. Electric power consumption fell, not because power was not available, but because demand had declined. Coal supply was primarily limited by the deficiency in low-cost shipping from Hok

kaido and Kyushu, and the inability of the railroad system completely to fill the gap. Although a decline in demand, shortage of coal were universal throughout the economy. Aluminum production was limited primarily by the continuing effects of the dispersion program brought on by the initial bombing, and aggravated by the sub

sequent destruction of nume rous plants prior to completion of dispersal. Had the level of production been any higher, however, aluminum stocks would have been exhausted and aluminum would have become the controlling bottleneck. In any event, not enough aircraft engines were being produced to apply the airframes. Aircraft engine production was plagued by shortages of special steels, but in July 1943, plant damage and delay in completing the underground and dispersed plants started in the spring of the year temporarily prevented the full use of the small stocks of such steels available at the time. Output of radar and radio equipment was limited by plant capacity, the small Japanese supplies having been destroyed in the Tokyo city raid and many of the larger plants either destroyed or forced to disperse. Shipbuilding and heavy ordnance pro

duction was limited by the availability of steel.

Oil refineries, aluminum plants and steel plants were essentially limited by lack of foreign raw materials. Explosive plants were still using up inventories of nitric acid but would shortly have had to adjust their output to the current availability of nitric acid.

The Japanese labor force had declined in effi

ciency due to exhaustion and rigidity, the dislocating effect of the urban housing and the lack of facil

ities for local transportation. Production
Much of Japan's coastal and inter-island traffic had already been forced to use her independent railroads. The principal rail routes of Japan are located on Kyushu and Honshu. This rail traffic, formerly water borne, was moving by railroads employing the Kaname tunnels and the Hakodate-Annai rail ferry. The railroads on Honshu include few main lines and an even thinner network of feeder lines to the main routes of the country than individually destroy Japan's cities and factories. It would have reached Japan in a series of isolated communities, incapable of any sustained industrial production, incapable of raising food from the agricultural areas to the cities, and incapable of large-scale movements of troops and munitions.

The survey foresees that such an attack, but it has well planned in advance, might have been initiated by north-based attacks against the Hokkaido ferry in August, 1944, would have been continued by aerial mining of inland waterways beginning in December 1944, and could have been further continued by initiating the railroad attack as early as April 1943. The survey has estimated that from requirements to effect complete interdiction of the railroad system would have been 843 B-32 strafing missions carrying 8,200 tons of high explosive bombs. Almost seven times equal to one and one-half times that required to effect the original interdiction should have been needed, in view of the Japanese lack of proportion and airworthiness in offsetting repairs, to maintain the interdiction by destroying such bridges and other facilities as the Japanese were able to repair. The use of A-50 guided bombs, which would have been made available at that time, would have greatly increased accuracy against targets of this type and reduced the requirement to approximately one-third of those given above. An inte
The health and morale of the Japanese civilian population under assault.

Total civilian casualties in Japan, as a result of 3 months of air attack, including those from the atomic bombs, were approximately 600,000. Of these, approximately 200,000 were fatalities. These casualties probably reached Japan's normal mortality, which the Japanese estimate as having totaled approximately 150,000 during the entire war. The greatest single of civilians death or injury was from the initial attack on Tokyo on 8 March 1943. Casualties in many extremely destructive attacks were comparatively low. Kobe, a city of 500,000 population, was 40 percent destroyed in a single attack lasting less than an hour. The fatalities suffered were less than 1,000.

The Japanese had constructed extensive fire-breaks by torching down all wooden structures or natural barriers. The total number of buildings burned down in this program, as reported by the Japanese, amounted to 610,000 as against 232,000 destroyed by the air attacks themselves. These fire-breaks did not effectively stop the spread of conflagration, which were dropped on both sides of the bomb. They did, however, constitute a serious annoyance for the civilian population.

The Japanese instituted a civilian defense organization prior to the war. It was not until the summer of 1944, however, that effectual steps were taken to reduce the vulnerability of Japan's civilian population to air attacks. By that time, the shortage of needed stores, equipment, and other construction materials was such that adequate air raid shelters could no longer be built. Each family was given the obligation of providing itself with some kind of an air raid shelter. In addition, families were directed to dig holes in the sides of hills wherever the topography permitted.

Japanese planning and the means for carrying out the plan were thus different for a free-city civilian defense program. In spite of these limitations, such civil defense measures as they were able to put through contributed substantially in minimizing casualties. School children and other essential laborers were conscripted to the country. Those who remained were organized in mutual aid and to provide mutual assistance.

