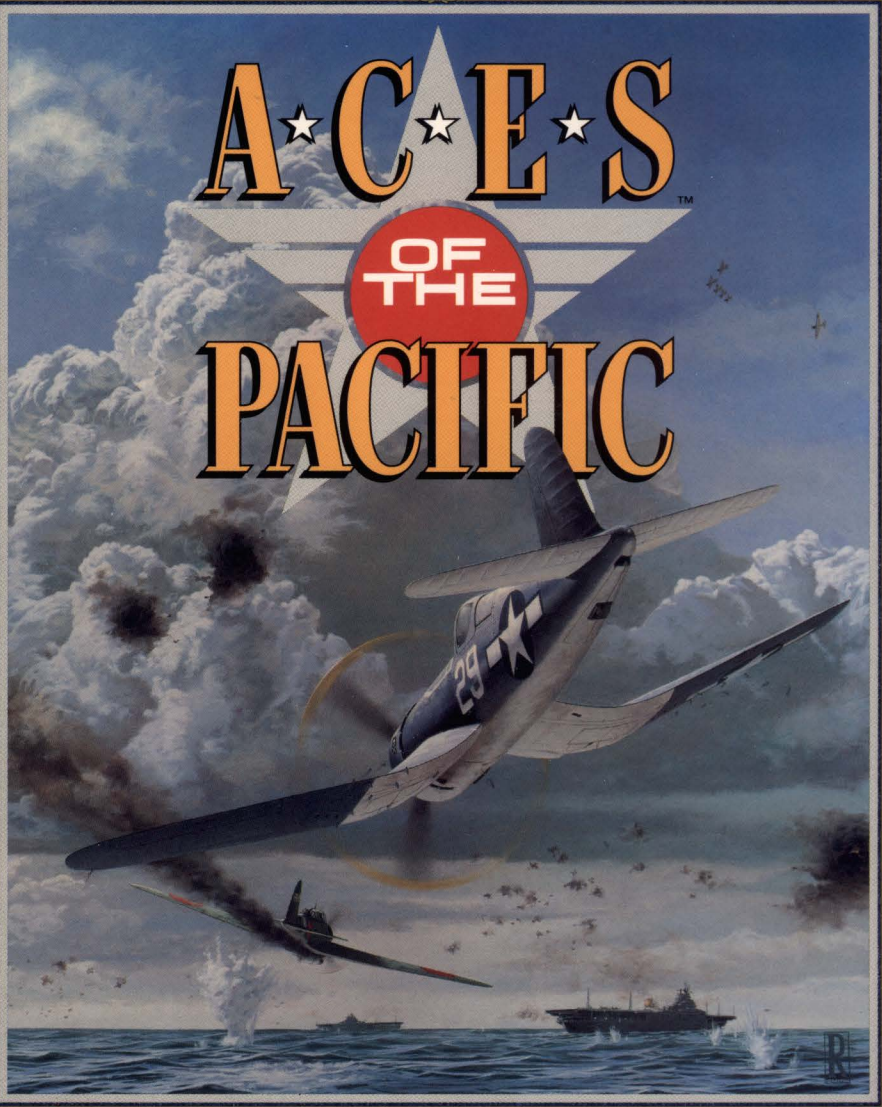
GREAT WAR PLANES

A·C·E·S™ OF THE PACIFIC



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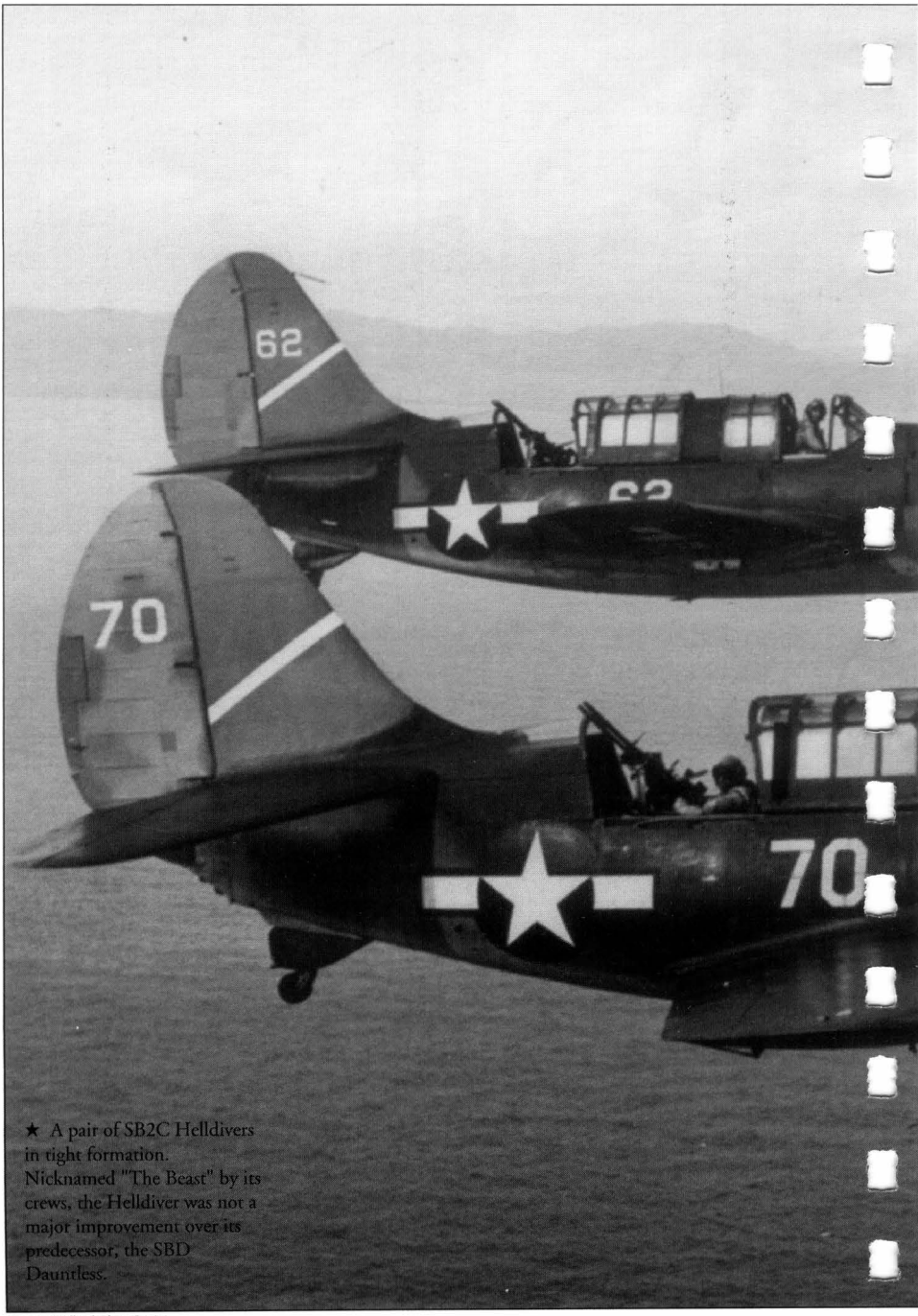
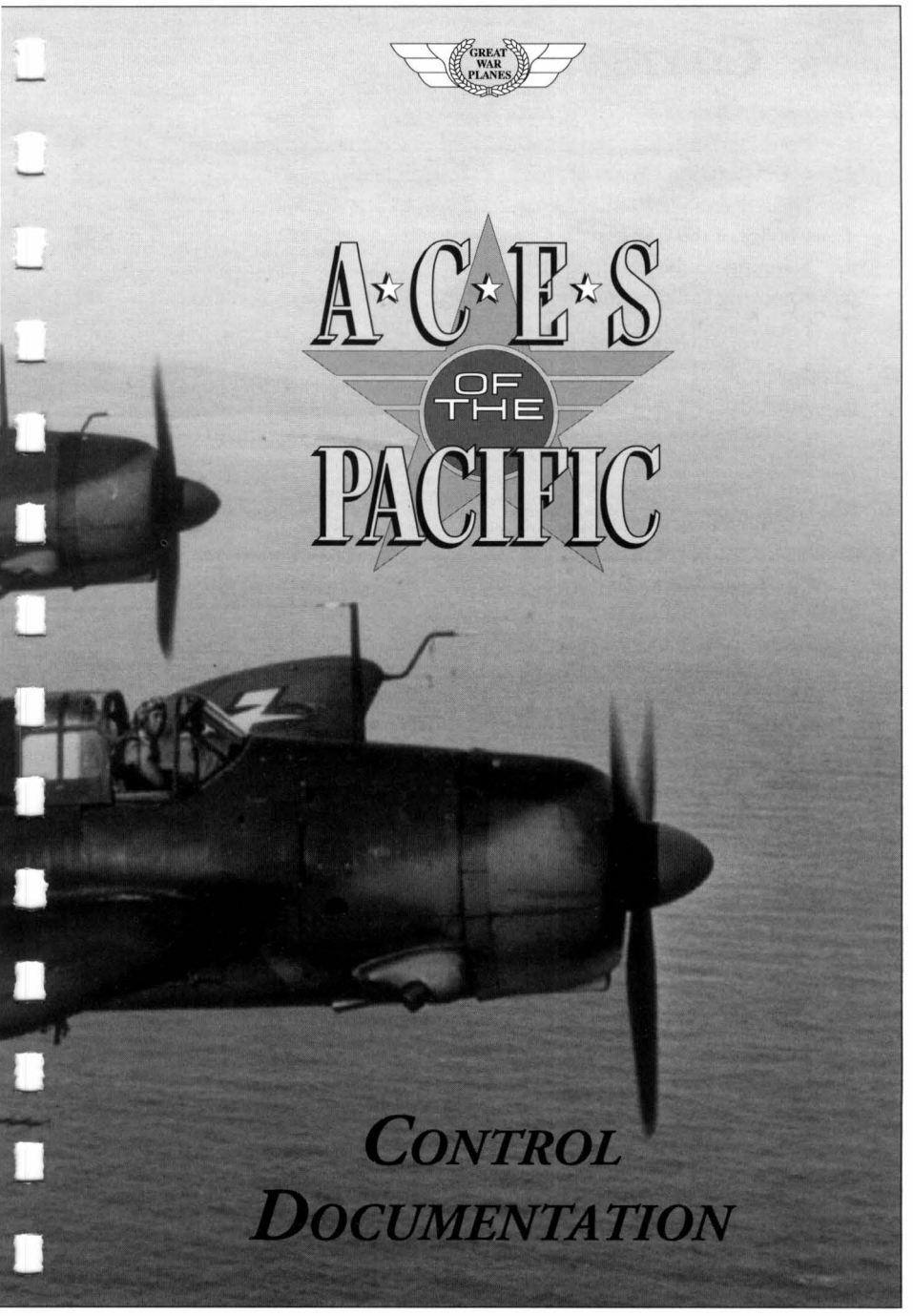


★ A pair of SB2C Helldivers in tight formation. Nicknamed "The Beast" by its crews, the Helldiver was not a major improvement over its predecessor, the SBD Dauntless.

Courtesy Tailhook Photo Service


GREAT
WAR
PLANES
A·C·E·S
OF
THE
PACIFIC
CONTROL
DOCUMENTATION

CONTENTS

Courtesy National Air & Space Museum, Smithsonian Institution

★ Pilots and deckcrew pose in front of the Navy's standard fighter for the last two years of the war, the F6F Hellcat.

On December 7, 1941, with Pearl Harbor in smoking ruin, aerial history would continue and new legends would be born as American pilots launched into battle against the Japanese Empire. They would fight with honor and fly with the spirit of legends and be remembered as "Aces of the Pacific."

Courtesy National Air & Space Museum, Smithsonian Institution

★ The crew of a Navy patrol bomber poses for the camera. Few Navy aircraft carried personalized plane markings like the one here.

Courtesy National Air & Space Museum, Smithsonian Institution

★ An American carrier task force escorted by battleships. Within days of the outbreak of the Pacific war, the aircraft carrier displaced the vaunted battlewagon as the reigning queen of the Sea.

PEARL HARBOR

The warnings of a Japanese attack were sounded long before the first bombs rocked Pearl Harbor. No one was listening.

In January 1941, months before the invasion, U.S. ambassador to Japan Joseph Grew received a tip that the Japanese were planning an attack on Pearl Harbor.

Hours before the attack, one submarine was spotted outside the harbor, another sub was sunk, and a "huge number of planes" appeared on the new radar installation on Oahu's north coast.

Many U.S. officials believed a Japanese assault was imminent. But they thought it would take place in the Philippines; not on an island 5,000 miles from Tokyo.

So, when the rising sun awoke Pearl Harbor on December 7, 1941, the U.S. Pacific Fleet was prepared only for another sleepy Sunday.

As dawn touched the horizon, the first wave of Japanese planes were launched from carriers in choppy waters 200 miles north of Pearl Harbor. Flying over fleecy clouds, pilots homed in on the soft music broadcast by Honolulu radio station KGMB. The Japanese objective was revealed as "God's hand pulled aside the clouds," strike leader Lieutenant Commander Mitsuo Fuchida recalled.

It was a raiding pilot's dream. U.S. Army planes at Hickam, Bellows and Wheeler fields were bunched together on the tarmac, wingtip to wingtip, for protection against saboteurs. Ninety-four vessels were anchored in Pearl Harbor, including seven battleships obligingly moored in a double row beside Ford Island.

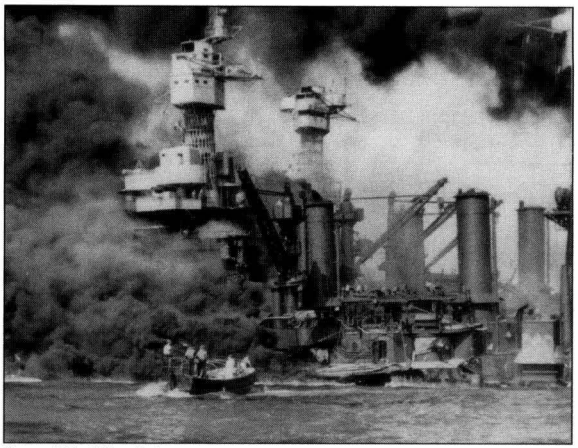
At 0753, Lieutenant Commander Fuchida radioed the coded message, "Tora! Tora! Tora!" Complete surprise had been achieved.

Courtesy Tailhook Photo Service

★ Planes being readied for takeoff from a Japanese carrier.

Two groups of Japanese planes approached the island from either side, then split into smaller groups and closed in on their waiting targets. Aichi-99 "Val" dive bombers began the charge, raining their 550-pound explosives on airfields and hangars. Nakajima-97 "Kates" swooped low toward the battleships and launched torpedoes, newly modified with wooden fins for the shallow waters of Pearl Harbor.

Within minutes, torpedoes found their marks. The *USS California* took two quick hits and began spilling oil like a wounded beast. The *West Virginia* shuddered from blast after blast. Alert officers counterflooded the ship, keeping her upright as she settled to the harbor bottom. Three torpedoes ripped the *Oklahoma* and she rolled over, her bottom rising until her superstructure hit the mud 25 feet below. Men climbed to safety aboard the overturned hull, only to be gunned down by enemy planes. On the *Nevada*, a 23-man band had just struck up the "Star-Spangled Banner" when the invaders descended. The band hastily finished the tune and scrambled for their battle stations.



Courtesy Tailhook Photo Service

★ The destruction of Battleship Row. The *West Virginia* settles to the bottom beside the damaged *Tennessee*. The small boat in the foreground is rescuing a sailor from the water.

Throughout the harbor, groggy sailors awoke to explosions, some angry at the brass for staging a drill so early in the morning. Many leapt to their stations, quickly manning anti-aircraft guns. The U.S. forces responded faster than Japanese troops might have, one of the invading Japanese pilots observed. But it was too little, too late.

Mitsubishi Zeroes soared high and low, controlling the air and strafing the ground. Horizontal bombers, each carrying one 1,760 lb. armor-piercing bomb, struck at ships the torpedoes hadn't found.

Two bombs hit the repair ship *Vestal*. One penetrated all seven decks and the hull, then buried itself unexploded in the mud below. The other exploded in a storage room, twisting steel bars like pretzels.

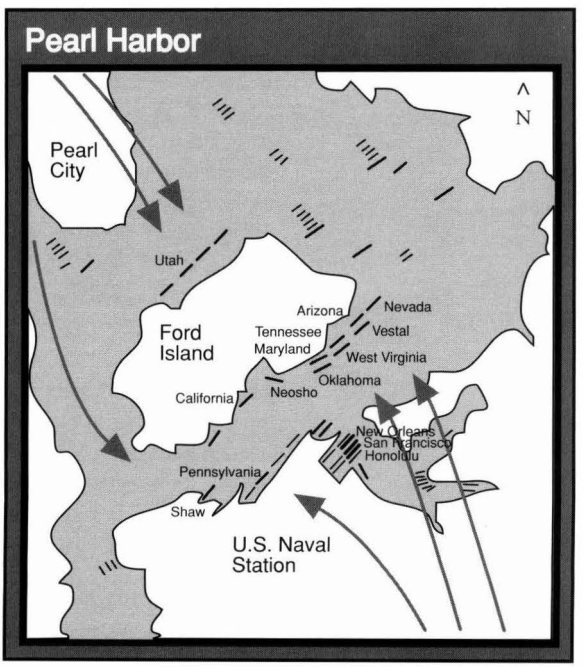
A bomb found its way into the *Arizona's* fuel storage area. Black powder had been stored there, contrary to naval regulations, and the ship erupted like a volcano. Flames shot 500 feet in the air. Fuchida's plane, almost 10,000 feet above the cataclysm, rocked from the explosion, then dropped from the suction of the afterblast. "I knew then," he said, "that our mission would be a success."

When the *Arizona* exploded, a grisly rain of pipe fittings, valves, bodies and body parts showered down on nearby ships. Burning debris from the blast lit fires on the *Tennessee*, causing more damage than the Japanese bombs. The intense concussion snuffed out fires on the *Vestal* as if they were birthday candles. The waters around Battleship Row blazed with oozing oil and the thick, suffocating smoke turned day to night.

So swift was the attack that only a few U.S. planes got off the ground to do battle. Men on ship and shore fought back with whatever they had: machine guns, rifles, pistols. More than a quarter-million rounds were fired at the Japanese, bringing down 29 of their planes.

By 10 o'clock, the airstrike was over. The last waves of Japanese intruders returned to their carriers and U.S. ships and planes searched for them in vain. The damage was considerable: 18 ships, 177 planes, and 2,403 human casualities, no less than 1,100 of them on the *Arizona* alone. But for all its destruction, the raid was merely a limited success for the Japanese.

In actuality, only five U.S. ships were destroyed beyond repair: the battleships *Arizona* and *Oklahoma*, the target ship *Utah*, and the destroyers *Cassin* and *Downes*. The Japanese had missed the huge fuel tanks, submarine pens, ship repair facilities, and, most important, the Pacific Fleet's carriers. All three were out to sea during the attack.



Commander Fuchida urged a second invasion to strike the missed targets. But Admiral Chuichi Nagumo, commander of the First Air Fleet, would have none of it. Japan had crippled the U.S. Fleet, he reasoned. The mission was accomplished. That decision may have been Nagumo's first major error for the U.S. Fleet would rise again, sooner than expected and stronger than ever.

Courtesy Tailhook Photo Service

★ Sailors struggle to save a damaged PBY from complete destruction during the Pearl Harbor attack.

Inching Toward War

Like Germany, Japan in the 1920s and '30s was an incubator for militarism. Eighty million people were crowded into an area the size of Montana, and the population was growing by a million per year. Poverty spread as a series of natural and financial catastrophes rocked the economy. An earthquake leveled Tokyo in 1923. Tariff policies instituted by many nations after World War I choked off Japan's export trade. The Great Depression caused the price of silk, Japan's leading export, to drop by half.

Militant army officers saw a solution to their country's woes: more land. Foreign expansion could obtain the needed resources, while ending Western colonialism in Southeast Asia. Japan currently occupied Formosa and Korea and had troops stationed in China. Japanese leaders also had plotted to exercise control over an alliance of Eastern countries, an alliance that would become known as the "Greater East Asia Co-Prosperity Sphere."

In 1931, the Japanese Kwantung Army, based in Manchuria, took the initiative. Defying civilian authorities in Tokyo, it seized control of the province. Belatedly recognizing the fait accompli, the Japanese government set up Manchukuo, a puppet state.

The successful conquest of Manchuria increased the Japanese army's prestige at home. By 1937, its officers dominated the Japanese government. They reached for another prize. In July, Japan invaded China.

Japanese and Chinese troops initially exchanged shots at an ancient stone bridge named after Marco Polo, then at a railroad station south of Peking. Within days, Japanese bombers struck three cities and a million troops began pouring into China. The Japanese soon captured port cities and advanced inland. But by the start of the 1940s, the Japanese army had been spread thin over the vastness of China, and the campaign was consuming more resources than it was providing.

In the U.S., a strong pro-China lobby urged intervention. Their point of view was reinforced when the U.S. gunboat *Panay*, escorting commerce on the Yangtze River, was sunk by Japanese bombers. Japan apologized and paid restitution, but the subsequent occupation of the city of Nanking brutalized relations between the U.S. and Japan. Citizens of Nanking were machine-gunned en masse by the Japanese invaders. A quarter- million Chinese civilians were killed.

In 1938, President Roosevelt asked for a voluntary embargo of U.S. arms and aircraft to Japan. The following year, in an attempt at deterrence, the U.S. Pacific Fleet was moved from San Diego to Hawaii. In 1941, Japanese troops occupied all of French Indochina and Roosevelt banned the export of petroleum and scrap metal to Japan. Since Japan's industries imported most of their raw materials from the West, including two-thirds of its oil from the U.S., Japanese leaders saw this as economic strangulation.

But Japan could obtain raw materials elsewhere: rubber, bauxite and tin in British Malaya, and oil in the Dutch East Indies. Since the British and the exiled Dutch government had their hands full fighting the Germans, the time was ripe, the Japanese decided, to capture Southeast Asia.

The only serious obstacle was the United States. From bases in the Philippines, U.S. bombers could strike at the sea lanes south of Japan. U.S. ships also could launch an attack from Hawaii. If Japan's expansion was to be successful, both U.S. military sites would have to be neutralized.