The air raid warning system was generally efficient. The weight of the individual attacks, however, far heavier than the Japanese had anticipated or were able to cope with. In the major last attacks, the civilian defense organizations were simply overwhelmed.

The greatest food shortages was the principal factor affecting the health and vigor of the Japanese people. Prior to Pearl Harbor the average per capita calorie intake of the Japanese people was about 3,000 calories as against 3,500 in the United States. The average of calorie intake in Japan is only 3 percent of that of the United States to support a population over half as large. In order to provide the present diet, this calorie shortage was more interestingly cultivated, using more manpower and larger quantities of fertilizer than in any other country in the world. Fishing was developed into a major industry; and rice, soybeans, and other foods including 19 percent of the calorie intake were imported.

Despite the reduction of food beginning in April 1943, the food situation became critical. As the war progressed, imports became more and more difficult, the waves available to the fishing fleet and the ships and fuel oil fell as the war became increasingly unfruitful. Droughts food production itself was affected by the reduction of the greater intake and by an increasing shortage of fertilizers.

By 1944, the average per capita calorie intake had declined from approximately 1,900 calories. By the summer of 1945 it was about 1,000 calories per
20 percent of the people believed Japan could not achieve victory. By March 1945, when the island defenses had begun to break and the food ration was reduced, this percentage had risen to 19 percent. In June, it was 63 percent, and just prior to surrender, 61 percent. Of those who had come to believe that Japan should sue for peace, one-half attributed the principal cause to air attacks, about one-third to military defeats, and about one-third to military defense.

Sixty-four percent of the population stated that they had received a point price for foodstuffs where they felt personally unable to go on with the war. Off these, less than one-third attributed the cause to military defense, one-quarter attributed it to shortages of food and civilian supplies, and the largest part to air attacks.

A striking aspect of the air attacks was the perseverance with which its impact on morale devastated Japan. Roughly one-quarter of all people in cities died or were evacuated, and three-quarters, who themselves were of singularly low morale, helped spread discouragement and disaffection for the war throughout the islands. This mass evacuation from the cities included an estimated 800,000 persons. Throughout the Japanese islands, whose people had always thought themselves remote from attack, United States planes represented the skies with an effective Japanese air antiaircraft opposition. That this was an illusion of impending defeat because of the ruinous destruction that was inevitable is another story.

Progressively lower morale was characterized by loss of faith in both military and civilian leaders, loss of confidence in Japan's military might and increasing distrust of government news sources and propaganda. People became short-tempered and more outspoken in their criticism of the government, the war, and affairs in general. Until the end, however, national traditions of obedience and conformity, reinforced by the public organization, remained effective in controlling the behavior of the population. The Emperor largely escaped the criticism which was directed at other leaders, and retained the people's faith in him. It is probable that most Japanese would have passively faced death in a continuation of the hopeless struggle, had the Emperor so ordered. When the Emperor announced the unconditional surrender, the first reaction of the people was one of regret and surprise, followed directly by relief.

The intercession of military, economic, and moral
The effects of the atomic bombs

On 6 August and 9 August 1945, the first two atomic bombs to be used for military purposes were dropped on Hiroshima and Nagasaki, respectively. Over hundred thousand people were killed, eight square miles or over 55 percent of the built-up areas of the two cities were destroyed. The first and crucial point about the atomic bomb that was used practically and conclusively atomic energy had been mastered for military purposes and the overwhelming scale of its possibilities had been demonstrated. A detailed examination of the physical, economic, and moral effects of the atomic bomb occupied the attention of a major portion of the government's staff in Japan in order to arrive at a more precise definition of the present capabilities and limitations of this radically new weapon of destruction.

Eyewitness accounts of the explosion all describe similar pictures. The bomb exploded with a tremendous flash of blue-white light, like a giant explosion. The flash was of short duration and accompanied by intense glare and heat. It was followed by a tremendous pressure wave and the rumbling sound of the explosion. The sound was not clearly recorded by those who survived near the center of the explosion, although it was clearly heard by others as much as fifteen miles away. A huge white cloud shot rapidly into the sky and the scene on the ground was obscured first by a black haze and then by a purple-brown cloud of dust and smoke.

Such eyewitness accounts bear the sequence of events. At the time of the explosion, energy was given off in the forms of light, heat, radiation, and pressure. The complete band of radiation, from X-rays through ultraviolet and light rays to the radiant heat of infra-red rays, traveled with the speed of light. The shock wave created by the enormous pressure built up almost instantaneously at the point of explosion but moved out more slowly, that is at about the speed of sound. The observed effect considering the original form of released nuclear and atomic energy must be accounted for some distance away.

The light and radiant heat wave accompanying the flash traveled in a straight line and any opaque object, even a single bed of a vitreous, shielded objects lying behind it. The duration of the flash was only a fraction of a second, but it was sufficiently intense to cause third degree burns to exposed human skin up to a distance of a mile. Clothing ignited, though it could be quickly blown out, telephones poles charred, thatched-roof houses caught fire. Black or other dark-colored surfaces of combustible material absorbed the heat and immediately charred or burned into flames; while light-colored surfaces reflected a substantial portion of the rays and were not incinerated. The heavy black clay tiles which are an almost universal feature of the roofs of Japanese houses lulled at distances up to a mile. Tests of samples of tiles by the National Bureau of Standards in Washington indicate that temperatures in excess of 1500°C, must have been generated in the surface of the tile to produce such an effect. The surface of granite blocks exposed to the flash scattered and splashed at distances up to almost a mile. In the immediate area of ground zero (the point on the ground immediately below the explosion), the heat charred persons beyond recognition.

Penetrating rays, such as gamma-rays exposed X-ray film stored in the basement of a concrete building almost a mile from ground zero. Symptoms of their effect on humans being close to the center of the explosion, who survived other effects, were generally delayed for two or three days. The bone marrow and its cells the process of blood formation were affected. The white corpus centrum went down and the bone marrow proceeded to molting in better were damaged. Death generally followed shortly thereafter.

The majority of radiation cases who were at greater distance did not show severe symptoms until 1 to 6 weeks after the explosion. The first symptoms were hemorrhage, nausea, and general discomfort. Within 2 to 6 hours, fever became evident in many cases, going as high as 100° to 103° F, which in fatal cases continued until death. If the fever abated, the patient usually
showed a rapid disappearance of other symptoms and soon regained the feeling of good health. Other symptoms were loss of white blood count, loss of hair, and decrease in appetite.

Even though may of these nature have great power of penetration, injuring structures directly and not far from them. As the weight of the interesting material increases the percentage of the rays penetrating greater depths. It appears that a few feet of concrete, or a few inches of thickness of earth, furnished sufficient protection to impede, even when close to ground zero, to prevent serious after effects from radiation.

The blast wave which followed the flash was of sufficient force to pass in the order of windmill-annihilating shatter and it sliced completely all less sturdy structures. Due to the height of the explosion, the peak pressure of the wave at ground zero was no higher than that produced by an explosion of a high-explosives bomb, and decreased at greater distances from ground zero. Reflection and shielding by intervening walls and structures produced areas of lower pressure in the pattern. The blast wave, however, was of greater extent and duration than that of a high-explosives bomb and most reinforced concrete structures suffered structural damage or collapse up to 500 feet at Hiroshina and 2000 feet at Nagasaki. Brick buildings were flattened up to 2,000 feet at Hiroshina and 5,000 feet at Nagasaki. Beyond these distances structures received less serious damage to roofs, walls, partitions, and the like. Glass windows were blown out at distances up to 5 miles. The blast wave, being of longer duration than that raised by high-explosive detonation, was accompanied by rumbled debris. Windows frames, doors, and partitions which would have been blown out by the flash were hauled at high velocity through the buildings which did not collapse. Machine tools and many other production equipment at industrial plants were blown away by the blast wave, but were damaged by collapsing buildings or moving general force.

The above description mentions all the categories of destructive action by the atomic-bomb explosions at Hiroshina and Nagasaki. There were no other types of action. Nothing was很正常 or disintegrated, vegetation is growing, again immediately under the center of the explosion; there are no indications that radioactivity continued after the explosion to a sufficient degree to harm human beings.

Let us consider, however, the effects of these various types of destructive action on the cities of Hiroshina and Nagasaki and their inhabitants.

Hiroshina is built on a broad river delta; it is flat and little above sea level. The total city area is 90 square miles but only 3 square miles at the center were closely built up. The principal industries, which had been greatly expanded during the war, were located on the periphery of the city. The population of the city had been reduced from approximately 300,000 to 60,000 as a result of a civilian defense evacuation program. The explosion caught the city by surprise. An alert had been sounded but in view of the small number of planes the all-clear had been given. Consequently, the population had not taken shelter. The bomb exploded little Northwest of the center of the building area. Everyone who was out in the open and was exposed to the initial flash suffered severe burns where not protected by clothing. Over 4 square miles in the center of the city were flattened to the ground with the exception of large buildings restored by trees. Many of which suffered structural damage. Most of the people in the flattened areas were forced to leave their homes by the collapsing buildings or flying debris. Shortly thereafter, numerous fires started, a few from the direct heat of the flash, but most from overheated chemical gas cylinders or other secondary causes. These fires grew in size, freeing into a general configuration framed by a wind moving into the center of the city by the rising heat. The civilian defense organization was overwhelmed by the multitude of the destruction, and the spread of fire was halted once by the air rushing toward the center of the conflagration, then by efforts of the fire-fighting organization.