In early 1941, Admiral Isoroku Yamamoto, Commander in Chief of the Japanese Combined Fleet, ordered a secret feasibility study for an attack on Pearl Harbor. Yamamoto, who attended Harvard University, was well aware of the military edge provided by America's industrial capacity and natural wealth. Like many other leaders, he doubted that Japan could defeat the U.S. in a prolonged war. But with the U.S. Fleet disabled, a swift victory might be possible. "In the first six to twelve months of war with the United States and Britain, I will run wild," Yamamoto declared. "After that...I have no expectation of success."

Disabling the U.S. Fleet might buy Japan the time to capture islands and territories, and establish an impregnable defensive perimeter stretching from New Guinea to the Aleutians. After a year or two of fighting a two-ocean, Pacific/Atlantic war, the U.S. and Britain would be so exhausted that they would be forced to negotiate peace and surrender possession of Japan's newly-captured lands. Thus, the attack on Pearl Harbor, one of the most famous offensive thrusts in military history, was essentially a defensive move.

Diplomatic efforts continued, even as Japanese forces were being trained for the attack. At the end of November 1942, Roosevelt stepped forward with a peace proposal. The U.S. would agree to resume normal economic relations on the condition that Japan would agree to cease all troop movements and renew serious peace talks with the government of China. Before the proposal was delivered, news came that a huge

Japanese warship and troop transport convoy were moving toward Southeast Asia. The initiative was scuttled.

Instead, U.S. Secretary of State Cordell Hull issued a set of stern conditions known as his "Ten Points." One was the removal of Japanese troops from China. Japanese leaders assumed this also meant Manchuria, to which thousands of Japanese had already emigrated. To leave was unthinkable. The negotiations stalled and war approached.

On November 26, six carriers set sail from northern Japan. To minimize the danger of detection by merchant ships, a route was chosen through winter seas between the Aleutians and Midway. Thick fog concealed the armada while submarines prowled far ahead. False radio messages were sent from home bases to fool U.S. Intelligence.

On December 2, the final order to attack came from Tokyo: "Climb Mt. Niitaka," a symbolic reference to the highest peak in the Japanese Empire. At the same time, Japanese ships and troops moved south down the Malayan peninsula, aiming to capture the British base of Singapore, and from there the East Indies.

The charade of negotiations had continued; but on December 6, Japan's ambassador in Washington D.C. received a lengthy 14-part message from Tokyo. The message broke off negotiations between the two countries and was to be delivered on December 7 at precisely 1:00 p.m., Washington time. Because of translation problems, the ambassador didn't deliver it on time. It didn't matter. U.S. Intelligence had intercepted the message. President Roosevelt read it and said, "This means war." To U.S. officials, the precise timing seemed ominous and orders to be alert were dispatched to military installations in San Francisco, the Philippines, the Panama Canal and Hawaii.

The orders came too late. At that precise hour, Japanese planes were approaching Oahu's north shore to initiate the first of 1,364 days of war.

NAVAL AVIATION COMES OF AGE

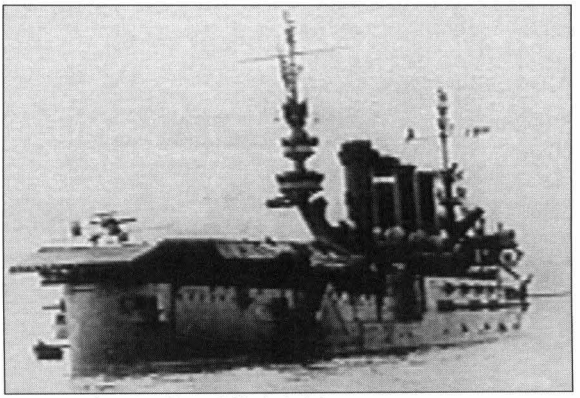
Death of the beast, birth of the bird.

More than a decade before Pearl Harbor, the U.S. Navy first faced the realities of modern naval aviation at the U.S. Navy's 1929 winter war games. In the tropical waters off Central America, the navy's Black Fleet was the "enemy," assigned to attack the Panama Canal from the Pacific Ocean. The plan was to attack, not with the battleships and cruisers that had been used in previous games, but with a new member of the fleet, the *Saratoga.*

The *Saratoga* was a lopsided hybrid, a battlecruiser's hull topped by a wooden deck. It was less than a year old, the third of a new type of warship called the aircraft carrier, and nobody was quite sure what to do with it.

The plan was simple. The *Saratoga* split off from the rest of the Black Fleet, snuck up close to shore in the middle of night, and launched 70 planes to bomb the canal's locks. The planes struck without warning, flying so convincingly that the referees ruled the canal had been shut down.

★ An early landing attempt on a U.S. Navy warship.



Courtesy National Air & Space Museum, Smithsonian Institution

The U.S. Navy would never be the same. Its forces had long centered around gunships, especially the thick-armored, massive-gunned battleships that were regarded throughout the navy as being virtually unsinkable.

Aircraft, on the other hand, were escorts used primarily to launch scouting planes. But after the *Saratoga's* surprise, the first carrier-based task force was formed. By 1942, battleships would be the escorts, used mostly as lumbering platforms of anti-aircraft guns.

But, earlier still in the history of naval aviation, it was the British who developed the first aircraft carrier. Groping for advantage over their German enemy in World War I, the Royal Navy laid a flat iron deck atop a narrow-hulled cruiser to produce a 10-plane carrier named the *Furious.* Pressed into service in 1917, the *Furious* made a mark when its Sopwith Camels destroyed two Zeppelins and their hangars at Tondern in northern Germany.

Unfortunately, the *Furious* was almost as dangerous to the British as it was to the Germans. The ship's superstructure stood in the middle of the ship, splitting the flight deck into two narrow lanes. Hot gases from the smokestacks and swirling air around the bridge made landings almost suicidal.

The British shared their knowledge with Japan. In 1921, a group of British airmen spent several months near Tokyo teaching the newly created art of naval aviation. About the same time, Mitsubishi hired a team from the recently collapsed Sopwith Aviation Company, which had designed many of the aircraft of World War I. In 1922, Japan commissioned its first aircraft carrier, the *Hosho.*

In 1919, Congress approved funds for the first U.S. aircraft carrier, the *Langley.* Sailors called it the *Covered Wagon.* It carried a normal complement of 37 planes, with enough below-deck repair facilities to make it an almost entirely self-sufficient high seas airfield.

This generation of carriers began an international naval arms race that escalated after World War I. The next generation was the result of an attempt to stop that race.

In 1921, several nations signed one of the first arms-control agreements. The Washington Treaty required the U.S., England and Japan to scrap battleships and cruisers already being built. But the treaty allowed some of the "scrapped" ships to be converted to aircraft carriers. The U.S. built the *Lexington* and *Saratoga.* Japan created the *Kaga* and *Akagi.*

BATTLESHIP THOUGHTS:

"A carrier would fall easy prey to big ships before the planes could get into action in the air."
Popular Science, June, 1933.

"Any naval aviator will tell you that aircraft can sink submarines, destroyers, and light cruisers, but they can't sink heavy cruisers or battleships."
Saturday Evening Post, April, 1937.

Billy Mitchell

When he joined the Army at age 18, Billy Mitchell wanted to be in the cavalry. But, since the Signal Corps offered quicker advancement, that's where he went. When the Signal Corps formed an aviation section and started buying planes, Mitchell learned to fly. After World War I broke out, he went to Europe to observe military tactics. When he returned, he set about to bring his country, kicking and screaming, into the age of airpower.

Son of a U.S. senator, Mitchell used his lineage to full advantage. He became a general at age 38. He was ahead of his time and let everybody know it. In 1919, he organized a coast-to-coast air race that led to national airmail service. After a visit to Japan in 1924, he predicted a Sunday morning attack on Pearl Harbor.

A frequent contributor to magazines and journals, he wrote of a science-fiction future: wars fought in the sky and under the sea, transatlantic bombers and armed paratroopers, air-raid drills in crowded cities. But Mitchell's blunt criticism of army policies created enemies, and most of his ideas were filed in what became known as the "Flying Trash Pile."

In 1925, he accused the War and Navy Departments of criminal negligence in a fatal dirigible accident. When he refused to recant, he was court-martialed. The trial was a public spectacle, with long lines of people waiting to enter the small courtroom. An unrepentant Mitchell was found guilty and suspended for five years. Instead, he resigned from the Army.

He continued writing articles and books about air power, but to a country that had crashed into the Great Depression, his words seemed increasingly irrelevant. He retired to his farm, where he died of cancer in 1936, shortly before the future of warfare caught up to him.

Attitudes, however, did not always keep up with technology. At first, few officers saw the potential of the floating airstrips. Carriers could handle only small planes incapable of flying long distances or transporting large bombs. And the strike potential was regarded as awkward and impotent. "You can't hit a ship from the air," went the saying, "and if you hit her, you can't hurt her."

Billy Mitchell didn't buy it and was determined to prove the viability of naval air combat. Mitchell, a brigadier general in the U.S. Army, had learned about airplanes from Orville Wright. The future of warfare, Mitchell was sure, was in the air. (See inset: Mitchell.)

In 1921, Mitchell convinced the Navy to loan him some captured German warships for a demonstration. First, Mitchell's flyers bombed a submarine, sinking it quickly. They next dispatched a destroyer, then a light cruiser. Still, many naval officers insisted, the planes would not sink the final target: the massive

battleship *Ostfriesland* which had taken 18 hits and struck a mine in the Battle of Jutland, yet still made it home.

For two days the airmen hit the *Ostfriesland* repeatedly, first with 250-pound bombs, then with 600-pound ones, then with 1,000-pounders. Naval inspectors boarded the vessel and found it damaged but sound.

The next planes carried 2,000-pound bombs, the biggest in Mitchell's arsenal. The first bomb landed off the starboard bow, exploding in 30 feet of water. Four more bombs hit on and around the ship. Its stern began to sink, and the bow lifted, exposing a huge hole in the hull. Twenty-one minutes after the first hit, the *Ostfriesland* disappeared beneath the waves.

Some of the naval officers sobbed. "A bomb was fired today that will be heard around the world," observed one army officer. But that bomb wasn't heard the following month, when the joint army and navy board issued its verdict on the test. The board found that "The battleship is still the backbone of the fleet and the bulwark of the nation's sea defense."

Nonetheless, there were some officers who saw the future. Rear Admiral William Moffett, the first chief of the Navy's Bureau of Aeronautics, spent the next 12 years (until his death in a dirigible accident) encouraging the "old fogies," as he called them, to build more carriers.

In Japan, a young naval officer, Isoroku Yamamoto, watched these developments carefully. Yamamoto had been a student at Harvard University and a naval attache in Washington D.C. He toured U.S. aircraft factories, studied reports of planes in combat, and read Billy Mitchell's writings. He understood what naval air power could do for Japan.

"I'm afraid you'll be out of work soon," Yamamoto told a colleague who designed battleships. "Aircraft are going to be the most important thing in the navy; big ships and guns will become obsolete."

Courtesy National Air & Space Museum, Smithsonian Institution

★ Admiral William Moffett, considered by many to be the father of U.S. Naval Aviation.

JAPAN TAKES THE PACIFIC

The flaming battleships of Pearl Harbor were only the most visible events of a larger drama. Hours before the attack on Oahu, Japanese troops began landing in Malaya and Thailand. Hours after the attack, Japanese planes raided Hong Kong, Singapore, Guam, Wake Island and the Philippines.

In the hours before dawn, the news of Pearl Harbor reached the Manila-based staff of General Douglas MacArthur, commander of the U.S. Armed Forces of the Far East. Major General Lewis Brereton, head of MacArthur's air force, urged an immediate bombing strike on Japanese airfields in Formosa. But for reasons that are still a matter of dispute (the later recollections of Brereton, MacArthur, and his Chief of Staff Brigadier General Richard Sutherland point fingers in sharply different directions), the request was denied.

Brereton ordered planes in the air, however, as a precaution; but by late morning the danger seemed to have passed and he brought the planes back. They parked in place when the Mitsubishis arrived. The Japanese approaching Clark Field were amazed to find rows and rows of P-40s and B-17s on the ground.

On the Philippine coast, U.S. radar spotted the incoming raiders, but the chain of communication broke down. Teletypes and radios didn't get through to Clark Field, and a junior officer failed to communicate a telephone message. The men at the field were relaxing at lunch when station KMZH from Manila broadcast an "unconfirmed report" of bombing in their midst. The news was greeted with laughter. There wasn't a single U.S. fighter in the air when the Japanese planes appeared.

Air raid sirens wailed and ground crews gazed incredulously at the V-formation overhead. Strings of bombs fishtailed toward the ground as the soldiers ran to their guns. For

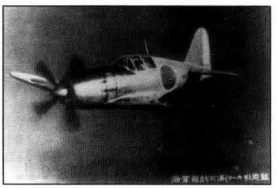
many, it was their first experience with live ammunition. Pilots of seven P-40s scrambled toward their planes and hurried them onto the runway. Bombs hit four P-40s before they could take off. The other three could do little against the swarm of Mitsubishis.

The bombing ended abruptly and groans of the wounded pierced the sudden silence. Soldiers aimlessly staggered out of trenches. Buildings blazed and smoke billowed from the oil dump across the field. Amazingly, only a few B-17s were damaged. But it was a short-lived blessing. Moments later, the Zeroes arrived.

The fighters roared over the airfield, strafing at will. Their tracers found the gas tanks of the Flying Fortresses and, one-by-one, the big bombers exploded. All but three were destroyed. All of the parked P-40s caught fire. It was a second Pearl Harbor. In 20 minutes, Japan had eliminated half of MacArthur's air force.

Still hoping he could stop the imminent invasion, MacArthur had his bombers attack Japanese convoys at sea. They did little more than get good headlines (See inset: Kelley). MacArthur deployed his forces along the beaches, trying to cover all possible landing points. But he spread his forces too thin, and when the Japanese landed in the early morning of December 22, they met little resistance. By afternoon, Japanese infantry and tanks were moving south down Route 3 toward Manila, and U.S. and Filipino troops were retreating around Manila Bay to the Bataan Peninsula.

On Christmas Eve, MacArthur withdrew to Corregidor, an island in the mouth of Manila Bay. He holed up in his tunneled headquarters until his own men dubbed him "Dugout Doug." He demanded reinforcements from the states and promised his soldiers that reinforcements were coming. But the reinforcements never arrived. Even before the war, U.S. planners didn't count on holding the Philippines. Now, with a disabled fleet in Hawaii and a war being fought in Europe, there wasn't enough military might to go around.



Courtesy National Air & Space Museum, Smithsonian Institution

★ Designed as a bomber intercepter, the Mitsubishi Raiden, or Thunderbolt, suffered from a series of production delays. Eventually, only a few hundred were built, but their pilots generally detested them since they lacked the maneuverability of the Zero.

Colin Kelley

Courtesy National Air & Space Museum, Smithsonian Institution

In the early days of the war, air combat heroes were hard to find. Captain Colin P. Kelley, Jr. became one for something he didn't do.

Kelley was the pilot of one of five B-17s that took off from the rubble of Clark Field on December 10 to bomb Japanese ships off the Philippines. When his navigator spotted a "concentration of ships," Kelley swung his Fortress around and headed for what appeared to be a battleship. The Fortress dropped three bombs, one, his crew triumphantly reported, hit dead center.

They were on their way back to Clark when they were jumped by Zeroes. The Japanese pilots pumped bullets and cannon shells into the Fortress, but it continued homeward. Finally Saburo Sakai, already an ace in the young war, charged the bomber from underneath with his guns ablaze. The Fortress caught fire. Kelley and his co-pilot, Lt. Donald Robins, struggled with the controls while the rest of the crew bailed out. The two were trying to escape themselves when the plane exploded. Robins survived, parachuting to safety after being blown clear of the plane. Kelley however, was found dead near the wreckage. For his bravery, Kelley posthumously was awarded a Distinguished Service Cross.

Japanese records later showed that no ships had been hit, but the legend of Colin Kelley didn't suffer. An army communique "confirmed" that he'd sunk a battleship. American newspapers seized on him like a savior. He'd sunk the ship in a suicide attack, they reported, he'd been given the Medal of Honor. It was the first winter of war, and good news was so scarce it sometimes had to be created.

The defenders of Bataan were on their own. There was so little food the cavalry ate their own horses. There was so much malaria that more than 500 men were hospitalized in one week. "We're the battling bastards of Bataan," sang the soldiers, "No mama, no papa, no Uncle Sam...and nobody gives a damn."

On March 11, MacArthur fled to Australia under Roosevelt's direct orders. When he reached his destination, he announced, "I came through, and I shall return."

On April 9, Major General Edward P. King, Jr., commander of the forces on Bataan since MacArthur's retreat, finally surrendered. The captured Americans and Filipinos were treated brutally as they were marched to the P.O.W. camps. Thousands died on what became known as the Bataan Death March. Less than a month later, General Wainright also surrendered. Corregidor and the rest of the Philippines fell.

The Japanese Empire spread out like a fan. On December 10, they took Guam. A few weeks later, Japanese marines captured Wake Island. Japanese forces moved into Thailand and Burma, steadily pushing British troops toward the India border. Seventy days after the start of the war, the British fortress at Singapore fell to a numerically inferior Japanese force.

At sea, the Allies fared worse. On December 10, 96 Japanese high-level and torpedo bombers found the British battleship *Prince of Wales* and the battle cruiser *Repulse* in the Gulf of Siam. Unlike the ships at Pearl Harbor, these vessels were not surprised at anchor, but were firing all their guns and twisting in the sea to avoid the attack. However, with no fighter planes to protect them, they couldn't last. It took 90 minutes for the *Repulse* to go under and a little longer for the *Prince of Wales* the ship that sailors once called the *HMS Unsinkable.* The battleship was no match for the airplane.

Japan extended its grip around Australia. Planes from four of Admiral Nagumo's carriers bombed Port Darwin on Australia's north coast, sinking several warships and wrecking the port. Troops landed on Sumatra, Celebes and Borneo in the Dutch East Indies capturing airstrips and oil fields. Japanese marines chased a few Australians out of Rabaul, a port on the island of New Britain, north of New Guinea, and began transforming it into a major naval and air base.

Admiral Chester Nimitz, newly appointed Commander of the U.S. Pacific Fleet, decided that offense was the best defense. Hoping to divert Japanese forces from the Dutch East Indies, he ordered raids on the Marshalls and Gilberts, two island groups at the easternmost reaches of the Japanese Empire.

Courtesy National Air & Space Museum, Smithsonian Institution

★ Formation of SBDs.

The first raids were launched from two carriers in the pre-dawn tradewinds of February 1. Three missions from the *Yorktown* headed for the northern Gilbert Islands but accomplished little. One mission was canceled by thunderstorms and the other two found few targets. However, 300 miles northwest in the Marshall Islands, planes from the *Enterprise* had better luck, inflicting damage on Japanese ships and installations.

On February 24, the *Enterprise* task force struck Wake Island, first with shells from cruisers and destroyers, then with bombs and bullets

from Dauntlesses and Wildcats. Eight days later, the *Enterprise's* planes hit Marcus Island, only a thousand miles from Japan.

But these early raids did little to slow the Japanese. They yielded minor injuries to the Japanese offensive, good mostly for morale and headlines, nothing more. "Fleas on dogs," said one naval officer. President Roosevelt, like almost everyone in the country, wanted to bomb Japan. The problem was how to get close enough to do it.

Captain Francis Low was watching twin-engine army bombers land at the Norfolk Naval Base when the "how" struck him. If long-range bombers could take off from aircraft carriers, and the carrier could get close without being detected, the U.S. could bomb Japan.

Lt. Colonel James Doolittle, a crack Army pilot and the first man to fly across the U.S., was given the job of training the crews. The only catch was that it was a one-way flight. The bombers could barely manage to launch from carriers. They were too big to land on them. The B-25s would have to continue on, landing at Nationalist-held bases in China.

On April 1, as thousands of onlookers watched, the carrier Hornet passed under the Golden Gate Bridge on its secret mission. The *Enterprise* joined from Hawaii, carrying fighter escorts and reconnaissance planes. The ships were far from Japan when they were spotted. The decision was made to launch the planes immediately, even though, at almost 700 miles from Tokyo, there was little chance the crews would survive. In choppy waters shortly before 8 a.m. on April 18, the Hornet turned into the wind and 16 bombers rolled down the bucking flight deck into the air.

Although the Japanese had spotted the carriers, they didn't suspect that twin-engined, long-range planes could launch from them. It was just a typical Saturday afternoon in Tokyo when the bombers appeared overhead. An air raid drill had just ended and many of the citizens of Tokyo thought the planes were just another part of the wartime drill.

Skimming the treetops after the four-hour flight, Doolittle led his group to Tokyo. Other groups headed for other cities. The bombers climbed to 1,500 feet, dropped 500-pound bombs on factories, oil tanks, and other industrial targets, then continued west.

Courtesy Tailhook Photo Service

★ Lt. Colonel James Doolittle and his Tokyo Raiders. Doolittle had made a name for himself by winning the Cleveland Air Races in 1932.

One plane made it to Vladivostok, where Russian authorities interned the crew—Russia was not formally at war with Japan—until their escape 13 months later. The other bombers came down in Japanese-occupied China. "I landed in a tree," recalled one airman, "stretched my 'chute between it and another tree, making a hammock, and proceeded to go to sleep." Three of the airmen were killed in crash landings or bailouts. Eight others were captured and, as one Japanese officer put it, "forced to tell the truth" about where they came from. Three were executed.

Physical damage was slight. Japanese called it the "do-nothing" affair. But the psychological effect was far-reaching. Admiral Yamamoto took it personally. "It's a disgrace that the skies over the Imperial capital should have been defiled," he wrote in a letter to a colleague. "One has the embarrassing feeling of having been caught napping."

"It hurt his pride," said Mitsuo Fuchida. "He loved the emperor and wanted to ensure his safety. He determined there must never be another Doolittle Raid on Tokyo again." With that determination, Yamamoto hurried through his plan to destroy the U.S. Fleet. The decisive battle would take place near an island named Midway.

CLASHES OF THE CARRIERS

The Coral Sea and Midway

In the spring of 1942, Japan's leaders faced a dilemma. Their conquest had progressed faster than expected; the problem was what to do next.

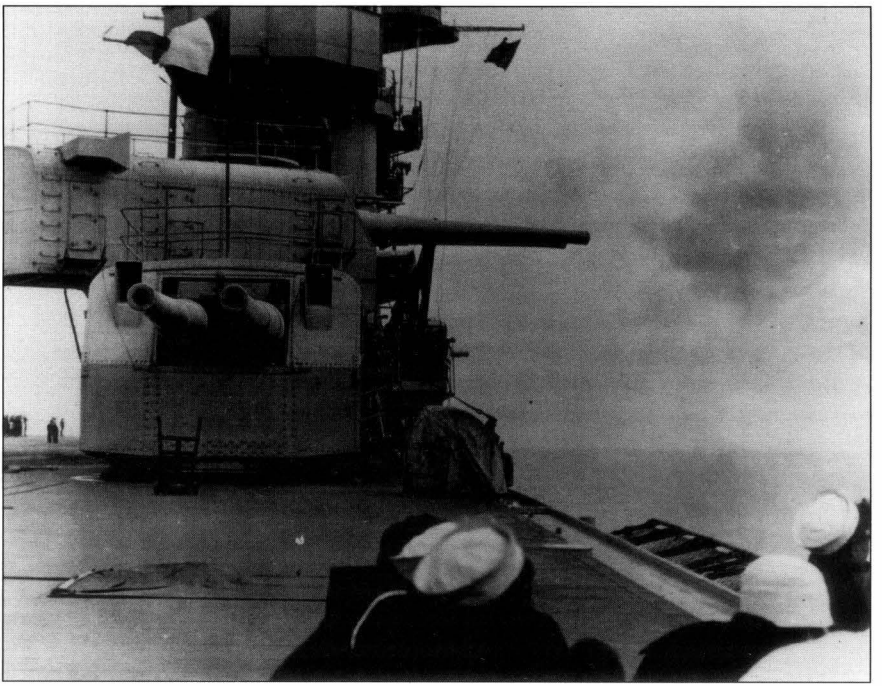
Some military leaders suggested that Japan strike the war-torn British Empire in India and the Middle East, then link up with German forces in Southern Russia and North Africa. Take Australia, counseled the Japanese Navy, this was the obvious starting point for an Allied counterattack.

The Army opposed both ideas. Japan's ground troops were already stretched thin. Either campaign would weaken them even more. In early March, a less grandiose plan was accepted. Japan would extend its empire southeast, cutting the sea lanes between Australia and America by seizing the islands of New Guinea, New Caledonia, Fiji and Samoa. The first step was the capture of Port Moresby, a key Allied base on the south coast of New Guinea, 400 miles from Australia.

For two months, Japan strengthened its bases in the area, especially Rabaul on the island of New Britain. By May 4, a formidable naval force had been amassed, and the 11 transports destined for Port Moresby headed south from Rabaul.

The move didn't surprise Admiral Chester Nimitz, commander of the U.S. Pacific Fleet. U.S. cryptoanalysts had broken the Japanese naval code and Nimitz already had sent two carriers—the *Lexington* and *Yorktown* —to the Coral Sea to stop the Japanese. The battle that followed would be epochal: the first naval engagement in which the opposing ships never fired a shot at each other.

Japan's campaign began with an invasion of the small island of Tulagi. The U.S. struck back quickly with planes



Courtesy National Air & Space Museum, Smithsonian Institution

★ When first constructed, the *Saratoga* and the *Lexington* carried 8-inch guns. Designed to protect the carriers from enemy warships, they proved to be useless in practice. In 1942, the *Saratoga* had them removed, though the *Lexington* still carried them right up to the Battle of the Coral Sea.

from the *Yorktown.* Overzealous pilots sent back exaggerated reports of the numbers of warships they'd sunk. In reality, little damage was done, but the Japanese now knew that U.S. carriers were nearby.

For three days carriers on both sides evaded detection, concealed by a wide band of clouds. But on the morning of May 7, an excited Japanese search pilot reported a U.S. carrier and cruiser. Dozens of bombers were launched from the carriers *Shokaku* and *Zuikaku,* only to find two small U.S. ships, the destroyer *Sims* and the oiler *Neosho.* Disappointed Japanese pilots flew off to find the main U.S. force. When that quest failed, they returned to bomb the two small ships. The *Sims* went down in less than a minute; the *Neosho* was left burning and helplessly adrift.

Thirty minutes later, 200 miles to the northeast, Lieutenant Commander W. L. Hamilton from the *Lexington* was

flying at 15,000 feet when he spotted "a number of thin white hairs on the blue sea." Following the wakes with his field glasses, he sighted the carrier *Shoho* with its escort of cruisers and destroyers, 30 miles away.

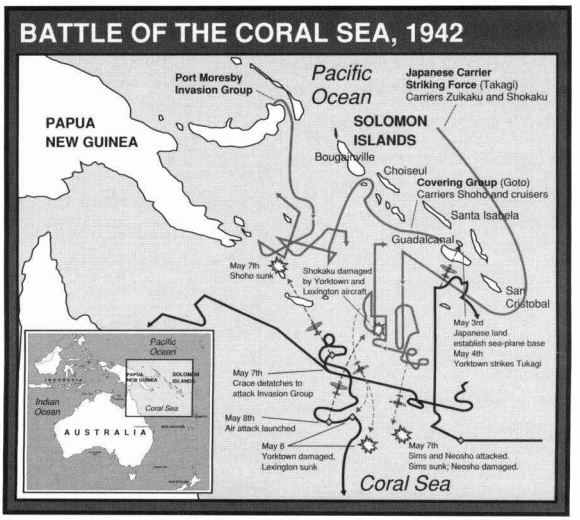
Courtesy National Air & Space Museum, Smithsonian Institution

★ In the ready room.

Air Group Commander William Ault led his bombers down first. Numerous bombs and torpedoes ripped into the small carrier. Flames seared the flight deck. Half an hour into the attack, the *Shoho's* power died, the water pumps failed, and fires spread out of control. The order was given: abandon ship. Four minutes later, nothing remained but an oily black stain on the emerald waters. For the first time in history, a Japanese carrier had been sunk.

Back on the U.S. carriers, sailors and air crews crowded around radios for news of the attack. Snatches of pilot conversations conveyed more transmission static than information until Lt. Commander Robert Dixon's voice suddenly burst through loud and clear. "Scratch one flattop." The men roared in triumph.

Rain clouds temporarily halted the hostilities, but planes from both fleets took off early the next morning in search of the enemy. By noon, both sides scored. Thirty-nine planes from the *Yorktown* descended on the



Japanese carriers *Shokaku* and *Zuikaku*. But the American pilots, making their first attack on a well-defended carrier, fared poorly. Dive-bombers waited for torpedo planes to get into position, which gave the *Shokaku* time to launch several Zeroes and allowed the *Zuikaku* to escape into a rain squall. U.S. torpedoes splashed wide of the mark or misfired, as was often the case early in the war. But three bombs seriously damaged the *Shokaku's* flight deck. Slowly, the stout carrier withdrew northward, out of the battle.

Courtesy National Air & Space Museum, Smithsonian Institution

★ A U.S. fighter's gun camera captures the final moments of this G4M Betty.

Japanese pilots had better luck. With only 15 American fighters on combat air patrol, the U.S. carriers had little protection. A 551-pound bomb slashed through four decks of the *Yorktown*, igniting fires, killing 66 men, and forcing the ship to limp back to Pearl Harbor for repairs.

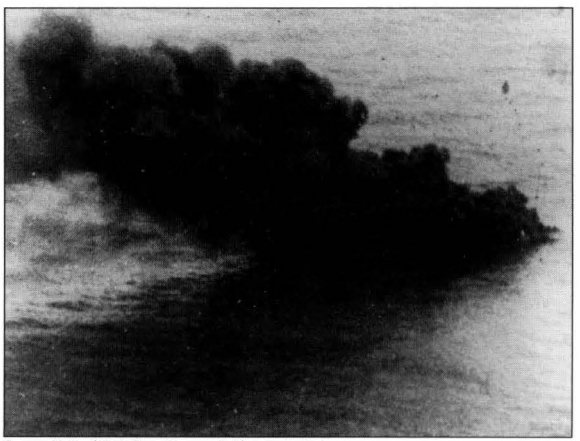
The *Lexington* was not so fortunate. Lieutenant Commander Shizekazu Shimazaki, leader of the second wave at Pearl Harbor, dove his squadron of Kate torpedo planes at the *Lexington*. There was a "wall of anti-aircraft fire," he recalled. "Burning and shattered planes of both sides plunged from the skies." But Shimazaki's squadron was not to be denied. Two small bombs hit the flattop's deck and smokestack. Two well-placed torpedoes tore into its port side. Fires spread, trapping sailors below deck. Water gushed into the boiler rooms and the ship began to list.

Within the hour crew members extinguished the fires and had the ship almost on an even keel. The damage seemed under control until an electric motor spark ignited aviation fuel vapors below deck. A tumultuous explosion wrenched

the 900-foot long carrier. The power went out as fires raced through the hull. The decision was made to scuttle her and four torpedoes from the destroyer *Phelps* sent the *"Lady Lex"* down. The first American flattop had been scratched.

The Battle of the Coral Sea was a tactical victory for the Japanese. They sunk one large carrier at the expense of one small one. But the Coral Sea was a strategic victory for the U.S. Japan forfeited two large carriers slated for the Midway operation. The *Shokaku* would take two months to repair, and the *Zuikaku* was missing too many planes and pilots to continue. The invasion of Port Moresby was postponed, as it turned out, forever.

The Japanese Navy began preparing another assault on Moresby, but Yamamoto disagreed. The Doolittle Raid convinced him of the need to eliminate U.S. carriers. His six months for victory were almost up. It was time to strike the big blow and destroy the U.S. Fleet at Midway.



Courtesy National Air & Space Museum, Smithsonian Institution

★ All that's left of the Betty is wreckage and a cloud of black smoke.

The tiny atoll of Midway was the most westerly of U.S. bases in the Central Pacific. Only 1,500 miles from Oahu, it was a perfect starting point for a conquest of Hawaii. If the base was threatened by Japan, Yamamoto reasoned, the U.S. Fleet would have to meet the challenge and could be lured into a hopeless battle with superior Japanese forces.

Yamamoto planned the mother of naval battles. Some 200 ships would participate, burning more oil in this mission than the entire peacetime navy used in a year. First, an invasion of the Aleutian Islands, 1,200 miles north of Midway. Next, planes from Admiral Nagumo's four carriers

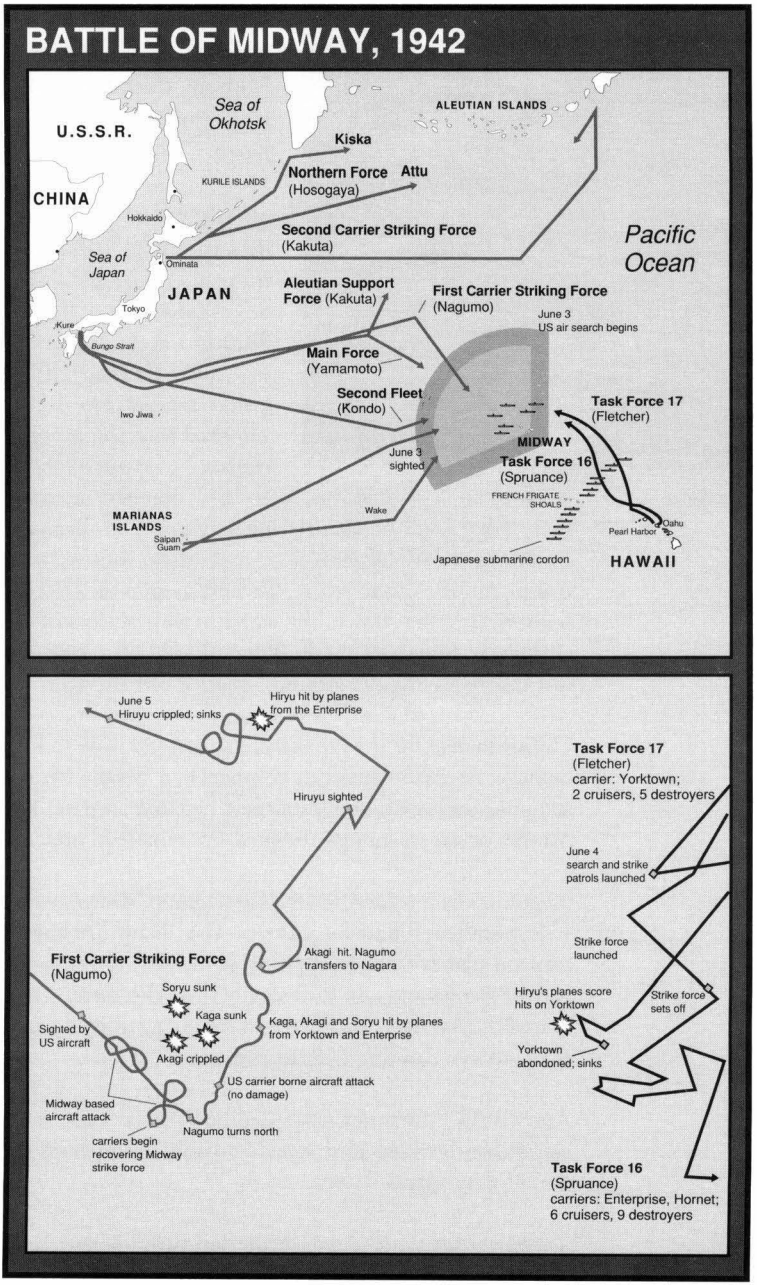
would strike Midway. Japanese marines would rush ashore and capture Midway's triangular airstrip. When the U.S. Fleet rushed out in defense, it would be crushed by the most powerful armada in history.

For more than five months, the Japanese Navy had triumphed. It had staged lightning strikes from Hawaii to Ceylon, losing no vessel larger than a destroyer. Smug with success, naval officers planned for Midway with a confidence that bordered on recklessness. They suffered, they would later admit, from "victory disease." At naval tabletop exercises held in May, the rules were bent to ensure victory, including the miraculous and unrealistic resurrection of sunken Japanese ships. Objections were swept aside.

"It's pointless and impossible," said a *Hiryu* officer. "But Yamamoto's set on it, so there's nothing more to say."

What Yamamoto still didn't know was that Admiral Nimitz was reading his thoughts. For weeks, U.S. Intelligence had known the Japanese were planning something big. Only the target, whose code letters were "AF," was unclear. Following a hunch, the Navy had Midway broadcast a fake message, complaining about the breakdown of its distillation plant. The Japanese bit the bait. Two days later, U.S. Intelligence picked up a message that "AF" had a water shortage.

Nimitz rapidly mustered his vastly outnumbered forces. The carriers *Enterprise* and *Hornet* sailed out of Pearl Harbor. The *Yorktown*, back from the Coral Sea for an estimated three months of repairs, was patched together in 48 hours. Miles of barbed wire were strung on Midway. Additional anti-aircraft guns were installed. Demolition charges were set in case of Japanese capture, until one of them accidentally set off a gasoline dump. "They were fool-proof," said one Marine, "but not sailor-proof."
On June 3, Japanese planes attacked Dutch Harbor in the Aleutians. Torpedo bombers, dive bombers and Zeroes from the carriers *Ryujo* and *Junyo* raided the island, shooting up an army barracks, radio station, and gas tank complex.


BATTLE OF MIDWAY, 1942
U.S.S.R.
Sea of Okhotsk
ALEUTIAN ISLANDS
Kiska
Northern Force
(Hosogaya)
Attu
KURILE ISLANDS
CHINA
Hokkaido
Second Carrier Striking Force
(Kakuta)
Pacific Ocean
Sea of Japan
Ominata
JAPAN
Aleutian Support Force (Kakuta)
First Carrier Striking Force
(Nagumo)
Tokyo
June 3
US air search begins
Kure
Bungo Strait
Main Force
(Yamamoto)
Second Fleet
(Kondo)
Iwo Jiwa
Task Force 17
(Fletcher)
MIDWAY
June 3
sighted
Task Force 16
(Spruance)
FRENCH FRIGATE SHOALS
Wake
MARIANAS ISLANDS
Saipan
Guam
Oahu
Pearl Harbor
Japanese submarine cordon
HAWAII
June 5
Hiryu crippled; sinks
Hiryu hit by planes from the Enterprise
Hiryu sighted
Task Force 17
(Fletcher)
carrier: Yorktown;
2 cruisers, 5 destroyers
June 4
search and strike patrols launched
Strike force launched
First Carrier Striking Force
(Nagumo)
Akagi hit. Nagumo transfers to Nagara
Soryu sunk
Kaga sunk
Hiryu's planes score hits on Yorktown
Strike force sets off
Sighted by US aircraft
Kaga, Akagi and Soryu hit by planes from Yorktown and Enterprise
Akagi crippled
Yorktown abondoned; sinks
US carrier borne aircraft attack (no damage)
Midway based aircraft attack
Nagumo turns north
carriers begin recovering Midway strike force
Task Force 16
(Spruance)
carriers: Enterprise, Hornet;
6 cruisers, 9 destroyers

Courtesy National Air & Space Museum, Smithsonian Institution

★ Jimmy Thach & Butch O'Hare.

Although only a minor incident in the Battle of Midway, the raid had dire long term consequences for Japan.

Shortly before sunrise the next morning, 108 planes from the *Akagi* and *Hiryu* set off for Midway. It was a beautiful sight, observers said, as the flashing red and green navigation lights vanished into the moonlit night. Approaching Midway in V-formations, high-level bombers dropped their lethal loads on the Marine defenses. U.S. Brewster Buffaloes and Wildcats rose to meet them, but were no match for the Zero escort. Seventeen out of 25 U.S. fighters were shot down, the worst Marine air loss of the entire war. "Pilots of the Buffaloes should be considered lost before leaving the ground," snarled one survivor.

Unfortunately for the Japanese, the raid did little serious damage. As most American bombers had already left the ground, strafing runs on the airfield had little impact. The Marine defenses, though roughed-up, remained intact.

Nagumo was considering a second strike on Midway when U.S. bombers found his carriers. U.S. Navy "Avenger" torpedo planes from Midway were the first to brave the fury of Zeroes and anti-aircraft fire from the *Akagi.* Only one of the Avengers survived and the *Akagi* easily dodged the few slow-running U.S. torpedoes.

Army B-26 "Marauder" twin-engine bombers came next, skimming the waves and weaving madly to throw off the aim of the dogged Zeroes.

Technical Sergeant Gogoj in the top turret of one B-26 watched his Plexiglas cover burst into his eyes. Flying

shards fragged his face at 300 mph. He fell to the floor, slammed back and forth by the evasive maneuvers of his pilot. Screaming at the Zeroes, he struggled back up and pressed his bloody hands back around his guns' triggers. A cannon shell exploded almost in his face. His guns went dead. Still he held on, trying to bluff the Zeroes away. A machine gun bullet ricocheted into his forehead like a hot poker and knocked him down again. Again he forced himself back up to the gun, where he remained for the rest of the attack.

Incredibly, Gogoj was one of the lucky ones. He was a survivor. Of the four waves of Midway-based planes that struck the Japanese fleet in quick succession, more than half went down. Thirty-three U.S. planes and crews were lost and not one Japanese ship was hit. Nonetheless, the Japanese net had begun to unravel.

The assaults by Midway's bombers convinced Nagumo of the need for a second strike on the island. However, that meant the planes on his carriers' decks,

Matchstick Maneuvers

Marine Lt. Cdr J.S. "Jimmy" Thach heard about the Zero's unparalleled maneuverability and climbing rate long before he experienced it. As a fighter pilot based in San Diego, Thach spent his evenings playing with matchsticks on his dining-room table, experimenting with formations that could overcome the Zero's superiority. The following day, he would try them in the air in mock fights with his squadron. Finally, he developed something he thought would work. He called it the "Beam Defense Position," but everyone else called it the "Thach Weave."

Thach's idea was to use two pairs of planes, flying a couple hundred yards apart. A plane under attack in one pair would need only turn toward the other pair. "The quick turn toward each other does two things to the enemy pilot," said Thach. "It throws off his aim, and because he usually tries to follow his target, leads him around into a position to be shot by the other part of our team."

The first test of the new formation came in the Battle of Midway, when Thach was escorting several TBDs from the Yorktown *on a mission to torpedo the Japanese fleet. The mission ran headlong into a swarm of Zeroes that far outnumbered Thach's four Wildcats. One by one the Japanese pilots roared past, guns firing, then turned around to do it again. One of the Wildcats went down. Then a Zero dove in on Thach's wingman, Ensign R.A.M. Dibb. Dibb turned toward Thach, and, just like the tabletop matchstick exercise, the Zero followed. Thach swung underneath his teammate, lined up for a head-on attack from below, and raked his bullets up the Zero's belly until its engine ignited. The Thach Weave had claimed its first victim. Before long, almost every fighter squadron in the Navy had adopted the position, and Army Air Force pilots followed suit. Its value was such that it outlasted the Zero—even pilots in Vietnam used the Thach Weave.*

The Zero

In the opening shots of the Battle of Midway, Japanese planes easily destroyed U.S. facilities at Dutch Harbor in the Aleutians. In the long-term however, the raid did more damage to Japan than to the U.S.

A lone Zero, damaged in an attack on a PBY, crash-landed on a small island. A Japanese submarine sent to retrieve the plane couldn't find it, but 5 weeks later, U.S. planes spotted it. Nearly intact, the fighter was brought stateside. Engineers were able to study its weaknesses and develop tactics to exploit it in combat. These tactics quickly paid off, causing the Zero to become hopelessly outclassed.

The ability of the U.S. to quickly overcome the Zero's advantage was, said one Japanese officer, one of the decisive factors in Japan's eventual defeat.

armed with torpedoes, had to be lowered to hangars, rearmed with bombs for a land attack, and raised again, a process that took about an hour. The task was half done when Nagumo received untimely news: a Japanese search plane had spotted U.S. ships nearby.