Approximately 10,000 to 20,000 people were killed, and 10,000 were injured. Of approximately 60,000 buildings in the city, 5,000 were rendered unusable and almost all the remainder received at least light superficial damage. The underground utilities of the city were undamaged except in those areas which were opened by the river cutting through the city. All of the small factories in the
center of the city were destroyed. However, the big plants on the outskirts of the city were almost completely undamaged and 94 percent of their workers returned. These factories accounted for 74 percent of the industrial production of the city. It is estimated that they could have resumed substantially normal production within 20 days of the bombing, had the war continued. The networks running through the city were repaired for the reception of through trains on 8 August, 4 days after the attack.

Nagasaki was a highly congested city built around the harbor and up into the rolling and river valleys of the surrounding hills. Some of these hills came down close to the head of the bay dividing the city roughly into two sections. The hilltop area was 4.4 square miles of which an estimated 1,000 acres were covered with trees. The park reserves of 265,000 had been reduced to around 200,000 by August 1945, largely by direct strafing. Nagasaki had been attacked sporadically prior to 6 August by an aggregate of 736 planes which dropped 960 tons of high explosives and 54 tons of incendiary bombs. Some 9 percent of the residential buildings had been destroyed or badly damaged; three of the large industrial plants had received minor damage. The city was thus comparatively intact at the time of the atomic bombing.

The blast was irregularly given and therefore few persons were in shelters. The blast exploded over the northeast portion of the city; the intervening hills protected a major portion of the city lying in the adjoining valley. The blast radiation and blast action of the Nagasaki bomb were more severe than those of the bomb dropped over Hiroshima. Reinforced concrete structures were structurally damaged at greater distances; the heavy steel frame industrial buildings of the Mitsui Shokuhin steel works and the main plant were pushed aside. Many of the chimneys were blown away from the chimneys of the explosion. Contrary to the situation in Hiroshima, the majority of the fires that started immediately after the explosion resulted from direct ignition by the blast. Approximately 40,000 persons were killed or injured and a like number injured. Of the 56,000 residential buildings in Nagasaki, 14,000 were totally destroyed and a further 14,000 badly damaged. Ninety-six percent of the industrial output of Nagasaki was concentrated in the large plants of the Mitsui Shokuhin Co., which completely dominated the town. The steel plant and the steel works were located within the area of primary damage; it is estimated that 94 percent of the total value of the steel plant and 91 percent of the value of the steel works were destroyed. The main plant of the Mitsui Shokuhin steel works was on the outskirts of the area of greatest destruction. Approximately 95 percent of its value was destroyed. The dockyard, the largest industrial establishment in Nagasaki and one of the few plants previously damaged by high-explosive bombs, was located down the slope from the fire. It suffered virtually no war damage. The Mitsui Shokuhin plant was all operating prior to the attack, at a fraction of its capacity because of a shortage of raw materials. Had the war continued, and had the raw material situation been such as to warrant their reactivation, it is estimated that the dockyard could have been in a position to produce at 80 percent of its full capacity within 6 months; thus the steel works could have resumed some production within 6 months and been back at capacity within 6 months; and that construction of the steel plant could have been completed at full capacity by 1946.
would have been required to appreciate the damage and casualties at Nagasaki. This estimate presupposed bombarding under conditions similar to those existing when the atomic bombs were dropped and bombing accuracy equal to the average attained by the Twentieth Air Force during the last 3 months of the war.

As might be expected, the primary reaction of the populace to the news was fear, uncontrollable terror, strengthened by the sheer horror of the destruction and suffering witnessed and experienced by the survivors. Prior to the dropping of the atomic bombs, the people of the two cities had fewer misgivings about the war than people in other cities and their morale held up after it better than might have been expected. Twenty-nine percent of the survivors interviewed indicated that after the atomic bomb was dropped they were convinced that victory for Japan was impossible. Twenty-four percent stated that because of the bomb they felt personally unable to carry on with the war. Some 40 percent testified to various degrees of depression. A greater number (54 percent) expressed themselves as being impressed with the power and scientific skill which underlay the discovery and production of the atomic bomb than expressed anger at its use (20 percent).

In many instances, the reaction was one of mitigation.

The effect of the atomic bomb on the conscience of the Japanese civilian population outside the two cities was more restricted. This was in part due to the effort of distance, lack of understanding of the nature of atomic energy, and the impact of other demoralizing experiences. The role of the atomic bomb in the surrender must be considered along with all the other factors which bore upon that question. Japan's struggle to end the war though governmental structure was such that in practice the Emperor never approved the decision of his advisors. A consensus among the eligibles of ruling factions at the top was required before a question of national policy could be decided. These factions, each of which had a different point of view, included the group around the Emperor of whom Moriyuki Kido, a supporter of the Yoki Sect, was the most important, the pro-pacifist constituting the junior or body of senior statesmen, and the

...The Army and Navy issued their own cabinet ministers, who, together with the two chief of staff, had direct access to the Emperor. The cabinet would deliberate about as long as it was able to assess or modify the views of the Army and Navy ministers, who, until the end, were strongly influenced by the fanaticism of the Army officers and many of the younger Navy officers. The ruling oligarchy considered the opinions of the Japanese people as only one among the many factors to be taken into consideration in determining national policy and as no more than controlling.

The first definitive break in the political coalition which began the war occurred following our success at Tarawa. Ten days thereafter, on 10 July 1944, the cabinet headed by General Tojo fell. This significant turn is the turning point in Japan's wartime policy was not merely the result of an immediate crisis. Even at that date, elements opposing continuance of the war had sound reasons for applying pressure against the fanaticism of Japan's militaristic clique. The original factors who had opposed war before Pearl Harbor, in peace, or “unarmed” in the first phase of the conflict recognized as early as the spring of 1943 that Japan was facing ultimate defeat. By that time, United States determination to fight and her ability to mount overpowering offensives in the Pacific, even before the opening of the European Second Front, had already been demonstrated to many of those who had access to all the facts. The political problem of those who saw the situation was to expedite among other leaders in government or outside the government a true picture of the war and thus shatter the Tojo government in favor of one which would bring the war to an end.

Dear Admiral Tojo of the Navy General Staff made a study between 20 September 1943 and February 1944, of the war situation up to that time. Based on an analysis of air, fleet, and merchant ship losses, Japan's inability to import essential materials for production, and the possibility of air attacks on the home islands, Tojo concluded that Japan could not win and should make a comprehensive peace. His study and a similar one made by Submariners of the Cabinet Planning Board discussed the facts of the situation, and through them of Moriyuki Kido, that all was not well with Tojo's preservation of the
With the loss of Saito, it was possible to build up sufficient pressure to force Tojo's surrender.

The government of General Kuni, who was chosen by the over-enthusiastic Kido to head the succeeding cabinet, did not have the strength to stand up to the military and was a disappointment to the more authoritative peace makers. In spite of original instructions to give "fundamental reconsideration" to the war, the members of the cabinet who opposed the war were eventually replaced.

The corruption and weakness of the peace party was increased by the confusion of Japanese military defeat, and by Jus'-s hesitation in opposing itself against the growing weight of air attacks on the home islands. On 7 August, less than a week after United States landings on Okinawa, Kido's government and Marquis Kido initiated Admiral Kurita as premier. Kido told the Japanese cabinet that, in his opinion, Kurita should take the blame for the loss of Okinawa.

Kido found the Japanese cabinet at the Bay of Tokyo, and succeeded in keeping the cabinet together for three weeks, after which it was dissolved. The cabinet was dissolved after three weeks, after which it was dissolved.

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CONCLUSION

The foregoing pages tell of the results achieved by air power in each of its several roles in the war in the Pacific, including the effects of the atomic bomb. The Survey has already reported on the results obtained by air power in the European war. It remains to seek out the degree to which the Pacific study modifies, adds to, or requires the adjustment of the results which were reported by the European study, to state the extent to which this insight suggests that air power might have been differently or better employed in the Pacific; to discuss the extent of the existence of atomic bombs on the role of air power; and to state the Survey’s recommendations. First, however, it is necessary to point out the unique feature of the Pacific war which must be kept in mind while considering bombs to be learned from it.

Uniqueness of Pacific War

The Pacific war was unique in many respects, as was the European war, and great reservations should be used in assuming that what was effective or not effective under those circumstances would be similarly effective at other times and under different circumstances. Japan’s initial war strategy called for a war of limited objectives. Her capabilities did not permit an attack on our basic supporting strength. She was, however, a basically determined enemy, well prepared initially, and the fighting quality of her ad hoc, season and driven men should not be underestimated.