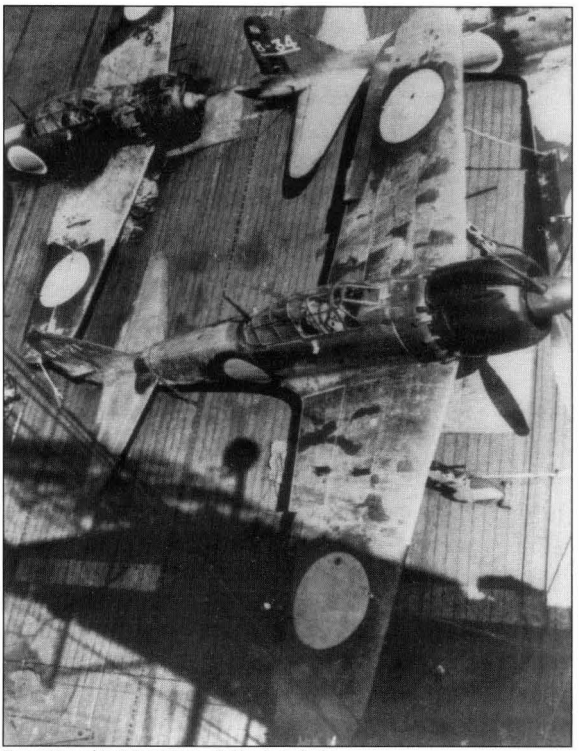
The admiral was faced with an agonizing dilemma. If he didn't order an immediate strike, he risked being caught by American bombs while his flight decks were jammed. But the first Midway strike planes would soon be returning, without enough fuel to circle while the planes launched from the carrier. If Nagumo ordered an immediate strike, some 200 experienced pilots would have to ditch in the sea. The strike would have to wait.

Elevator warning bells clanged as the aircraft were lowered to clear the decks. "Here we go again," cried the *Akagi's* flight officer. "This is getting to be like a quick-change contest." Crews hurried to replace the planes' bombs with torpedoes. There wasn't time to stow the off-loaded bombs safely in the magazines, so they were stacked in the hangars, many still fused.

In 30 minutes, all the returning planes had landed. Refueling hoses snaked across the deck and trolleys of explosives were wheeled out to rearm the planes. The carriers turned into the wind in preparation for launch. In 15 minutes, the planes would all be in the air again.

But the opposition had other plans. Lt. Commander John Waldron of VT-8 from the *Hornet* followed his hunches and led his planes to Nagumo's fleet. From a distance of eight miles, he spotted the four carriers arranged in a square. Flying at 1,500 feet, Waldron led his 15 TBD torpedo bombers into battle. Zeroes ripped into the bombers like wolves on deer. One by one the TBDs—"flying freight cars," the airmen called them—caught fire and fell.
Only one U.S. pilot, Ensign George Gay, survived the raid, crashing into the sea and clinging to his seat cushion in the cool water. He watched as VT-6, a squadron of 14 unescorted torpedo planes from the *Enterprise*, made their

run. This time, four of the planes made it past the Zeroes and anti-aircraft guns, dropping torpedoes that the carriers deftly avoided. Moments later, the 12 torpedo bombers of VT-3 from the *Yorktown* arrived. Their luck was little better. Five torpedoes were released. None found their marks.



Courtesy National Air & Space Museum, Smithsonian Institution

★ Captured A6M5 Zeroes on board an American escort carrier bound for the United States. Dozens of captured Japanese planes were flight tested and evaluated in the U.S. during the war.

Three successive attacks had cost the U.S. 41 planes and the lives of 80 airmen. The Japanese ships had not been touched. But the sacrifice was not in vain. The Zeroes were still low, guarding against torpedo planes, when U.S. dive bombers approached from high. Seventeen Douglas Dauntlesses from the *Yorktown*, led by Lt. Commander Maxwell Leslie, descended from 20,000 feet through an opening in the clouds. Almost simultaneously, Lt. Wade McClusky also arrived, leading a squadron of 36 Dauntlesses from the *Enterprise.*

The Zeroes couldn't climb quickly enough to stop the Dauntlesses. The American pilots dove sharply at the carriers, aiming for the big rising suns painted on the flight decks. The first bombing attempts missed their marks. Then, four struck the *Kaga* in quick succession. One exploded in the midst of planes readied for takeoff. Another bomb struck a small gasoline truck, propelling burning debris that killed everyone on the bridge. The *Kaga* suddenly was engulfed in flames.

Three hits ignited the *Soryu's* ammunition rooms and gas tanks. Flames burst from the deck and black smoke billowed skyward. The hangar deck was turned into an impromptu hospital where doctors treated those who might survive. Captain Ryusaku Yanagimoto ordered his men to abandon ship, but personally refused to leave. The last man off the ship saw him holding a sword, singing the Japanese national anthem.

At least three bombs hit planes waiting to take off from the *Akagi.* Fires spread from the planes to the bombs carelessly stacked on deck. "There was a blinding flash," recalled a Japanese airman. "Then a second explosion, and a weird blast of warm air...I was horrified by the destruction wrought in a matter of seconds. There was a huge hole in the flight deck, the elevator was twisted like molten glass, and planes stood tail up belching livid flames and jet-black smoke."

In 10 minutes, 53 U.S. planes had turned the tide of the Pacific war, leaving three Japanese carriers dead in the water. Only the *Hiryu* remained. The *Hiryu's* skipper, Rear Admiral Tamon Yamaguchi, a Princeton-educated officer who was often mentioned as an heir to Yamamoto, launched an immediate counterstrike. Within an hour his planes were over the *Yorktown.*

U.S. Navy Wildcats met the Japanese formation while it was15 miles away from the carrier. In the ensuing dogfight, over half the Japanese bombers were shot down; but the remainder reached their target. The *Yorktown's* gunners opened fire, blowing apart the first bomber. Its three sections fell into the water, but its bomb hit the ship, punched a hole in the flight deck, and exploded below. Two more bombs hit the flattop. One with a delayed action fuse exploded in the stack, rupturing uptakes from three boilers. The *Yorktown* ground to a halt.

The fast-working crew had the *Yorktown* moving again in less than an hour. Its survival looked likely when a second *Hiryu* strike came. Six Zeroes busied the *Yorktown's* fighters, while ten Nakajima torpedo planes slipped in to make

their runs. Two torpedoes opened the hull. The carrier began to list and Captain Elliott Buckmaster gave the order to abandon ship. Two days later, the carrier was sunk by a Japanese submarine.

While the *Yorktown* was being attacked, the *Hiryu* itself was pounced on by dive bombers from the *Enterprise.* Approaching out of the setting sun, the American planes pounded the *Hiryu* with four quick bomb hits. Admiral Yagamuchi went down with his ship, despite the pleas of his fellow officers. He obeyed the traditional values that would inadvertently contribute to the U.S. war effort by sacrificing the best and the brightest of Japanese officers to a code of honor.

The worst naval defeat in Japanese history was over. In one day, almost half of the Japanese Navy's carriers had been destroyed. Lost with them were 332 planes and 2,155 men, including many of Japan's prized pilots. Never again would Yamamoto have the naval strength to engage the enemy far from home. Never again would Japan move so aggressively.

"Pearl Harbor has now been partially avenged," wrote Nimitz in his communique on the battle. "Vengeance will not be complete until Japanese sea power is reduced to impotence. Perhaps we will be forgiven if we claim that we are about midway to that objective."

Courtesy National Air & Space Museum, Smithsonian Institution

★ Rear gunner on a SBD Dauntless.

STEPPING UP THE SOUTH PACIFIC

With the Japanese turned back in the Central Pacific, Allied leaders decided it was time to stop them in the south. General MacArthur suggested a swift invasion of Rabaul, the key to Japanese strength in the South Pacific. But U.S. Navy leaders overruled him, wary of losing their precious remaining carriers, and pushed through their own plan. They would advance gradually toward Rabaul, starting at the southeastern finger of the Japanese Empire: an island named Guadalcanal.

In the summer of 1942, the Japanese began building an airstrip on Guadalcanal and the island became strategically important. A Japanese airbase there would close much of the Coral Sea to Allied shipping and could support an invasion of the islands still in Allied hands: the New Hebrides, New Caledonia and Samoa. If those islands fell, main shipping routes from the U.S. to Australia would be exposed to Japanese bombers. Guadalcanal had to be seized quickly, U.S. leaders decided, before the Japanese could finish the airstrip and bring in their planes.

The invasion began on the morning of August 7, 1942. U.S. cruisers and destroyers shelled the island, followed by fighters and dive-bombers from nearby carriers. U.S. Marines clambered down wide rope nets into landing craft and onto the beaches of Guadalcanal.

The Japanese were taken by surprise. The first Marines to reach the airstrip found rice breakfasts still warm on the tables. But retaliation was soon to come. The Japanese launched an immediate air strike from Rabaul, 600 miles away, to bomb the U.S. transports. The Rabaul pilots were among the world's best, including among them Saburo Sakai, who had 60 kills, and Hiroshi Nishizawa, destined to become one of Japan's greatest aces. But their first attack on Guadalcanal was in vain. In their haste to launch the

planes, the Japanese neglected to rearm the twin-engine Betty. They were stocked with bombs for a raid on a New Guinea airfield, instead of the torpedoes that were so deadly against ships. As a result, the Betty pilots dropped their loads from high, only to watch them splash in the water around the dodging U.S. ships. By dusk, 11,000 Marines had landed on Guadalcanal.

In Rabaul, Vice Admiral Gunichi Mikawa assembled a force of cruisers and destroyers to blast the invaders off the island. Under cover of darkness, the ships slipped down the narrow passage through the Solomons that Americans would later name "The Slot." U.S. ships detected them, but thought they were friendly vessels. In the pre-dawn hours of August 9, Mikawa found himself near the small island of Savo in the middle of an unsuspecting Allied force. The Allies didn't learn of his hostile presence until two torpedoes plowed into the Australian cruiser *Canberra.* Mikawa pressed his attack, picking his choice of targets, until he was surrounded by flaming wreckage. By the time the sun rose, four Allied cruisers and more than a thousand men had perished in the waters of what would be known as Ironbottom Sound.

Courtesy National Air & Space Museum, Smithsonian Institution

★ Hiroshi Nishizawa, one of the top Japanese pilots of the war. He died when his transport was shot down in the Philippines in 1944.

But Mikawa didn't press his advantage. Instead of moving in to sink the transports, he pulled back, fearing daybreak retaliation from U.S. carrier planes. His boldness had ravaged the Allied naval force, but Guadalcanal was still in American hands. U.S. engineers labored to complete the airstrip on the island. In two weeks

it was ready and the Americans christened it Henderson Field, in honor of Major Lofton Henderson, a Marine pilot killed at Midway. The first planes arrived—Wildcats and SBD dive-bombers from a nearby carrier—and the Cactus Air Force, named after the U.S. Navy's code word for Guadalcanal, was in business.

At first, Japanese leaders thought it would be easy to recapture Guadalcanal. Their soldiers, after all, had yet to be stopped anywhere by Allied troops. Not realizing the number of U.S. Marines already on the island, the Japanese assembled 6,000 men to retake the airfield. Just before midnight on August 18, the first contingent, 915 men under Colonel Kiyono Ichiki, slipped ashore 20 miles from Henderson Field. Ichiki ordered them to wait for the next contingent; but when he met no military resistance, he led his men confidently along the coast until only the Ilu River separated them from the airstrip. In the dark morning hours of August 21, Ichiki gathered his troops in a coconut grove and gave the order to attack. The soldiers burst out of the grove with fixed bayonets and grenades, shooting from the hip and crying "Banzai!" A barrage of rifle and machine gun fire met them. Charge after charge of Japanese troops came screaming out of the trees and across the river, only to be cut down by U.S. Marines. "It was like flies attacking a tortoise" one Japanese officer observed.

By dawn, Ichiki's force was reduced to a few hundred men scrambling for shelter among the palms. By afternoon, they were surrounded, but would not surrender. Wounded men cried out, and Americans who went to help were shot by snipers. Major General Alexander Vandegrift, commander of the U.S. Marines, sent in five light tanks. The machines rolled into the grove, knocking down trees and running over cornered Japanese. At dusk, Ichiki knelt in the sand and committed hari-kiri. A few survivors escaped along the coast, leaving a battleground littered with the mortal remains of more than 800 men. Only 35 of them were Americans.

The assault had failed, but the Japanese weren't prepared to surrender Guadalcanal. Yamamoto assembled a force of more than 60 ships: transports full of troops, warships to protect them, and aircraft carriers to lure the U.S. Navy into a trap. The bait was the light carrier *Ryujo*. Yamamoto knew that the Americans had carriers covering their Guadalcanal resupply operation. If they could be tricked into launching strikes against the *Ryujo*, Japanese planes from the *Zuikaku* and *Shokaku* could counterattack and catch the U.S. carriers with few fighters around to protect them.

The Battle of the Eastern Solomons began on the afternoon of August 24, when the *Ryujo* launched an air strike against Henderson Field. The attack was ineffectual, as the Cactus Air Force kept Japanese pilots off balance and brought down six planes.

Still, the effort convinced Admiral Frank Fletcher, in charge of the *Saratoga* and *Enterprise*, to strike back. He launched several waves of planes at the *Ryujo*. Dauntless dive-bombers reached it first, dropping bombs that shattered the carrier's decks. After being hit by at least three bombs and one torpedo, the *Ryujo* came to a halt.

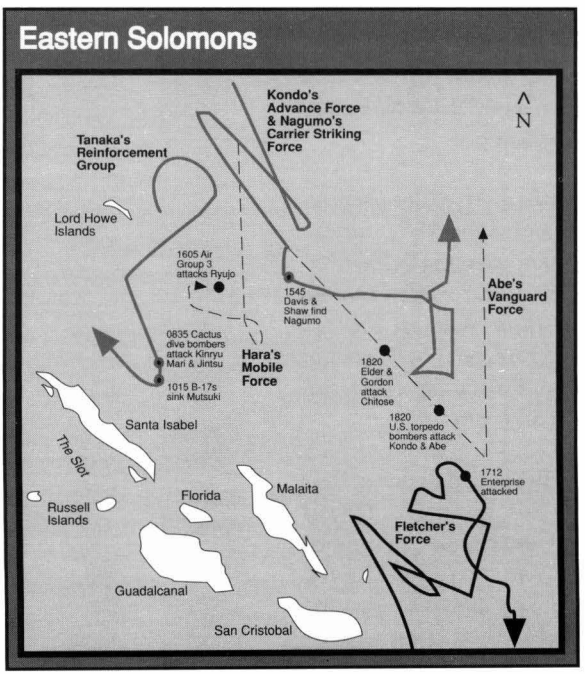
The *Ryujo* was doomed, but it had served its purpose. Japanese planes were able to locate the U.S. carriers. Screaming down from towering cumulus clouds, Val dive-bombers attacked the *Enterprise* with clockwork precision, one every seven seconds. Fifty-three Wildcats downed many of the Vals. Ensign Donald Runyon shot down four planes by himself; but three bombs hit the *Enterprise*, forcing it home for two months of repairs.

When the big ships of both sides began withdrawing, Rear Admiral Raizo Tanaka raced his transports toward Guadalcanal. But dive-bombers from Henderson stopped him, sinking a Japanese cruiser and transport. Minutes later, B-17s from the Allied-held New Hebrides appeared and sank a destroyer picking up survivors. The transports retreated.

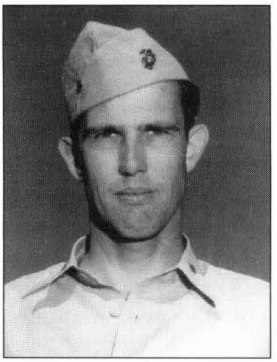
Although Yamamoto had succeeded in knocking the *Enterprise* out of action, the Battle of the Eastern Solomons was not a Japanese victory. Japan failed to land more troops on Guadalcanal, lost one small carrier, and sacrificed 70 planes with experienced, irreplaceable crews.

The Japanese switched tactics. They sent two contingents of troops to retake Henderson Field. One went by Ant Freight—barges that moved at night and hid along coastlines by day—and the other by Rat Express—destroyers that ran down The Slot at night. The plan was for the two contingents to land on either side of Henderson, head inland, and come up behind the airfield for a joint attack that would be coordinated with shelling from Japanese artillery and warships.

Things didn't go according to plan. The Ant Freight was plagued by stormy weather and aerial attacks on the journey down The Slot. It didn't reach Guadalcanal until more than half the 1,100 men had died, and the survivors arrived too late for the battle. The other contingent, 2,400 men under General Kiyotake Kawaguchi, hacked through the jungle and reached Henderson Field on the night of September 12, but it couldn't drive the U.S. Marines from a ridge overlooking the airstrip. Once again, Japanese leaders had fatally underestimated the U.S. presence on Guadalcanal. By dawn, 600 Japanese and 40 American bodies littered the slopes of what U.S. Marines later called Bloody Ridge.



America still held Henderson Field, and the Cactus Air Force grew steadily larger as new planes arrived. By mid-October, it had enough planes to stop the daily Japanese air raids. The U.S. seemed to be winning the struggle for Guadalcanal, so Yamamoto sent in the big guns—the battleships *Kongo* and *Haruna.*



Courtesy National Air & Space Museum, Smithsonian Institution

★ A native Oregonian, Marion Carl became one of the Marine Corps's highest-ranking aces. After the war, he served as a test pilot and eventually rose to the rank of Brigadier General.

The men of the Cactus Air Force were accustomed to hardship. The aviators, including such aces as Joe Foss and Marion Carl, lived in soggy tents in a strip of coconut grove they called Mosquito Gulch. The cuisine was Spam, dehydrated potatoes and captured rice. Most of the airmen contracted one or more tropical diseases. Torrential rains turned the airstrip into a mudhole, tropical sun turned it into choking dust, and Japanese bombers appeared with such regularity that midday became known as "Tojo Time."

But the American airmen had never experienced anything like the message delivered by the Japanese battleships in the early morning of October 14. For 90 minutes the 14-inch guns of the battleships pounded Henderson Field. Most of the aviation fuel went up in flames, and the Cactus Air Force was reduced to a handful of planes. Worse yet, the shell-shocked Marines soon learned, that another Japanese convoy was steaming toward Guadalcanal.

The Marines patched up 11 planes and drained the fuel out of a destroyed B-17 to fill their tanks. Brigadier General Roy Geiger had his own personal aircraft, a lumbering PBY fitted with torpedoes. The patchwork air force caught the Japanese convoy by surprise. Many of the Japanese supplies were blown to pieces, leaving little food for the Japanese soldiers who had made the landing.

Japanese ships and planes continued their almost daily bombardments of Henderson. Nightly reinforcement runs down The Slot, dubbed the "Tokyo Express" by the U.S. press, slowly delivered supplies and reinforcements to the Japanese garrison. By the night of October 23, they were

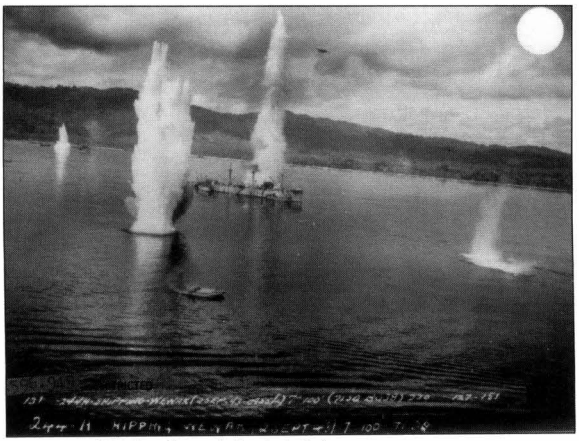
ready for another ground assault on Henderson. It was to be a coordinated three-pronged attack on the airfield, with a naval force delivering reinforcements.

Once again, the plans went awry. One of the contingents couldn't hack its way through the jungle on time, and another contingent launched its attack a day early. In two days, more than 3,000 Japanese were killed, and the survivors were forced to retreat back through the jungle.

This land battle precipitated the last sea-going carrier battle of 1942. The Battle of Santa Cruz, as it was known, was a tactical victory for Japan. Wave after wave of Japanese planes attacked the *Hornet* with its fighter protection flying too low to stop them. The carrier was pounded until it was no longer salvageable. The *Enterprise*, just returned to action, was hit by two bombs, and sprang an oil leak. In the space of a few hours, U.S. carrier strength in the South Pacific was temporarily eliminated.

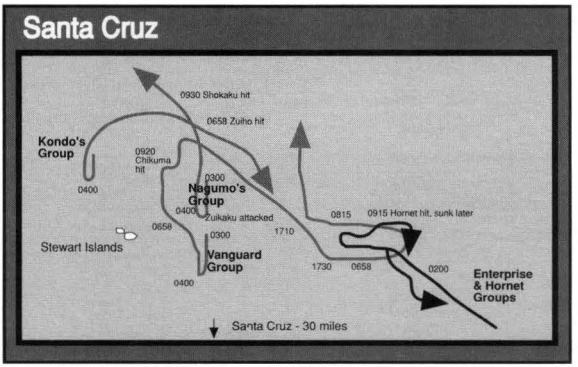
But the Japanese couldn't exploit the advantage. The 15,000 Japanese troops on Guadalcanal hadn't received supplies, and the Japanese carriers had lost so many planes in the battle they were forced to withdraw north. The U.S. took advantage of the lull to reinforce Guadalcanal and the Cactus Air Force. By the time the Japanese could mount another major resupply operation, the Americans were able to stop them in a three-day series of clashes known collectively as the Naval Battle of Guadalcanal.

★ Bombing at Wewak.



Courtesy National Air & Space Museum, Smithsonian Institution

The curtain rose on this battle when Yamamoto sent a force of cruisers, destroyers and two battleships—the *Hiei* and *Kirishima*—to



pulverize Henderson Field in preparation for a landing by 11 transport and cargo ships. On the night of November 12, 1942 they encountered a U.S. naval force that had been sent to stop them at all costs. The U.S. force took a beating, losing several cruisers and destroyers, but accomplished its mission. The Japanese were unable to shell Henderson, and the *Hiei* was damaged by U.S. ships. By nightfall, the *Hiei* had become the first Japanese battleship sunk in the Pacific War.

The next night, the *Kirishima* met a similar fate. It was greeted by two U.S. battleships, the *South Dakota* and the *Washington*, as it steamed south toward Henderson. The *South Dakota* suffered a power failure and was battered like a defenseless animal, but the *Washington* hit the *Kirishima* with several well-placed salvos. The *Kirishima's* pagoda-like superstructure crumbled, the rudder jammed, and fires raged out of control. In the early morning, the captain ordered it scuttled.

Persistently, the Japanese tried to land their troops. Rear Admiral Raizo Tanaka ordered the transports run aground, but the Cactus Air Force bombed them with fragmentation devices the Marines called "Molotov breadbaskets." The transports and their tons of supplies went up in flames. When the smoke cleared, Yamamoto was convinced that Guadalcanal was not worth the price. The long struggle had claimed dozens of Japanese ships, hundreds of planes, and most of the nation's best aviators. Japanese troops on the island were living on moss, roots, termites and betel nuts. By the end of the year, Japan's leaders threw in the towel. In early February, the last soldiers were evacuated from what they called "Starvation Island."

It had taken six months, but Guadalcanal was securely in U.S. hands. Henderson Field would be a base from which to strike Japanese bases in the Solomons, as the U.S. Navy pushed north toward the great base of Rabaul. At the same time, the Army was approaching Rabaul from the southeast, as MacArthur tried to squeeze the Japanese back and fulfill his promise of returning to the Philippines.

MacArthur's first obstacle was the island of New Guinea. The world's second largest island, New Guinea was the key to the northern defense of Australia. By mid-1942, the Japanese controlled most of the island. The only section still in Allied hands was the southeast corner, protected by the base at Port Moresby.

Japan's first attempt to capture Port Moresby by sailing around the eastern tip of New Guinea was turned back at the Battle of Coral Sea (See Chapter 4). The second attempt came in July when Japanese troops advanced over the steep, wet and forbidding Owen Stanley Mountains. Australian troops met them in the mud and blood of the Kokoda Trail, but were pushed back. By September, the Japanese had advanced

Battle of the Bismarck Sea

In late February 1943, the Japanese decided to reinforce their garrison at Lae. The Americans were just as determined to stop them.

On the first afternoon of March, a B-24 reported 14 enemy ships in the Bismarck Sea. The next day, B-17s attacked. Dropping bombs in close patterns, the Fortresses left several ships on fire. But the convoy plowed on.

As the ships neared the New Guinea coast on March 3, Allied planes roared down, strafing the antiaircraft gunners. B-17s came next, raining bombs from medium altitude. Then a dozen B-25 bombers broke out of some low clouds.

B-25s raked the decks with bullets from the multiple machine guns fitted in their noses. Others came in just above sea level and sent their bombs skipping across the water into the ships. Within a few minutes, all eight destroyers and seven transports had been damaged.

The convoy was crippled, but it was close to shore, and Japanese survivors crowded into lifeboats. Knowing that the Japanese who made it ashore would fight to the death, Allied commanders asked for volunteer airmen. The airmen flew in low, strafing the men in the water. The sea turned red.

At a cost of 13 airmen killed and 12 wounded, the Fifth Air Force sunk all seven transports and four destroyers. Few, if any, of the troops made it to shore. It was a key Allied victory, ending Japan's last major effort to send reinforcements to New Guinea.

to within 30 miles of Port Moresby. The fate of New Guinea was in doubt until planes of the U.S. Fifth Air Force (formerly the U.S. Far East Air Force) interdicted Japanese supply lines. Isolated in the malaria-infested jungles without food and medicine, the Japanese had to retreat.

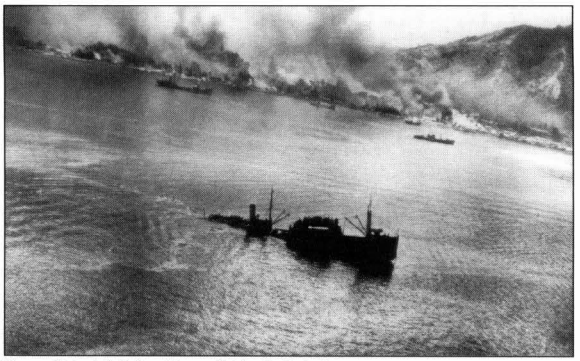
The Australians followed the Japanese over the Owen Stanley Mountains until the ragged defenders were cornered at Buna. By January 1943, in a horrific, costly battle, the Allies anihilated the Japanese within the Buna perimeter. Although the Japanese were finally cleared out in late January, the fighting was so brutal and the Allied losses so high that MacArthur decided to switch tactics. From now on, he would "hit 'em where they ain't," capturing their weak positions and leaving the strong ones to wither in isolation.

Courtesy National Air & Space Museum, Smithsonian Institution

★ The end of a Japanese Merchantman in Simpson Harbor, Rabaul.

MacArthur planned to move up the New Guinea coast toward the Japanese bases at Lae and Salamaua, then up to Hollandia, Biak and Morotai. Though the Japanese reinforced their garrisons, they could not stop the Allied advance. In March 1943, a supply convoy destined for Lae was destroyed by Allied planes, marking the end of Japan's major resupply efforts in New Guinea.

By the spring of 1943, Japan was facing the possible loss of both the Solomons and New Guinea, as the Allies were pressuring Rabaul like a nutcracker. MacArthur was using airpower to drive the Japanese from New Guinea. Regular "barge-hunting" patrols flew over the ocean, sinking scores of motorized launches the Japanese were using to ferry troops into New Guinea. On August 17, 1943, a massive



Courtesy National Air & Space Museum, Smithsonian Institution

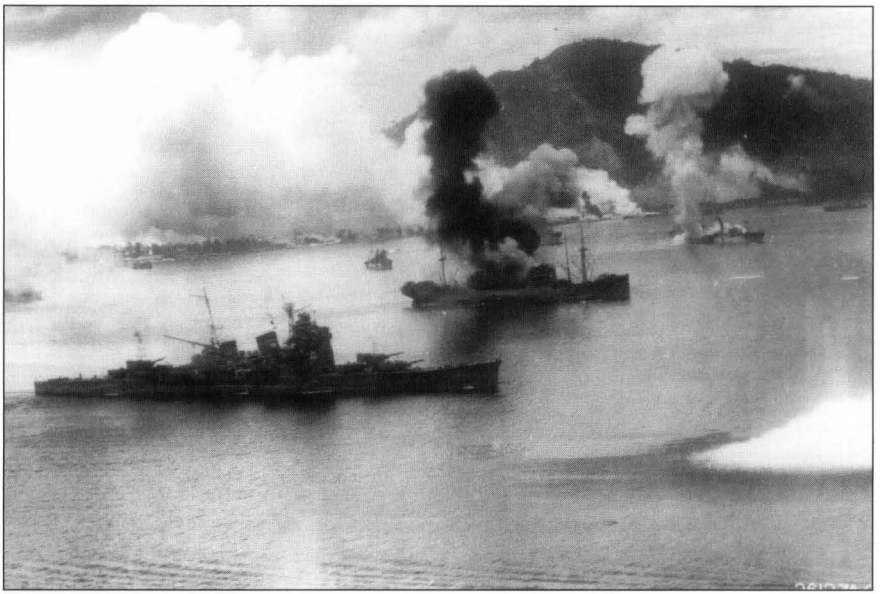
★ Skip bombing at Rabaul.

surprise raid by the Fifth Air Force destroyed 200 planes on the ground at Wewak airbase on the north coast. Two weeks later, 1,700 paratroopers descended on a Japanese airstrip at Nadzab, 15 miles upriver from Lae. More parachute drops followed and, by the end of September, Allied troops controlled the Papuan Peninsula at the eastern tip of New Guinea. The way was cleared for an advance on the Philippines.

While MacArthur isolated Rabaul from the southwest, the U.S. Navy slowly advanced from the east in a series of amphibious landings, step-by-step up the Solomons. The first landing in June, on the island of New Georgia, proved harder than most had expected. The Japanese had excavated gun emplacements five feet into the coral and covered them with logs and earth. Hand-to-hand combat dragged on for weeks. It took almost 50,000 U.S. soldiers to crush the estimated 9,000 Japanese on the island. By the time the Japanese were removed from New Georgia on August 1, 136 U.S. soldiers had been killed.

The heavy casualties convinced Admiral Halsey of the wisdom of bypassing enemy strong points, choosing instead to "starve them" in isolation. A key to this strategy was airpower. U.S. pilots flew thousands of sorties against targets in the Solomons: jungle airstrips, barges creeping along coastlines, infantry in caves, and the most feared of targets, Kahili Airdrome.

Marines moved up the Solomon ladder in Fall 1943 until only Bougainville stood between them and Rabaul. Halsey decided that Bougainville was needed to provide Allied airbases within range of Rabaul. So, on November 1, the Marines invaded the island. To avoid the bloody attrition



Courtesy National Air & Space Museum, Smithsonian Institution

★ A Japanese heavy cruiser under attack in Simpson Harbor, Rabaul. By the end of 1943, incessant Allied attacks had forced the Japanese to abandon Rabaul as a major naval base. Its warships withdrew to Truk, never to venture south again.

of previous campaigns, they landed on a lightly defended beach and built several airfields. The Japanese, caught by surprise, hastily began massing a naval force in Rabaul to drive out the invaders. When Admiral Halsey learned of this force, he sent two carriers, the *Saratoga* and *Independence*, to destroy it.

Ninety-six U.S. planes from those two carriers descended on Rabaul on the morning of November 5. The sky was pockmarked with brown explosions as anti-aircraft guns in the hills fired down on U.S. planes flying over the harbor. Ten Japanese warships and dozens of planes were damaged.

Six days later, after three new U.S. carriers had arrived in the South Pacific, a second attack was launched against Rabaul. Japanese Zeroes dropped incendiary bombs in an attempt to ignite the U.S. planes, but the American pilots avoided them. Avengers, Dauntlesses and the new Helldivers went for the Japanese ships, sinking one destroyer and damaging several cruisers. The Japanese launched a retaliation raid, but U.S.

Courtesy Tailhook Photo Service

★ Lt.L.G. Ira C. Kepford. Before the war, Kepford was a star quarterback for Northwestern University.

land-based aircraft stopped it. In the action depicted in the cover illustration, Ensign Ira Kepford of Fighting 17 (See inset: Jolly Rogers) blew up a Kate as it was about to release its torpedo, then found a Zero on his tail. Kepford, who would go on to become the top ace of VF-17, was saved when a Hellcat dispatched the Zero.

Raids on Rabaul went on through January, steadily reducing the size of the Japanese garrison there. Hundreds of Japanese aircraft were destroyed, and the besieged warships withdrew north to Truk, never to return. Rabaul had been effectively neutralized. Airpower had spared Marines the bloody trouble of invading it.

Japan's hold on the South Pacific weakened, as Yamamoto's prophecies about America's industrial capacity became reality. The American manufacturing machine was pushing out new weaponry and resources at a remarkable rate.

Two new fighters also joined the Navy in 1943: the Grumman F6F Hellcat and the Chance Vought F4U Corsair. The Hellcat, which was assigned mostly to carriers, was fast and rugged, and would account for almost 75% of the U.S. Navy's air-to-air victories in the Pacific War. The Corsair, a little less stable than the Hellcat in carrier landings, was assigned mostly to land-based squadrons. Nicknamed "Whistling Death" by the Japanese for the sound it made while diving, it was at the time, the fastest fighter in the air. These two planes would eventually down more than 7,000 enemy aircraft, allowing U.S. pilots to reclaim the skies of the Pacific.

The U.S. Army also received a new fighter, the twin-tailed Lockheed P-38 Lightning. Faster and more heavily armed than the Curtiss P-40 it replaced, the P-38 could outspeed most Japanese planes. Invaluable in New Guinea and the Philippines, the P-38 also helped in the Solomons, where it ended the career of Admiral Yamamoto. (See inset: Yamamoto).

Japan's leaders had discovered that their new empire was consuming more resources than it could provide. Planes, ships and supplies were being destroyed at an alarming rate, while only a fraction of what was produced in Japan's new possessions actually reached the country. The Japanese merchant fleet wasn't big enough, and U.S. submarines were continually shrinking it. Japanese workers could labor around the clock in shipyards and airplane factories, but still not keep up with the U.S.

By 1943, Japan's sword had lost its edge.

Jolly Rogers

No American fighter squadron in the South Pacific was deadlier than the Jolly Rogers. Sporting their trademark skull-and-crossbones on the long noses of their Corsairs, the pilots of U.S. Navy Fighting Squadron 17 downed 154 planes in 76 days of combat. Much of their success was due to their commander, Tom Blackburn, an amiable lieutenant with a serious streak of perfectionism. Blackburn tolerated no slackers.

Formed shortly after Pearl Harbor, VF-17 was based at Norwalk Naval Air Station in Virginia until local residents complained about low-level practice flights—what the pilots called "flat-hatting." After Ensign Ike Kepford fought a mock dogfight with an Army pilot 500 feet over the city of Norwalk, VF-17 was transferred to the boondocks of Manteo, North Carolina.

In October of 1943, the Fighting 17 was sent to the Solomons, just in time for the U.S. invasion of Bougainville. Flying the big-engined Corsairs—"Hogs," the pilots called them—the Jolly Roger supported the invasion by attacking enemy airfields, harbors and ships. Three months later, VM-17 was transferred to Bougainville. Although the airman smuggled 148 cases of beer into their new base, Bougainville was not a plush assignment. Being at the end of the supply line, the airmen sometimes had to make do with such delicacies as ram's tongue, and the coral dust of the island caused problems with the sensitive engines of the powerful Hogs.

Despite the adversity, the Jolly Rogers excelled at combat flying, a job that was, commented Blackburn, "hours of complete boredom punctuated by moments of sheer terror." By the time VF-17 flew its last mission in March, 13 of the pilots had become aces.

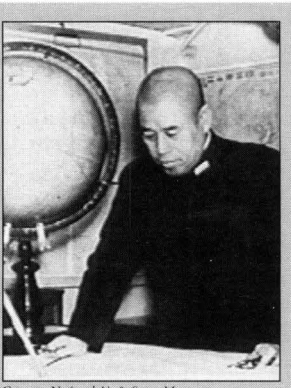
Yamamoto's Last Ride

U.S. naval offices buzzed when the message was translated. Combat Intelligence in Pearl Harbor had learned that Admiral Isoroku Yamamoto was traveling to the Solomons. Nimitz moved quickly, ordering him to be assassinated by the 339th fighter squadron's P-38s.

The 59-year old Yamamoto had planned a one-day visit to the Solomons on April 18, 1943, to spur his troops on. His first stop would be a small island off Bougainville, where a division of soldiers were recuperating from their ordeal on Guadalcanal. Accompanying him in a second "Betty" bomber, was his chief of staff, Vice Admiral Matome Ugaki. When the Betties reached the coast of Bougainville precisely on time, a squadron of P-38s, fitted with auxiliary tanks for the 600 mile trip from Henderson Field, were waiting. While most of the P-38s climbed to provide top cover, four P-38s closed for the kill. One of the Lightnings couldn't release his drop tank, and the pilot and his wingman broke off the attack. This left Thomas Lanphier and Rex Barber to get Yamamoto.

Here's where the stories differ. Lanphier says he met the Zero escort, shot one down, and was in a steep dive when he spotted a Betty near the treetops. He fired a quick burst as the bomber crossed his line of fire. Its engine began to burn, the right wing broke off, and the plane crashed into the jungle.

Barber says he went straight for the Betties but at 300 mph, overshot them. He banked, came out above and behind one Betty, lined up and fired until its right engine started smoking. Last he saw, it was going down into the jungle. Barber then saw the second Betty. He made firing pass at it, joined by the other pilots who had originally disengaged. The Mitsubishi bellied into the sea.



Courtesy National Air & Space Museum, Smithsonian Institution

★ Admiral Isoroku Yamamoto.

Yamamoto died when his plane crashed into the jungle. He was found by a search party still strapped to his seat. For decades, historians and participants in the mission have argued over who exactly got Yamamoto. The Air Force has awarded joint credit to Lanphier and Barber. Most historians, however, credit the Oregon farm-boy, Rex Barber, with full credit. Decisive evidence proving exactly who shot Yamamoto's plane down will probably never be uncovered, so the debate will in all likelihood rage for years to come.

KNOCKING ON TOKYO'S DOOR

Closing in on Japan was supposed to be easy, nothing like the savage jungle fighting in the Solomons. The U.S. Navy was going to push through the Central Pacific, capturing islands step by step, each conquest serving as a springboard for the next, until U.S. bombers were within range of Japan itself. Most of the islands were small atolls with relatively few defenders. The men of the Fifth Fleet were confident as they sailed toward their first objective, a Japanese base on the atoll of Tarawa in the eastern Gilbert Islands.

Courtesy Tailhook Photo Service

★ A typical jungle strip probably made from crushed coral and covered with Marsten Matting.

On the morning of November 20, 1943, U.S. ships shelled Betio, the most important islet of the atoll, until fires were burning from one end of the islet to the other. Dozens of landing craft full of Marines plowed toward the islet. They were still half a mile from shore when the Japanese opened fire. Some of the vessels were caught on a high reef where the Japanese guns were aimed. Machine gun bullets hailed down on Marines as they fled into the chest-deep water, scrambling for what little shelter they could find. All day they were pinned to the beach with no escape through the blood-stained waters and no advance into the deadly fire. By nightfall, 1,500 of the 5,000 Marines who tried to hit the beach were dead or wounded.

Darkness brought relief, and Marines and weapons moved ashore. One by one Japanese pillboxes were silenced by tanks, dynamite or flamethrowers. But it cost three days and 3,000 U.S. casualties to capture Tarawa's meagre acreage, and the American public was appalled. The Navy vowed to improve its invasion techniques. Rear Admiral

Chester Nimitz, commander of U.S. naval forces in the Pacific, had replicas of Japanese pillboxes built on an outlying Hawaiian island, and studied how best to destroy them. Precision bombing with airplane rockets and armor-piercing shells seemed to be the answer with time allowed after each strike to let the smoke clear and judge success.

The lessons learned were put to use on the Navy's next objective: the Japanese naval base on Kwajalein in the Marshall Islands. For three days, the atoll was hit with some of the most concentrated bombardment of the Pacific War—36,000 shells launched from ships and artillery on a nearby islet. The invasion went smoothly and fewer than 350 Marines died in the four days it took to capture Kwajalein.

Confident in the face of such success, the Navy continued its sledgehammer assault and, by mid-February 1944, had swept through the Marshall Islands. Planes from U.S. carriers ranged further west to ravage Truk, Japan's most important base in the Central Pacific. The raid destroyed some 200 Japanese planes and dozens of merchant ships. With Truk effectively neutralized, Nimitz decided it was time for a bold move: a leap of more than 1,200 miles to the Marianas, from which the new long-range B-29 Superfortress could reach Japan.

Courtesy Tailhook Photo Service

★ A Marine Corsair on an airstrip carved out of the jungle. By 1944, American Sea Bees and U.S. Army Combat Engineers could construct an airfield in only a few weeks.

By this time, some members of the Japanese government were considering making overtures of peace to the Allies. Some of the less militant leaders realized that the struggle had taken a bad turn, and the truth about war losses was being concealed from the Japanese people. In fact, most

would not know their country was losing the war until massive bombing raids hit their cities in early 1945.

Japanese naval commanders, however, still saw a chance for a decisive victory over a U.S. Navy that was far from its home. When U.S. Marines invaded Saipan, the most populated island of the Marianas, Vice Admiral Jisaburo Ozawa moved in with orders to "annihilate the enemy fleet."

A thoughtful, quiet man, Ozawa carefully studied carrier tactics. Although he was outnumbered two to one in flattops, he believed he could beat the Americans. There were hundreds of Japanese planes on bases in the Marianas. Ozawa could use these, along with Japanese carrier-based planes that had a longer flying range than the U.S. planes, to attack American flattops while they were too far away to strike back. The Japanese planes could fly to Guam for refueling and rearming, then take off to strike U.S. carriers again.

What Ozawa hadn't been told was that U.S. air strikes had already destroyed many of the land-based planes in the Marianas. Vice Admiral Takeo Kurita, commander of the land-based planes, compounded the disinformation by inexplicably reporting that his squadrons were inflicting heavy damage on enemy ships. When Ozawa began launching air strikes against the U.S. carriers on June 19, he was unwittingly sending his young pilots to slaughter.

U.S. radar picked up the first wave of planes when it was still 150 miles away, and Hellcats raced to meet it. Japanese planes fell like leaves. The few planes that did penetrate the defense flew into deadly anti-aircraft fire. Only 24 of the 70 Japanese planes survived, and none of the U.S. carriers were damaged.

Half an hour later, Hellcats met the second wave. Ninety-eight of 128 Japanese planes came down this time. Thinking that his planes were continuing on to make successful base

landings, Ozawa didn't realize the extent of the losses. He launched two more strikes. His inexperienced airmen were no match for the American vets. Lieutenant David McCampbell, eventually the top Navy ace, downed seven planes. Lieutenant Alexander Vraciu downed six. "Hell," exclaimed one U.S. pilot, "this is like an old-time turkey shoot." The Battle of the Philippine Sea became known as the Great Marianas Turkey Shoot.

Courtesy National Air & Space Museum, Smithsonian Institution

★ Lieutenant David McCampbell was one of the highest scoring aces with 34 kills. On one mission in 1944, McCampbell flamed nine planes, a feat no other U.S. pilot achieved.

In one day, almost 350 Japanese airplanes were destroyed, and two Japanese carriers were sunk by prowling U.S. submarines. The next day, planes from U.S. carriers attacked Ozawa's ships, sinking the carrier *Hiyo* and destroying 65 more Japanese planes. In two days, the back of Japanese naval air power was broken.

It took until the middle of July to secure Saipan, at a cost of more than 16,000 Americans dead or wounded and 29,000 Japanese dead. But now, the U.S. finally had an island within air-striking distance of Japan. On July 18, Prime Minister Hideki Tojo, the man most responsible for his country's entry into the war, resigned. His successor, an army general named Kuinaki Koiso, began to plot out the last-ditch defense of his homeland.