Japan’s geographical situation determined that the Pacific war should be a war for control of the sea and for control of the air. Control of the sea over the area was a result of superior surface ships and amphibious operations for possession of island positions on which forward bases could be located. Control of the air was at the heart of the struggle. Carrier task forces, amphibious ships, and land-based aircraft worked together to support the ground forces and improve their effectiveness. The successful employment of air power in the Pacific war was not only the result of the role of ground forces but also the result of the joint employment of land and air forces, and their supporting services, backed up by the full effect of all phases of the home front that enabled us to secure control of the air, of sea locally and then on a more general front.
virtual freedom of the skies over the Japanese home islands themselves.  

1. The limitations of air control deserve special mention. It was never completely possible to deny the air to the enemy. It was considered that we had control of the air when the enemy could not operate as he pleased or operate with impunity. The principle involved dictates the degree to which defensive air control must be imposed on enemy bases, beyond the range of enemy suicide planes or guided missiles from such land or sea as we propose to use.  

2. Given air control, there were also limitations as to the specific results which could be achieved in exploiting such control by aircraft carrying conventional high-explosive bombs. Low level, unengaged patrols and other proform defenses could not in many cases be terrorized, and it was necessary to eliminate remaining ground forces in enemy close-range fighting areas through those forces were isolated and completely cut off from supply and reinforcement. Weather and darkness limited exploitation of air control, but as the war progressed technical and tactical advances were made which progressively reduced these limitations.  

Combat radius of fighters and time on patrol at maximum radius, although great by previously existing standards, required that airfields or carriers be available within 500 nautical miles or less of the area to be covered in a combat operation to prevent fighter loss. The effective radius of our longest range bombers was limited to 1,500 miles and bases still closer to Japan were considered essential for emergency landing and fighter support.  

The importance of reducing those limitations of control of the air and its exploitation by the application of research, development work in the future is obvious.  

6. The experience of the Pacific war supports the findings of the Survey in Europe that heavy, concentrated and accurate attack against carefully selected targets is required to produce decisive results when attacking an enemy's sustaining sources. It further suggests the finding in Germany that no nation can long survive the free exploitation of air weapons over its homeland. For the future it is important to grasp the fact that many planes enjoying control of the sky over enemy land can be as disastrous to each enemy country as its occupation by physical invaders.

Nightlight  

Nightlight essentially suggests that in some respects air power might have been differently or better employed.  

Prior to the European war, we underestimated the predominant role that air power was to play and allocated to it too small a share of even the inadequate resources then available to the Army and Navy. At the outbreak of the Pacific war, air defense was particularly great in modern land-based fighters and in carriers. Over 1,000 planes in the Philippines, at least equal in performance to the best then available to the Japanese, including types effective against shipping, well-armed, equipped and supplied, and dispersed on some 40 airfields, would have seriously impeded the original Japanese advance if knowledge of their existence had not entirely dissipated the Japanese from making the attempt. The loss of relatively antiquated battleships at Pearl Harbor had little effect on the Navy's combat capabilities at that time, while the addition of a few carriers would have enormously increased its capabilities. Larger overall appropriations to the armed forces, beginning at the time of Japanese occupation of Manchuria when the threat to peace in the Far East became evident, might have made our situation unnecessary and would have paid for itself many times over in reduced casualties and expenditures had war still been avoidable.  

Upon entering the war, we were deficient not only in numbers, but in quality of many of our aircraft types. We were forced thereafter into hasty and costly modifications and technical development programs to raise the performance of our aircraft to acceptable standards. These programs could have been conducted more efficiently and economized during peacetime years.  

In the actual conduct of the war we were quickly grasped the strategic resolution brought about by the capabilities of air power than did the Japanese. By the end of 1943 we had achieved
through combat and the augmentation of our forces, each side cut separately over the Japanese line of advance. Air power that eventually victory was secured.

In explaining this superiority greater accuracy of effort was possible. The nature of our pre-

war operational planning provided no webs, strict of the President, for integrating our armed

forces. Under the pressures of war the Joint Chiefs of Staff were the most effective mechanisms then pos-

sible to fill this gap. Each of its members had in effect the power of veto and the required un-

animity was produced by consensus. It proved impossible to agree on an overall commander for the Pacific as a whole. Our military and economic strength, however, made it possible to plan and execute a dual line of advance across the Pacific; and to mount in air attacks of sufficient weight to induce unconditional surrender concurrently with the preparation of the necessary forces.