The U.S. Navy rolled on. In late July, the Stars and Stripes once more flew over Guam. By mid-August, most Japanese

ground troops had been cleared from the Marianas, and work began on airfields big enough to handle the massive bomber that would bring the war to Japan, the B-29 Superfortress. The Navy moved west to the Palau Islands, a last step before the Philippines. September air strikes on the Palaus provoked little resistance prompting Admiral Halsey to suggest bypassing them and going right for the Philippines. But his superior, Admiral Nimitz, was reluctant to skip Peleliu, the main Japanese base in the Palaus. In a decision that looks unwise in hindsight, Nimitz ordered it occupied.

Peleliu was an island fortress with limestone cliffs and miles of tunnels. The Japanese were well dug in, and days of bombardment by planes and ships didn't silence their guns. Aerial photos hadn't revealed the concrete-and-steel pillboxes in the bluffs overlooking the shore. When the U.S. First Marine Division landed on Peleliu they were inundated with fire from machine guns, mortar and artillery in the pillboxes. Two-thirds of Captain George Hunt's company was hit. It took days for the Americans to secure the beach and months of burning and blasting cave after cave to clear the island. Ten thousand Japanese and 2,000 Americans died for an objective of dubious strategic value.

"I CLAIM ONE DESTROYED"

When a pilot wrote on his mission report that he had destroyed an enemy aircraft, he had in essence placed the burden of proof on himself. He was given some latitude, but not much.

Seeing smoke belch from a target would not suffice. Seeing a good-sized piece of airplane come flying off didn't count either. After all, we had them returning on a regular basis sans meaningful hunks. No, it took more than that:

1. It had to blow up—literally come apart in the air.

2. A piece big enough to render the airplane unflyable had to come off—like a whole wing or engine—the next thing to "blowing up".
3. It had to be abandoned. The pilot had to be seen exiting his aircraft.
4. The gun camera had to prove to the operations and intelligence people who evaluated it that a plane was doomed.
5. One had to see the plane crash.
6. There had to be confirmation by someone in the vicinity that damage inflicted did in fact verify the claim.

To get a victory credit it took at least one and usually more than one of the above.

Courtesy National Air & Space Museum, Smithsonian Institution

★ Richard Bong in a P-38.

By the time Peleliu was captured, MacArthur had returned to the Philippines. The U.S. Navy had wanted to skip the Philippines. Nimitz favored a jump to Formosa, which would place the B-29s within easy bombing range of Tokyo. But at a late July meeting of the minds in Hawaii, MacArthur successfully appealed to President Roosevelt to let him keep the promise he'd made in 1942. The Philippines would be liberated.

MacArthur moved his forces into place. For over a year, they had been advancing up the north coast of New Guinea, capturing some Japanese bases while bypassing others. The Fifth Air Force led the way, raiding Japanese bases, harassing Japanese ships, and steadily eliminating Japanese planes. Many of the war's greatest fighter pilots, including Richard Bong and Thomas McGuire, became aces in the New Guinea campaign.

By September 1944, MacArthur's troops had secured not only New Guinea, but also the island of Morotai, 300 miles northwest, from which they would invade the Philippines. This conquest called for the largest combined sea and land operation ever attempted by the U.S. MacArthur would lead the invasion, attacking Leyte, Mindoro and the Luzan. The Navy was to neutralize Japanese air power and prevent the Imperial Navy from attacking the beachheads.

In mid-September, Admiral Halsey's Third Fleet launched a series of raids against airfields in and around the Philippines. Almost 500 Japanese planes were destroyed,

including some that had been caught on the ground at Clark Field almost three years earlier.

MacArthur's invasion came on October 20. Just before dawn, battleships and cruisers, with directions provided by

THE HOMETOWN HERO: Gerald R. Johnson

Gerald Johnson, Ged to his friends, learned to fly while attending the University of Oregon as a pre-Med student. He later joined the Army Air Corps and, as war broke out, was deployed to the Aleutians, where he claimed his first victories in combat. He moved on to the 49th Fighter Group in New Guinea where his skill in air combat quickly showed as he racked up kills. He gained command of the 9th Fighter Squadron at the end of the summer, knitting his men into a tight, inspired outfit. A year later, the young pilot returned to Oregon, where he married his high school sweetheart, Barbara.

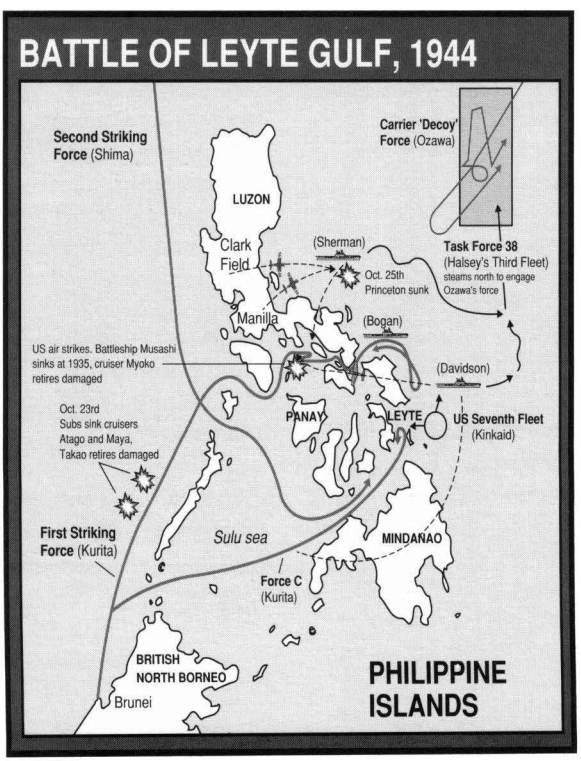
Back in combat at the end of 1944, Ged took command of the 49th while in the Philippines. By then, over 20 planes had been brought down by his guns. As his score grew, so did his reputation as an excellent pilot and a remarkable shot. In December of 1944, he flamed four planes on one mission, two of them crashing within a hundred yards of each other.

On October 7, 1945, as Ged was flying between the Philippines and Japan, he encountered an unreported Typhoon. Just off Honshu, he got lost. Low on fuel, and with the storm ravaging his B-25, Ged performed a final act of valor. He and his copilot gave their parachutes to two passengers who had forgotten theirs. Making a low pass over a beach, his passengers bailed out, and were rescued. Ged and his copilot where never seen again. As his childhood pals returned home, shedding their uniforms for civilian clothes, they were deeply shaken that Ged was no longer among them.

The devotion Ged's friends held for him has never wavered in the years since the war. Remembered as a bright, fun-loving man, they sought to memorialize him in a local church and the YMCA. Over the years, these shrines to his memory have disappeared, victims of vandalism or apathy. Today, only a small plaque in the University's Student Union bears testimony to his success as a fighter pilot, and his sacrifices as a man.

Filipino guerillas, located and blasted Japanese positions along the coast of Leyte. Four U.S. Army divisions charged ashore along a 10-mile front. By early afternoon, MacArthur, with a corncob pipe and aviator glasses, was able to wade ashore and announce into a battery of microphones set up by the Signal Corps, "People of the Philippines, I have returned."

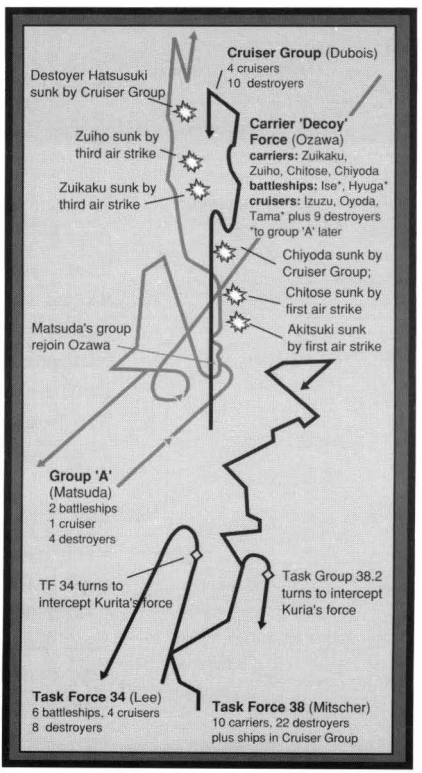
To the American public, it was headline news. To Japan's misinformed leaders, it was yet another chance for the decisive battle. Novice Japanese pilots had mistakenly reported sinking so many enemy ships in recent weeks that the Allies were thought to be incapable of launching a major invasion. Admiral Soemu Toyoda, commander of the Japanese Navy, decided to risk all to stop the enemy. If the Philippines fell, U.S. planes would control the sea lanes between Japan and the East Indies leaving Japan starved for raw materials.



Toyoda divided his fleet into three forces. Vice Admiral Takeo Kurita's Center Force, with the huge battleships *Musashi* and *Yamato*, steamed east through the central Philippines to come down into Leyte Gulf from the north. Vice Admiral Teiji Nishimura led a second force of warships northward through the Surigao Strait. These two forces were to catch the U.S. invasion force in a pincers, while a third force under Admiral Ozawa lured American carriers away from the battle. Ozawa's force centered around four

carriers, all that remained of the mighty Japanese air fleet that had once ruled the waves from Hawaii to Ceylon. With only 116 planes left among the four carriers, the flattops were now expendable and would be used as decoys.

The three-day Battle of Leyte Gulf didn't begin as Toyoda had hoped. At dawn on October 23, two U.S. submarines caught Kurita's force shortly after it had left Borneo. Torpedoes sank two Japanese cruisers. Kurita was in the Sibuyan Sea in the middle of the Philippine archipelago the next morning when planes from U.S. carriers attacked. Kurita radioed Manila for fighter protection, but most Japanese land-based planes had been sent to attack Halsey's carriers (an attack that sank the light carrier *Princeton*). With no fighter protection, Kurita's battleships had little defense against the waves of Helldivers and Avengers. All five of the Japanese battleships were damaged, and the "unsinkable" *Musashi* went under.



Fearing complete annihilation, Kurita turned his force around. Halsey, in the Philippine Sea on the other side of the islands, assumed that the Japanese battleships were retreating. Several hours later, when U.S. scout planes spotted Ozawa's decoy carriers 300 miles north, Halsey bit Toyoda's bait. He ordered his ships toward the Japanese carriers, away from the U.S. invasion force in the Leyte Gulf.

For a brief time, Toyoda's plan looked like it might succeed. Unbeknownst to Halsey, Kurita had reversed course again under cover of darkness. By early morning, his ships were approaching Leyte Gulf from the north, while Nishimura's force was entering the Surigao Strait from the south. The pincers might have worked, if the Americans hadn't detected half of it. Warned

Courtesy National Air & Space Museum, Smithsonian Institution

★ A brave Japanese torpedo bomber pilot takes his B6N Tenzan into the teeth of American antiaircraft fire.

by scout planes and coastwatchers, a U.S. naval force under Admiral Jesse Oldendorf was waiting for Nishimura. PT boats and destroyers harassed the Japanese force as it moved single file through the Surigao Strait, sinking a battleship and two destroyers. Then a line of U.S. battleships, including several that had been resurrected from the wreckage of Pearl Harbor, opened fire in the dark. In a frenzied hour of shelling, all but one of Nishimura's ships were crippled or sunk.

The Japanese had one final card to play. Kurita was steaming south fast. At daybreak on October 25, he surprised a small force of U.S. destroyers and escort carriers ("baby flattops" that held no more than 28 planes) under Rear Admiral Clifton Sprague. Sprague's force was all that was guarding the Marine transport vessels in the Leyte Gulf, and it was badly outgunned. The *Yamato's* 70-foot long cannons hurled 3,220-pound shells that hit the U.S.

ships, "like a truck smacking a puppy," one American officer remembered. After two hours, several U.S. ships went down, several more were damaged, and Kurita seemed on the verge of breaking through to the thin-skinned U.S. transports. Then, in a decision he later admitted was a mistake, Kurita called off the attack. He didn't know how close he was to overwhelming Sprague's force, and when he heard that Halsey's carriers were less than 100 miles away, he headed off to attack them. Aboard one of the battered U.S. vessels, a quick-witted signalman yelled, "Hell boys, they're getting away."

The respite didn't last long. Two hours later, Sprague's sailors encountered an even more terrifying weapon. Five Zeroes with bombs lashed to their wings slashed down on the American ships. Four of the Zeroes were knocked away by U.S. fighters and anti-aircraft fire, but one slammed into the flight deck of the escort carrier *St. Lo.* Fires raced through the hangar deck, setting off a chain of explosions that sank the baby flattop. Incredulous American sailors nicknamed the pilot "devil diver." The Japanese called him "kamikaze."

With fewer than 100 operational planes, Admiral Takijiro Onishi, commander of the Japanese Fifth Base Air Force in the Philippines, had decided the only way to stop the U.S. invasion was to implement a suicidal plan that had been discussed informally for some time. Onishi formed a core of volunteer pilots with an average age of 20, the least experienced and, therefore, the most expendable, for one-way flights to crash bomb-laden planes into enemy ships. Officially called the Special Attack Groups, they themselves took the name "kamikaze," or "divine wind," after a typhoon that had scattered a Mongol invasion fleet in the 16th century.

Unlike that 16th century storm, the 20th century "divine wind" couldn't save the Japanese Navy. The morning after the Kamikaze attack on the *St. Lo*, Halsey launched air strikes against both Kurita's force and Ozawa's flattops.

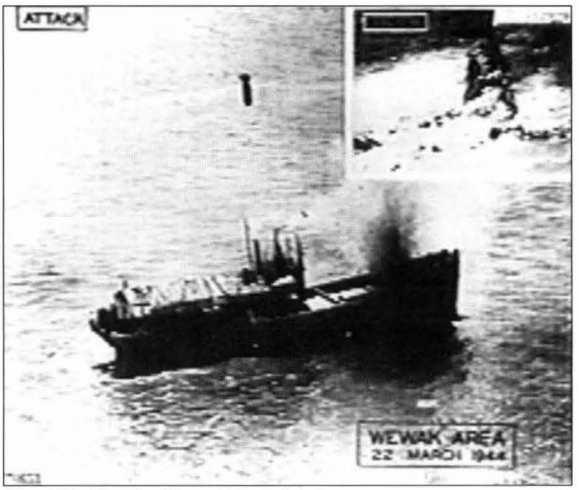
One Japanese cruiser and two carriers went down, including a veteran of Pearl Harbor, the *Zuikako*. By the time the Battle of Leyte Gulf ended on October 26, the Japanese Navy had been virtually wiped out.

On land, U.S. forces were not as dominant. After the Battle of Leyte Gulf, Sprague's escort carriers withdrew for repairs; Halsey's carriers steamed away to attack Japanese bases in the north; and MacArthur was left with little air support. His troops had captured several airfields, but monsoons kept washing out efforts to expand them. Few U.S. planes could land, and for several weeks the Japanese ruled the skies over Leyte, striking the Tacloban airstrips whenever weather permitted. One raid destroyed 27 U.S. planes on the ground. Another ignited fuel dumps. Some U.S. squadrons lost almost half their planes. Slowly, the rains let up, the airfields were expanded, and the Fifth Air Force finally took control of the skies.

The U.S. Army pushed forward and on December 27 MacArthur announced the Leyte campaign was "closed except for minor mopping up" (that "mopping up" would take four more months). MacArthur's troops jumped forward to Mindoro, an island just 100 miles south of Luzon, to provide the Fifth Air Force with bases from which to support the primary objective, the main Philippine island of Luzon. On Luzon, MacArthur planned an invasion similar to the one that Japan had successfully staged three years earlier. A large force would land at Lingayen Gulf, then forge down the 110 miles to Manila via the Luzon's wide central plain.

Early in January 1945, the 850 ships of the invasion force began the six-day journey from Leyte Gulf to Lingayen Gulf. Kamikazes assaulted them throughout the journey. On January 4, a twin-engine Japanese bomber plunged into the escort carrier *Ommaney Bay*, killing 97 men and causing so much damage the ship was scuttled. Two days later, as the fleet entered the Lingayen Gulf, a flaming kamikaze hit the battleship *New Mexico*, full of dignitaries.

Twenty-nine men were killed, including Winston Churchill's personal envoy to MacArthur. Other kamikazes struck, badly damaging 11 vessels and killing hundreds of sailors. It was the worst day for the U.S. Navy in more than two years.



Courtesy National Air & Space Museum, Smithsonian Institution

★ A Japanese lugger seconds before its destruction by 5th Air Force bombers. Note the 500-pound bomb at the top of the photo.

To defend against the deadly threat, the U.S. Navy installed additional anti-aircraft guns on its ships. Dive-bombers and torpedo planes were taken off carriers to make room for more fighters, including the fastest fighter in the U.S. Navy, the Corsair. The idea was to stop the kamikazes before they came close.

Defensive fighters patrolled as far as 60 miles from the fleet, while carriers coordinated air strikes to keep continuous fighter patrols over Japanese airfields. But the defensive measures gave only partial protection, and kamikaze attacks in the Philippines continued until the Japanese ran out of planes.

Still, the assault on Luzon succeeded. MacArthur's troops pressed towards Manila, destroying dozens of Japanese units. Marine and Army planes protected the flanks of the Allied advance. Finally, in February 1945, American units reached the gates of Manila.

The Japanese defended Manila ferociously. The Sixth Army used artillery to blast them out, building by building. Day and night, the shelling continued in the Pacific War's only major urban battle. More than 100,000 Filipinos died, both from American bombardment and Japanese butchery. The graceful architecture of Manila, the "Pearl

Courtesy Tailhook Photo Service

★ A trio of aces from VF-17: Roger Hedrick, Tom Blackburn and Ira Kepford. Hedrick returned to the Pacific as the CO of VF-84 in 1945. Blackburn also returned as an observer on board the *Lexington* during the Battle of Leyte Gulf.

of the Orient," was reduced to rubble. Even after the last organized resistance in Manila was eliminated on February 17, 100,000 Japanese troops held out in the mountains of northern Luzon. Most were still there when the war ended six months later. Remarkably, some were still there, ready to fight, a quarter of a century later.

While MacArthur busied his forces with mopping up Luzon and capturing the rest of the Philippines, Nimitz took another step toward Japan. On February 19, the U.S. Navy invaded Iwo Jima, a tiny island halfway between the Marianas and Tokyo. The objective was the island's airfields. In Japanese hands, they posed a threat to the B-29s that would soon be flying out of the Marianas. In American hands, the airstrips could provide fighter protection for those B-29s, and serve as an emergency landing areas for any damaged bombers. Without Iwo Jima, American leaders decided, Japan couldn't be bombed effectively.

Aerial photos had revealed more than 200 gun emplacements on the eight-square-mile island, and the Americans feared there were miles of underground trenches and tunnels that the photos didn't show. For six weeks, U.S. bombers pounded the island almost daily. But when the Marines began landing, the Americans' worst fears were confirmed. Shells and mortar bombs came pouring down from the slopes of Mt. Suribachi. Two thousand Americans were hit on the first day. Five bloody days wore on before a patrol under Lieutenant Harold Schirer could fight its way through to the top of Mt. Suribachi and hoist a flag in what became the single most famous photograph of the war.

By the time the last Japanese troops were cleared from Iwo Jima on March 26, more than 6,000 Americans had been killed and 19,000 wounded. The casualties were horrendous, but the pieces were finally in place for the final assault on the Land of the Rising Sun.

VMF-214, The Black Sheep

U.S. Marine fighter squadrons were usually formed in the states, then shipped overseas intact. But when Admiral Halsey needed fighter pilots quickly for the Solomons campaign in mid-1943, he cut through the red tape. He took an existing squadron number whose personnel were on leave, filled it with fresh faces, and gave command to Major Gregory Boyington.

Boyington had already downed six Japanese planes with the Flying Tigers in China. He was a boisterous airman, a former college wrestler who liked to challenge his fellow pilots to a couple of tumbles after downing a few drinks. Because he'd reached the venerable age of 30, the younger pilots named him "Pappy." The pilots of VMF-214 called themselves Boyington's Bastards until a Marine press officer told them that newspapers wouldn't print that, so they came up with another moniker they liked—The Black Sheep.

Boyington wasn't the world's best disciplinarian, but his tactics worked. He stressed small formations and precise shooting. It required a lot of nerve, but proved effective. Flying the fast Corsair, the Black Sheep shot down 97 planes in the 84 days they served in the Solomons.

At the end of 1943, Boyington had 25 kills, and the pressure was on him to get one more to equal the Marine Corps record shared by Eddie Rickenbacker in World War I and Joe Foss in World War II. He got his chance on January 3, 1944, when he led a raid on Rabaul. He downed three Japanese planes before a Zero sent him plummeting into the sea. After eight hours afloat on his life raft, Boyington was picked up by a Japanese submarine. He spent the rest of the war in captivity. When the war ended, he was hailed as the U.S. Marines Corps' top ace with 28 kills, and received a Congressional Medal of Honor.

"I got publicity and a medal," he said, "but many men who never received mention gave everything they had—they're still out there."

Courtesy National Air & Space Museum, Smithsonian Institution

★ Perhaps the most famous image of the war, American Marines raising the flag on Mount Surabachi, Iwo Jima in 1945.

FINAL ASSAULT

The Japanese were steadily losing ground, but they weren't giving up. Even after Tojo resigned, power in Tokyo was held by militarists who believed that national suicide was preferable to surrender. U.S. leaders planned for what looked like an inevitable, full-scale invasion of Japan. Knowing that the costs would be high, perhaps as many as a million American deaths, the brass looked for an alternative. They found the B-29 Superfortress.

The B-29 was the world's biggest bomber, a 37-ton behemoth that could carry up to 10 tons of bombs. With a range of 4,000 miles—twice that of its predecessor, the B-17—it was ideal for the vast distances of the Pacific. When the first Superfortresses rolled out of the Boeing plant in Wichita, Kansas in March 1944, they were flown to airfields near Chengtu in central China, which at the time were the Allied bases closest to Japan.

The early missions were discouraging. Many of the big birds crashed on takeoff. Operational problems brought down more planes than enemy fire. From Chengtu, the planes could only reach southern Japan, and fuel was so scarce in China that it had to be flown in over the Himalayas. The gas-gulping Superfortresses could only fly twice a month. The flights from China were obviously not going to bring Japan to its knees, so after U.S. engineers completed the first big airstrip in the Marianas in October, the bombers were transferred there.