The Impact of Atomic Bombing in the Pacific

The importance of atomic bombs in achieving unconditional surrender without invasion. By late 1945, the weight of the air attack had so far realized only a fraction of its potential, and Japan's government had lost its confidence in victory and was approaching the limits of its endurance, and its leaders, most of all, the inevitability of defeat, were preparing to accept surrender. The only remaining problem was the timing and terms of that surrender.

Having suffered the war inadequately prepared, we continued all-out an unconditional surrender. The logic of all-out surrender complicated all means to bring ever-increasing pressure on Japan, beyond the time when this was still reasonably required.

The Impact of Atomic Bombing on the Role of Air Power

Does the existence of atomic bombs invalidate all conclusions relative to air power based on pre-

atomic experience? In his history, it is the very existence of atomic bombs that is in question, not the basic principles and relationships involved. The atomic bomb, in its unique form of development, raises the question of whether the effect of a single bomb by a factor of 1000 and 2000 times, depending upon the nature and size of the target. The ability to destroy, given control of the air and an effective supply of atomic bombs, is beyond question. Whether both of these conditions are met, however, any attempt to predict war depends on accidental factors through air bombardment may encounter problems similar to those encountered in conventional bombing.

The problem of control of the air, primarily of our own air, and should we be attacked, of the enemy's air as well, because of even greater signifi-

ance. The most intense effort must be directed to perfecting defensive air control both by day and night through the improvement of our radar and fighter control systems, anti-aircraft ordnance and defensive fighters, not only from the standpoint of technological improvement and value, but also of disposition and tactics. It would be rash, however, to predict an increase in the effectiveness of defense as control sufficient to make that not a single enemy plane or guided missile will be able to penetrate. It therefore behooves us to accept the possibility that at least a small
number of enemy planes or guided missiles may be able to avoid all our defenses and to attack any objective within range.

The threat of immediate retaliation with a striking force of our own should deter any aggressor from striking.

If we are not to be outnumbered out of hand, in the event we are nevertheless attacked, we need to increase our vulnerability to such attack. The experience of both the Pacific and European war has emphasized this aspect which civilian and other forms of passive defense can reduce a country's vulnerability to air attack. Civilian defense and fortifications can be reduced by present knowledge in non-lethal or less of the exact line which would be struck were these techniques not employed. This does not include making everything underground; but does involve a progressive evacuation, dispersal, warning, air-raid shelter, and potential emergency assistance programs, the benefits of which can only be held in postponement. The study of the effects of the atomic bomb on Hiroshima and Nagasaki indicates that the above statement is an area in which much more急需 is needed to reduce the extent of its effects than is needed in an age of conventional weapons. Similarly, economic vulnerability can be curtailed by a well-coordinated program of stockpiling, dispersal, and special construction of particularly significant segments of industry. Such programs in the economic field can also be worked out satisfactorily only in postponement.

At the army's military field the impact of atomic weapons and guided missiles on strategy and tactics can only be developed by military specialists. It is in the Survey's opinion, however, that further study by such specialists will support the conclusion that the dispersal of military forces and the use of atomic weapons and guided missiles will be significant considerations that heavy bombers similar to those used in this war will not be able, for example, to sortie effectively and on a scale much beyond the range of protective fighters, and that these types of offensive weapons and much more in the future must be developed to do so that missile hit-and-run will have to be deleted. This is the result of the study of the atomic bomb and that the basic principles of war, when applied to the field of the raw weapons, will be found to be the same. In the case, atomic weapons will not have eliminated the need for ground troops, for nuclear rockets, for surveillance, or for the full coordination among them, the supporting services and the civilian effort, but they will have changed the extent in which they are employed to such a degree that radically changed equipment, training, and tactics will be required.

Recommendations

Our recommendation is that the atomic bomb be used in a manner which will have the effect of bringing about a military cooperation with the United States in the form of a peace treaty. This will ensure the security of the United States.

Research and Development.—The "uncertain" techniques used are even more dangerous. This uncertainty, derived initially from the European war, is strongly supported by the Japanese experience. A mobilized and well-organized striking force employing a certain technical superiority can overwhelm in short order the forces of a country of the great basic long-term strength. In the opening phase of the Pacific war the Japanese were able to overrun 100,000,000 people and an area of economic strategic importance in the space of a few months. This may be a form of the fact that from the time of the Munich conference in 1938 we had been so aware of the threats against the peace of the world and that the intervening years and the experience of our Allies had been invaluable in permitting us to take the necessary steps to return our world to a state of peace. The United States should be in the lead in the development of new atomic weapons and should be in a position to develop new and improved atomic weapons.
131