Although the Marianas are hundreds of miles closer to Japan than Chengtu, the early missions were hardly an improvement. Flying at high altitudes, the bombardiers encountered the jet stream, with 200 mph winds that made accuracy impossible. Of the more than 1,000 bombs dropped on the Nakajima aircraft engine plant outside Tokyo on November 24, only 48 fell near the target.

Washington was impatient for results, and in January 1945, General Curtis LeMay was given command of the

Marianas program. He had been commanding the B-29s at Chengtu before they transferred to the Marianas. He'd seen that conventional horizontal bombings, which had devastated the concentrated industrial complexes of Germany, weren't effective against the spread-out production facilities of Japan. He'd also seen that incendiary bombs, used in a December 1944 raid on a Japanese military depot in China, had ignited huge fires that gutted half the target area. The wooden buildings of Japan, LeMay suspected, would burn just as easily.

Without notifying Washington, LeMay removed the guns and ammunition from his B-29s so they could carry heavier payloads. He filled the planes with incendiary bombs. To ensure accuracy, he instructed his pilots to fly in low, below 10,000 feet. The industrial targets he was aiming for were surrounded by crowded neighborhoods, and he knew that thousands of civilians would be killed. "But if you don't destroy Japanese industry," he reasoned, "We're going to have to invade Japan. Would you rather have Americans killed?"

On the night of March 9, 279 Superfortresses flew the 1,300 miles from the Marianas to Tokyo. They arrived over Tokyo and bombed for three hours,

TIPTOEING AROUND "THE FORT"

"Ye though I walk through the valley of the shadow of death I will fear no evil because I'm the meanest S.O.B. in the valley" That somewhat ribald parody of a biblical quote pretty much sums up the reputation that the B-17 took to war. Particularly in the Pacific.

All told there were probably not more than 100 Flying Fortresses operational in the Pacific theatre at any one time and, for all practical purposes, they had been withdrawn from combat in that theatre by the beginning of 1943. In that thirteen month period the vast majority of those that were destroyed were dispatched on the ground or by operational accidents or simply worn out. Not more than a few dozen were actually destroyed by fighter attacks. For instance, not one was shot down at Midway.

With a handful of exceptions, the Japanese were very tentative in dealing with the B-17. We can only assume that in reading all the press clippings, and in seeing one for the first time they decided that discretion was the better part of valor. This was one case where a great reputation went largely unchallenged.

igniting a devastating firestorm. Winds were strong that night, and the flames spread eagerly. Balls of fire leapt between buildings. The heat grew so intense that entire blocks ignited before the flames even reached them. Residents ran for the Sumida River, only to roast as the water boiled away. Sixteen square miles of Tokyo burned to the ground. City officials later estimated that 130,000 people died.

Courtesy National Air & Space Museum, Smithsonian Institution

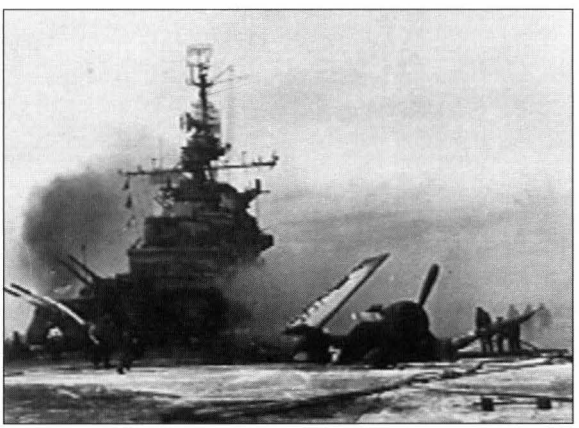
★ Burning from a kamikaze hit, the *Hancock's* crew tends to the wounded and rushes to control the damage. Eighty-four men died in this attack.

Anxious to push the war to its end, LeMay ordered fire-bombings of the cities of Nagoya, Kobe and Osaka. The Japanese fought back with anti-aircraft fire and fighter planes such as the Ki-45 "Dragon Killer." Some desperate Japanese pilots tried to ram the Superfortresses in suicide attacks. The defenses knocked down a few bombers, but couldn't stop the annihilation. In one week, more than 30 square miles of industrial areas were incinerated. Despite government urgings to stay in the city, hundreds of thousands of people fled for the safety of the countryside. Relief for the Japanese populace didn't come until late March, when LeMay ran out of incendiaries and the B-29s were given another job: the invasion of Okinawa.

Three hundred and fifty miles south of Tokyo, Okinawa was the last important bastion guarding the homeland. With flatlands for airfields and deep water bays for naval bases, it was an ideal staging area for an invasion of Japan. Knowing it wouldn't be easy to take the island, the Americans spent weeks softening Japanese defenses. Planes from the 16 carriers of Task Force 58, under Admiral Marc Mitscher, raided Japanese airfields, destroying hundreds of planes on the ground.

On Easter Sunday, April 1, the first two Army and two Marine divisions landed on Okinawa. They met almost no resistance, and by nightfall, more than 50,000 Americans were crowded into a beachhead three miles long. On the second day, they captured an airstrip. By the third day, they'd spanned the three-mile-wide island, cutting Okinawa in two. They'd done just what Lieutenant General Mitsuru Ushijima expected them to do.

Ushijima, commander of the Japanese Army troops on the island, had concentrated his defenses in the southern tip of the long narrow island. Thousands of defenders were dug into caves, tunnels, and above-ground burial vaults (an Okinawan funerary custom) in a line of hills running across the island. Minefields and traps guarded the approaches to the hills. Trenches of riflemen lined the lower slopes, machine guns filled the higher reaches, and artillery stood on top.



Courtesy National Air & Space Museum, Smithsonian Institution

★ Scenes of destruction on board the *USS Hancock*. The carrier had been hit off Okinawa by a single kamikaze.

On April 5, the U.S. Tenth Army ran headlong into Ushijima's defenses. Hundreds of guns opened fire on the GIs, and the U.S. advance halted. For a month, Ushijima's troops held the hills. While the American invasion armada was tied up resupplying the GIs, Japan struck back like a cornered animal. Few Japanese leaders entertained hopes of defeating the U.S. invasion of Okinawa, but they hoped to inflict enough damage to forestall an invasion of the homeland.

Buoyed by the success of kamikaze attacks on U.S. ships in the battle for the Philippines, Japanese leaders unleashed the full fury of the "divine wind." On April 6, hundreds of kamikazes descended on the American ships near Okinawa.

The young Japanese pilots concentrated on destroyers that were stationed far from shore to guard the rest of the ships. Isolated and with little anti-aircraft protection, the destroyers couldn't fend off the suicide attacks. By the end of the day, 13 U.S. ships had been knocked out of the war.

Suicide attacks also came by sea. On April 6, the superbattleship *Yamato*, accompanied by a cruiser and eight destroyers, sailed south to Okinawa. Its mission was twofold: to divert the U.S. carriers, giving Japanese planes a better chance to get through, and to break through the U.S. warships to bombard the invasion forces. But U.S. submarines spotted the ships shortly after they left Japan. The next day, hundreds of Helldivers and Avengers from Mitscher's carriers pummeled them. One TBF pilot, VT-84's Lieutenant Dewey Ray, earned the Navy Cross that day for getting a hit on the *Yamato* despite his malfunctioning aircraft. In less than two hours, the *Yamato* went down with an explosion that was seen on Kyushu, 120 miles away. Five other ships were sunk, and the four surviving destroyers turned back.

Courtesy National Air & Space Museum, Smithsonian Institution

★ Damage control parties battle a fire on the *USS Hancock.*

By mid-May, six large kamikaze attacks involving more than 1,500 planes had sunk a score of U.S. ships and damaged dozens of others. But the invasion of Okinawa was not stopped. American ground troops were slowly moving forward with some help from above.

The sheer mass of American firepower gradually overwhelmed the Japanese defenders. Organized Japanese

resistance ended on June 22 when Ushijima, his troops isolated into scattered pockets, committed hara-kiri. The campaign had claimed almost 12,000 Americans lives, including 4,320 killed by kamikazes—the highest toll in the Pacific War. More than 110,000 Japanese troops and 75,000 civilians died in a futile attempt to keep the wolves from the door.

While the Americans made plans for a November invasion of the Land of the Rising Sun, the Japanese prepared their defenses. More than 27 million civilians, many armed with sharpened bamboo spears, were organized into a national guard. Caves that honeycombed the islands were stocked with provisions. Several thousand planes were amassed for kamikaze attacks. "If we could destroy the invasion fleet when it came," said Rear Admiral Toshitane Takata, "we could hold out for years."

Prime Minister Kantaro Suzuki, who had taken over when the previous administration resigned in April, looked for an honorable escape for his country. Suzuki knew that Army militants still held the strings of power and any overt offers of surrender could lead to his quick removal or assassination.

In late June, he discretely approached the Soviet government to help negotiate a peace with the Allies. Two weeks later, Emperor Hirohito sent a personal envoy to Moscow with the same request. But the Soviets put them off. Before his death on April 13, President Roosevelt had promised the Soviets several Japanese possessions if they entered the war, and Soviet Premier Josef Stalin was secretly massing troops along the Manchuria border.

Suzuki knew nothing of this, nor of an even darker threat that loomed across the Pacific. On July 16, scientists in New Mexico had successfully detonated the first atomic bomb. The news was relayed to the new American president, Harry Truman, as he met with Stalin and British Prime Minister Winston Churchill in the Berlin suburb of Potsdam.

With the world's mightiest weapon now in his arsenal, Truman pushed through what became known as the Potsdam Proclamation, a document that called for Japan to surrender unconditionally or face "prompt and utter destruction."

When the Japanese ignored the proclamation, the U.S. military shipped two atomic weapons, the 9,000-pound uranium-based "Little Boy" and the 10,000-pound plutonium-powered "Fat Man," to the island of Tinian in the Marianas. A group of B-29s were modified to handle the new weapons, and Colonel Paul W. Tibbetts, Jr., a veteran B-17 pilot and B-29 test pilot, was chosen as commander. Tibbetts had the name of his mother, Enola Gay, painted on his plane.

At 1:45 am on August 6, 1945, B-29 weather planes rolled off the runway on Tinian and headed for three cities: Hiroshima

Operation X-ray

Operation X-ray was handed over to the Marine Corps by the Navy, which had in turn, received it from the Army, after exhausting all efforts and abandoning the project completely. The brainchild of a Pennsylvanian surgeon, Operation X-ray, if successfully executed, would launch from planes an air force of bats armed with incendiary capsules. The intent was to set Japan's paper cities ablaze. The bats, having first been frozen in ice-cube trays, were armed, packaged, and dropped from high altitudes and would awaken from their hibernation as they descended into warmer elevations. They were expected to seek refuge within the city structures, at which time their payload would detonate, igniting the building.

Experiments with the project were somewhat less than successful. In Carlsbad, New Mexico, the Army's bats set fire to a general's automobile and a hangar. The Marines managed to get 30 fires started, 22 of which burned out and of the remaining fires, only four would have required firefighters. There was also a problem getting the little devils to go in the right direction. In a another test of 25 bats, only one managed to land safely. One can only speculate as to where the other 24 exploded. The mating cycle of the bats also limited their use to less than half the year, as the females got pregnant and the males lost their appetites. The project was cancelled in March 1944.

and the two alternate targets Kokura and Nagasaki. An hour later, the *Enola Gay* took off. To avoid the possibility of blowing up Tinian should the plane crash on takeoff, "Little Boy" was armed in flight. When the weather planes reported clear skies over Hiroshima, Tibbetts headed in that direction. At 8:15 am, the bomb bay doors were opened, and "Little Boy" toggled free. Three parachutes slowed the bomb as it dropped almost six miles. Six hundred and sixty yards above the ground, it exploded.

Those who survived couldn't agree on the color of the initial flash—blue, pink, yellow, brown or purple. It was instantly followed by a concussion that flattened all but a few earthquake-proof buildings in a two mile radius. A thermal wave swept across the city, igniting buildings and debris. Hurricane force winds roared into the vacuum that followed, fanning a fire storm that raged for hours. Japanese investigators later estimated that 100,000 people died that day. Another 100,000 would die later, mostly from burns or radiation.

Courtesy National Air & Space Museum, Smithsonian Institution

★ A B-25 skip-bombing a Japanese patrol craft. Skip-bombing was a highly successful way to sink shipping and was adopted by U.S.A.A.F. units after 1942.

Air power had reached its apocalyptic apogee. Still Japan fought on.

Surrender

News of the Hiroshima disaster reached Tokyo in fragments. Early reports on the damage were not believed, even after the U.S. announced it had dropped an atomic bomb—a weapon that Japan had also been working on. Not until August 8, two days after the bombing, did Japan's ambassador in Moscow, Naotake Sato, renew his efforts to have the Soviets help negotiate a peace. To Sato's surprise, he was quickly granted an audience with Soviet Foreign Commissar Vyacheslav Molotov. But instead of offering the help that Japan sought, Molotov read a declaration of war. That night, Soviet armies invaded Japanese-held Manchuria.

The next morning, August 9, Suzuki convened an emergency meeting of the six-man Supreme War Council. "There is no way left to us but surrender," said Suzuki. "We must act now, while our chief adversary is still the United States, before the Russians penetrate Korea and northern Japan." The six men argued for hours, but could not reach an agreement. Three of them refused to accept surrender.

The full Cabinet met that afternoon to debate the issue with the same result. Even the news of a second atomic bomb dropped on the southern port city of Nagasaki didn't sway the militants. When the meeting adjourned that evening, it had achieved no agreement. It was then that Emperor Hirohito, fearing more atomic blasts on his people, took the initiative.

Although he was lord of the land, the Emperor did not normally make policy decisions. He reigned without ruling, more of a figurehead than a true leader. But convinced that only he could break the impasse, he called the members of the Cabinet and Supreme War Council to his underground complex near the imperial palace. For two hours Hirohito listened to the hopelessly opposing views of the ministers. Then he spoke. "Ending the war is the only way to restore world peace and relieve the nation from the terrible distress

with which it is burdened," he said. "We must bear the unbearable."

After much internal wrangling, the Emperor again stepped in. He made a recording announcing to his people that it was time to surrender. Though some officers tried vainly to squelch the recording, it was aired on every radio station in Japan on August 15.

Activity all over the country came to a halt at noon, as people gathered around radios to hear what an earlier newscast had promised would be a very important message. For most people, it was the first time they'd heard the high-pitched voice of their Emperor. His words came out haltingly, in a formal court dialect that was hard to understand. But the message was clear. The war was over. The Japanese people began to wonder what U.S. occupation would be like.

On August 28, their questions were answered when 45 American C-47 transports landed at Tokyo's Atsugi Air Base, carrying the first of nearly a half-million Americans who would land within the month. The following day, hundreds of Allied warships steamed into

A Charmed Life

There are probably hundreds of thousands of combat survivors who can look back and say, "I should be dead." Most of them are referring to some incident that providence shown upon with grace. There are thousands who can apply that same standard in a pluralistic way. It is after all, possible to dodge a bullet more than once.

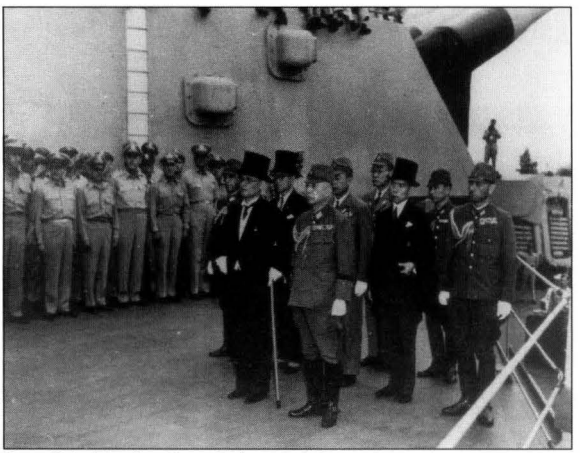
But the number of men who can count their trips to the edge of the abyss in the dozens and still survived, are probably few. Saburo Sakai is one of that group. It is doubtful that even he knows how many combat missions he flew, or how often he landed in a plane riddled by gunfire.

We do know that he flew in China and the gods were charitable. He flew with Nishizawa in New Guinea with the Lae wing and survived. In the Solomons he flew, was grievously wounded, flew 700 miles more, (literally on a wing, a prayer and instinct), spent a year in the hospital and finally returned to combat as a one-eyed squadron leader. He not only survived, but he prevailed.

You cannot always count on superior airmanship. Sometimes you must have the luck of the gods on your side.

Saburo Sakai, still living, is one of the highest scoring Japanese airman to survive the war. By any standard you choose he should not only be dead, he should be dead several times over.

Tokyo Bay. On August 30, General MacArthur's personal C-47, the Bataan, touched down to take command of the vanquished land.



Courtesy National Air & Space Museum, Smithsonian Institution

★ The Japanese delegation at the surrender ceremony aboard the *USS Missouri.*

The formal surrender ceremonies were held aboard the *USS Missouri* on September 2. Hundreds of newsman from dozens of countries arrived early in the morning to take their assigned positions. Thousands of U.S. servicemen crowded the battleship. A color guard ran the Stars and Stripes up the mainmast—the same flag that had been flying above the U.S. Capitol on December 7, 1941. Shortly after 8 am, the American delegation filed on, led by Admiral Nimitz and General MacArthur. Then, the 10-man Japanese delegation boarded and walked along the deck to a battered felt-covered mess table that held the surrender documents.

MacArthur conducted the ceremonies. "It is not for us to meet in a spirit of distrust, malice or hatred," he began. "It is my earnest hope, indeed the hope of all mankind, that a better world shall emerge from the blood and carnage of the past." Two Japanese representatives approached the table and signed the documents. MacArthur and Nimitz then affixed their signatures, followed by representatives of China, Britain, the Soviet Union, Australia, Canada, France, the Netherlands and New Zealand.

In the distance, Mount Fuji sparkled in the sun. Two thousand Allied planes flew overhead in a massive salute. Eight years and 15 million deaths after Japan invaded China, the Pacific War was over.

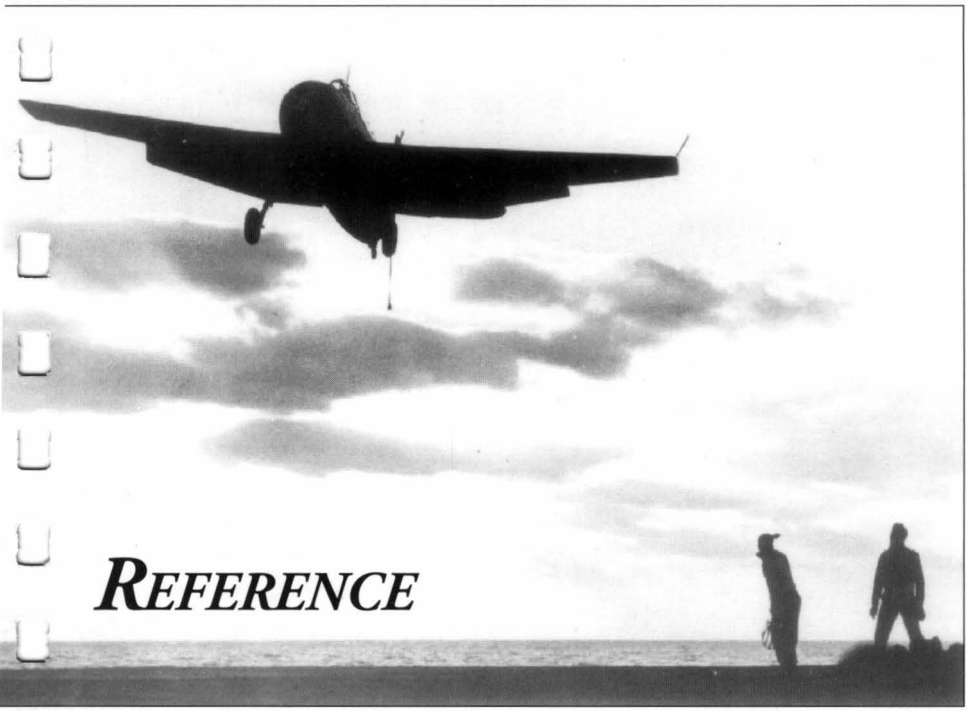
Admiral Yamamoto's prophecies had come true. The U.S. industrial capacity had overwhelmed Japan. The bold strike on Pearl Harbor, far from demoralizing America as some Japanese leaders expected, united the nation like never before. It took many months for the U.S. war industry to come up to speed. But when it did, Japan could not compete.

The post-war world rapidly changed shape. The U.S., keeping a promise made before the war, granted independence to the Philippines on July 4, 1946. India declared its independence from Great Britain in 1947. Burma followed in 1948, Malaya in 1957. Singapore became self-governing in 1959. In the Dutch East Indies, Achmed Sukarno led a movement that created the sovereign state of Indonesia in 1949. In what had been French Indochina, Cambodia gained independence in 1953, while the Vietminh, who had fought against the Japanese during the war, continued the struggle against the French, and later the Americans, until South and North Vietnam were united as an independent republic in 1976.

Many of these former impoverished colonies have since become world economic powers. Japan, with the help of billions of dollars in post-war aid from the U.S., quickly became the strongest. By 1954, the Japanese economy was once more self-sufficient. Within a few decades, Japan was so strong that it was again creating friction with the U.S.

However, unlike the military tensions that existed before the attack on Pearl Harbor, the friction between the United States and Japan is now between two allies and economic competitors.

It is a tribute to those who died in the Pacific War that a half-century later, the Pacific is still at peace.



REFERENCE

Courtesy National Air and Space Museum, Smithsonian Institution

Courtesy National Air and Space Museum, Smithsonian Institution

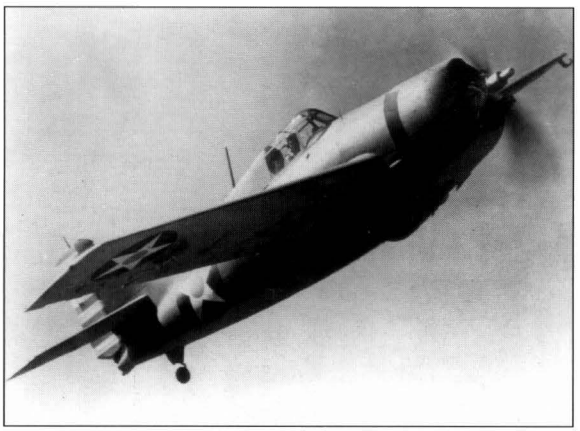
GRUMMAN F4F WILDCAT

USN Fighter

The stubby, squat Grumman F4F Wildcat was the U.S. Navy's principle fighter during the first half of the war. The first active version was the F4F-3, which saw combat in the battle at Wake Island, the Battle of the Coral Sea, and other early war engagements. Initially, the Wildcat fared poorly in dogfights against its adversary, the Japanese A6M Zero.