...hearty and adequate mobilization every time the thrill of aggression strikes in the world. It is essential that the field of military weapons and tactics be technologically at least equal to the actual threat of punishment. It is not generally realized the degree to which basic scientific research was neglected in the United States during the course of the war in order to concentrate on the limited development of the specific weapons immediately required; nor the degree to which we lagged behind (Japan) in advanced aeronautics, jet propulsion and the development of guided missiles. In air armament and technology, even the Japanese were ahead of us. One or two years lag in other basic research or in the development of feasible military application of such research can only be made up with difficulty, if at all. This type of work has become as complex that expenditures for research and development in the order of one billion dollars annually may be required to assure an acceptable degree of national security.

**Intelligence—**At the start of the Pacific war our strategic intelligence was highly inadequate, and our overall war plans, insofar as they were based on faulty information and faulty interpretation of accurate information, were unwarranted. As a result our failure to collect and analyze economic and industrial information necessary to the planning of our attack on Japan's industrial resources required several months of the most strenuous effort on the part of our intelligence agencies.

If a comparable lack of intelligence should exist at the start of a future national emergency, it might prove disastrous. In the field of operations intelligence coordinated forward orders were made during the Pacific war. The requirements in this field for large scale, highly detailed and accurate work for complex analysis, are rapidly changing conditions of forces and defenses, and for speed, all place a heavy burden on training, competence and organization. These requirements were not fully met in the Pacific war. The deficiency was attributed to inexperience in these services. This was due to the large number of trained and competent operational intelligence officers to provide an adequate staff for an expanding organization.

The basis for adequate intelligence can only be laid in planning. It is evident in the field in question that a basis for the general reorganization is to be found in the establishment of the National Intelligence Authority, particularly in the changing of the services to an adequate coordination and dissemination. It appears that the necessary provisions have not been made in the various operating organizations of appropriate intelligence units, adequate budgets and personnel. This is a major criticism that must be corrected in the planning to meet the highest possible standards. The result can only come from increased training in intelligence and active cooperation of all functions on the part of the Army, Navy, and Government officials.

The present lack of trained personnel for intelligence work by the various operating organizations and the general shortage of trained and competent intelligence personnel give cause for alarm and require correction.

**Integration of the military establishment—**Organizational deficiencies in the Japanese Government contributed to Japan's defeat. They were steadily increased by a series of errors in planning and adoption of effective coordination between the Army and Navy. Military policy was inconsistent with the foreign policy of the cabinet, the Japanese Army and Navy failing to make their own foreign policy in accordance with the individual aims, ambitions and requirements. During the war inadequate unity between the Army and Navy impeded coordinated strategic and tactical planning, the proper employment of air force power, the development of adequate logistics and the efficient utilization of her economic resources. The existence of such joint or coordinated organizations as the Supreme War Council, the Supreme War Direction Council, the Board of Field Marshals and Chief Admirals, the Imperial General Headquarters served mainly to hide the fact that real unity, integration, and coordination were essential lacking.
Strength as a force for peace—The Survey's report on the European war stated that the great lesson to be learned in the battered cities of Europe and the ruined cities of Germany is that the best way to win a war is to prevent it from occurring. This is fully supported by the examples of the devastated cities of Japan and their unhealing and hungry suffering inhabitants. The prevention of war must be the ultimate and to which our best efforts are devoted. It has been suggested, and wisely so, that this objective is well served by increasing the strength and the security of the United States. The United States was founded and has since lived upon principles of freedom, freedom, and good will at home and abroad. Strength based on these principles is no threat to world peace. Prevention of war will not be furthered by neglect of strength or lack of fear of evil or a threat to our own. Those who contemplate evil and aggression find encouragement in such neglect. Neither can humanity afford it. The Japanese would never have attacked Pearl Harbor had they not correctly assessed the weakness of one defense in the Pacific and had they not instrumentally succeeded in the fighting determination of the United States when attacked.

Suggestions for ensuring the military strength and security of the United States are by no means included as a recommendation for a race to arms with other nations, nor do they reflect a lack of confidence in the prospect of international relationships founded upon mutual respect and good will which will themselves be a guarantee against future war. The development of an intelligent and coordinated approach to American security can and should take place within the framework of the collective organization of the United Nations. The United States as a member of the United Nations has committed itself to use force except in defense of law as embodied in the purposes and principles of the United Nations Charter. An assurance of the great powers we must be prepared to set in defense of law and to do our share in assuring that other nations live up to their commitment. The United States must have the will and the strength to be a force for peace.