Although the Wildcat was more durable and had somewhat greater firepower, it was outmatched by the climb rate and phenomenal maneuverability of the Zero.

By June of 1942, the F4F-4 had replaced the F4F-3. The F4F-4 had more firepower with the addition of two .50-caliber guns in the wings. Its primary asset was its folding wings, which allowed more to be stored on board the fleet carriers.



Courtesy National Air and Space Museum, Smithsonian Institution

★ An F4F Wildcat in flight. The F4Fs remained in service on escort carriers until the end of the war. After 1943, they were built by General Motors and redesignated FM-2s.

The F4F-4 saw combat at the Battle of Midway, in which Jimmy Thach employed his famous "Thach Weave" tactic. By working as a team, he demonstrated that a Wildcat division could successfully fight against a division of Zero fighters.

The Wildcat remained the mainstay of the U.S. Navy until mid-1943 when it was replaced by more powerful aircraft such as the F6F Hellcat and F4U Corsair.

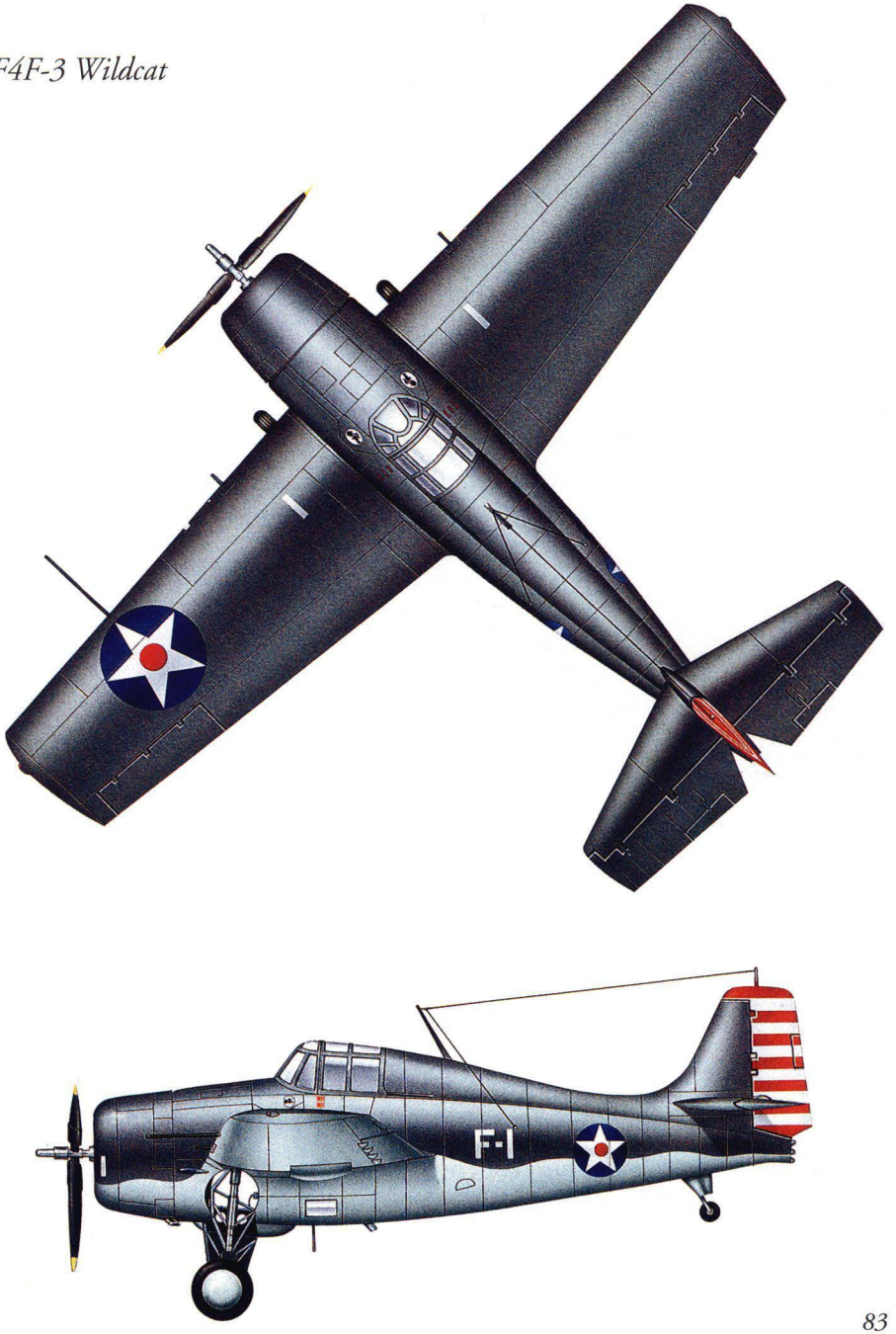
Specifications for the F4F-3 and F4F-4

Type: Fighter
Introduced: December 1940
Length: 28.8 ft.
Wingspan: 38 ft.
Crew: 1
Weight Empty: 5,342 lbs. (F4F-3), 5,758 lbs. (F4F-4)
Weight Loaded: 7,002 lbs. (F4F-3), 7,406 lbs. (F4F-4)

Power Plant: One 1,200 hp. Pratt and Whitney R-1830 radial
Armament: Four .50-caliber machine guns in the wing (F4F-3).
Six .50-caliber machine guns in the wing (F4F-4).
Ordnance: Two 100-pound bombs.

Top Speed: 331 mph (F4F-3), 328 mph (F4F-4)
Range: 860 miles (F4F-3), 830 miles (F4F-4)
Ceiling: 29,000 ft.
Climb Rate: 2,300 ft./min. (F4F3), 2,200 ft./min. (F4F-4)
Maneuverability: Average
Firepower: Good
Durability: Good

F4F-3 Wildcat

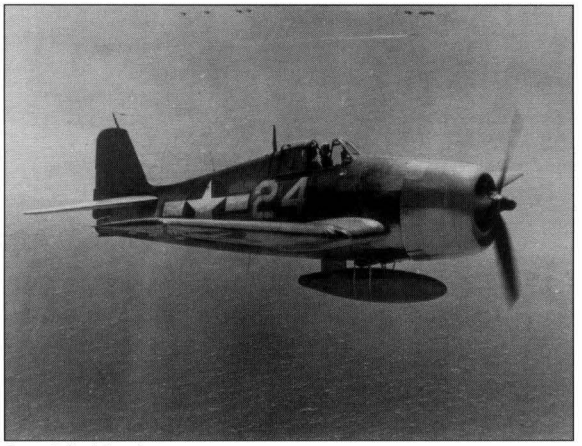


GRUMMAN F6F HELLCAT

USN Fighter

The Hellcat joined the fleet in large numbers in August of 1943. It remained the principle U.S. Navy fighter until the end of the war.

From the day the Hellcat entered combat, it had the Zero completely outmatched. It was far faster, could climb more quickly, had greater firepower, was more durable and, at high speed possessed greater maneuverability. It is therefore, not surprising that more American aces flew the Hellcat in combat than any other aircraft type.



Courtesy Tailhook Photo Service

The Hellcat was also a very stable gun platform, and its forgiving flight characteristics made it easy to fly. This was a critical factor contributing to the success of the Hellcat which was flown by many young, inexperienced pilots.

The Hellcat was produced in far larger numbers than any other U.S. Navy fighter in WWII. By the end of the war, Grumman had produced over 12,000 Hellcats. It can safely be called the most successful naval fighter of the war.

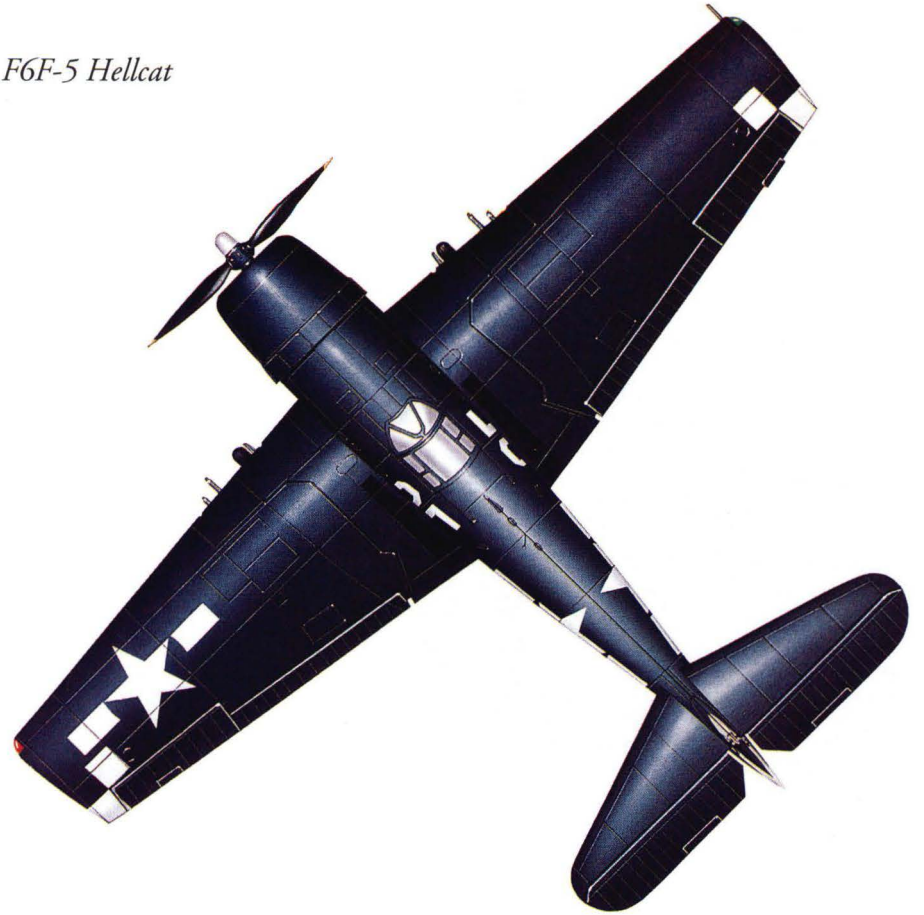
Specifications for the F6F-5

Type: Fighter/fighter bomber
Introduced: Jan. 1943
Length: 33.6 ft.
Wingspan: 42.8 ft.
Crew: 1
Weight Empty: 9,101 lbs.
Weight Loaded: 12,441 lbs.

Power Plant: One 2,000 hp. Pratt and Whitney R-2800 radial
Armament: Six .50-caliber machine guns
Ordnance: Two 500-pound bombs and six rockets.

Top Speed: 386 mph
Range: 1,090 miles
With drop tanks: 1,530 miles
Ceiling: 37,000 ft.
Climb Rate: 3,500 ft./min.
Maneuverability: Excellent
Firepower: Good
Durability: Excellent

F6F-5 Hellcat



CHANCE-VOUGHT F4U CORSAIR

USN and USMC Fighter

The F4U became the standard USMC fighter from early 1943 until the end of the war. However, the U.S. Navy did not consider it suitable for carrier use. The pilot's visibility over the nose was poor, and the plane had a tendency to bounce when landing. These factors, plus the tendency of the Corsair to spin when stalling made it a dangerous plane to land on a carrier deck. Eventually, these teething problems were worked out, and by late 1944 the Navy began basing Corsair units on its Essex-class carriers in large numbers.

Courtesy National Air and Space Museum, Smithsonian Institution

★ Two Corsairs on the deck of the *USS Enterprise* waiting to takeoff. Equipped as nightfighters, small numbers of F4Us served with VF-101 on the *Enterprise* and *Intrepid.*

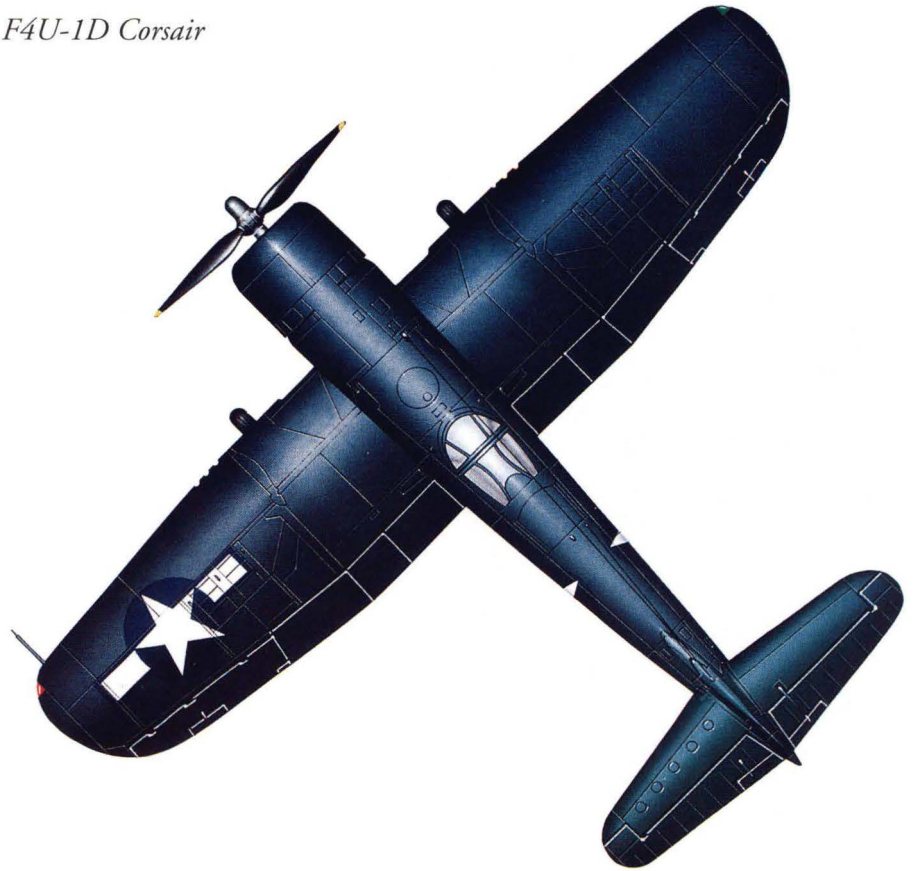
The F4U was faster, could climb and dive more quickly, and had better acceleration than any of the mid-war Japanese planes it faced. It also demonstrated itself to be very durable and rugged. Although it was not as maneuverable as the Hellcat, it was 50 mph faster.

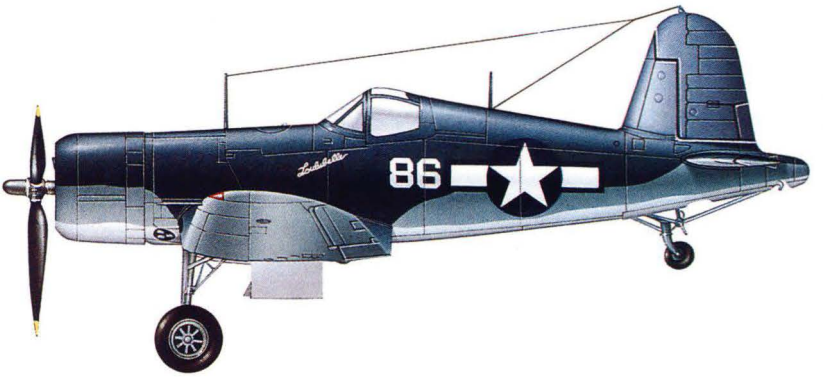
The Corsair's tendency to spin made it a difficult plane to fly, and it was quickly named the "ensign eliminator." However, in the hands of a skilled flier, it was the U.S. Navy fighter of choice.

Specifications for the F4U-1A

Type: Fighter-bomber
Introduced: February 1943
Nickname: Hog, Hognose,Hosenose, Ensign Eliminator
Length: 32.8 ft.
Wingspan: 41 ft.
Crew: 1
Weight Empty: 9,205 lbs.
Weight Loaded: 12,420 lbs.
Power Plant: One 2,000 hp. Pratt and Whitney R-2800 radial
Armament: Six .50-caliber machine guns in the wings.
Ordnance: Two 500-pound bombs and eight rockets
Top Speed: 425 mph
Range: 1,015 miles
With drop tanks: 1,562 miles
Ceiling: 37,000 ft.
Climb Rate: 3,200 ft./min.
Maneuverability: Good
Firepower: Good
Durability: Excellent

F4U-1D Corsair

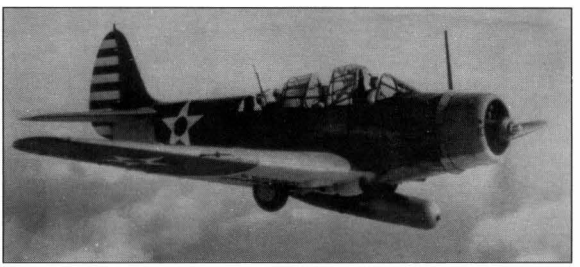




DOUGLASS TBD DEVASTATOR

USN Torpedo Bomber

The TBD torpedo bomber entered service in the mid-1930s as one of the most modern aircraft in the U.S. Navy's inventory. By 1941 however, it had become obsolete. The Devastator was a terrible airplane that was slaughtered in combat when not heavily escorted by Wildcats. At Midway, 37 of 41 were wiped out in about an hour of fighting. Most of the crews were killed. After this fiasco, the TBD was quickly replaced with the TBF Avenger, a much better aircraft.



Courtesy Tailhook Photo Service

★ A TBD in flight. Most Devastators did not survive the first six months of the war, especially after Midway when three full squadrons were destroyed.

Due to the nature of the torpedoes the Devastator carried, the pilots had to fly at 50 feet and slower than 100 mph in order to successfully release their load. If the torpedo was dropped from a higher altitude or from a faster speed, it would porpoise, break in two, or propel itself straight down towards the ocean floor.

The TBD with a torpedo slung under the fuselage had a maximum speed of 125 mph at sea level. With a full ordnance load, the plane could barely achieve 14,000 feet.

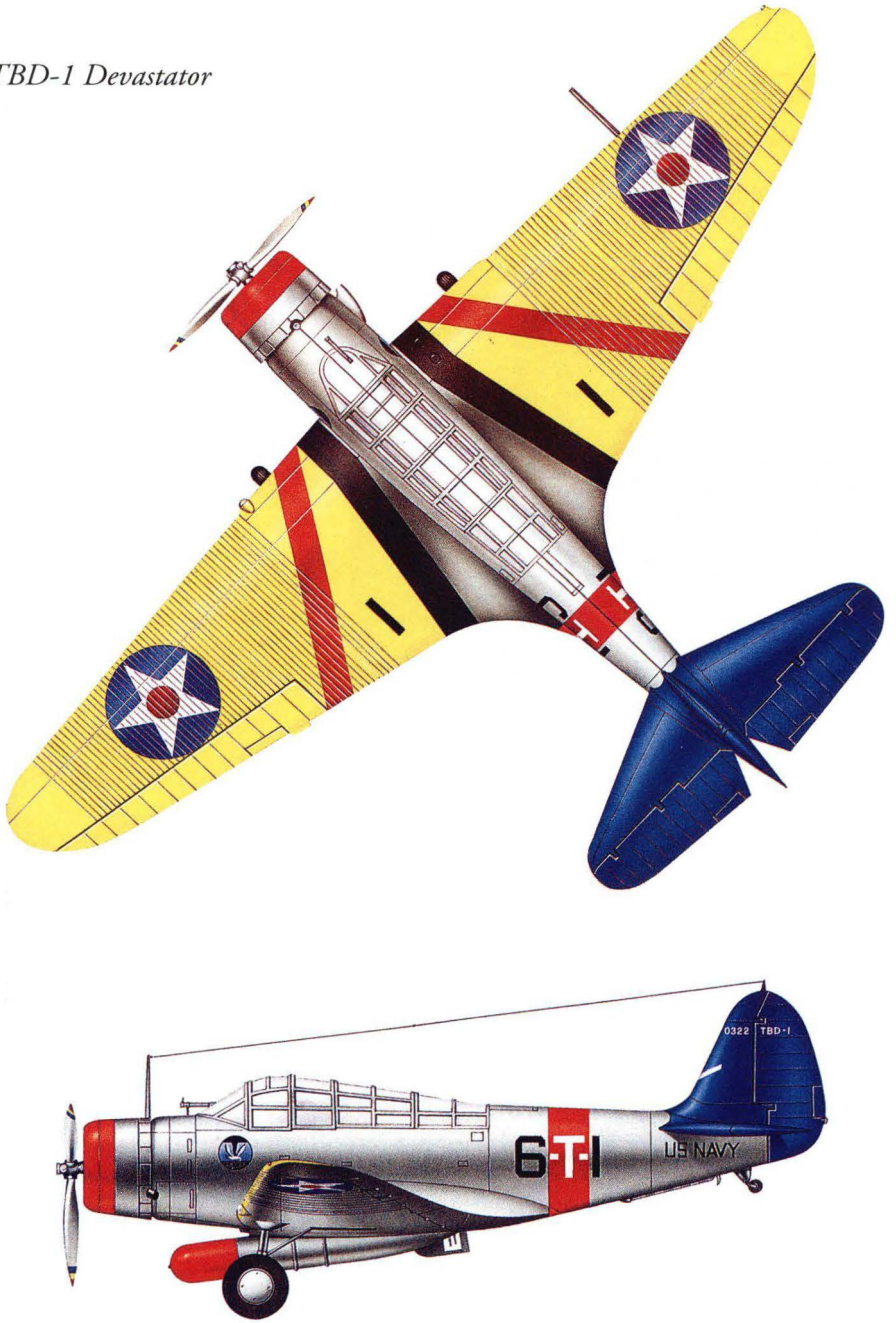
Specifications for the TBD-1

Type: Torpedo bomber
Introduced: 1937
Length: 35 ft.
Wingspan: 50.3 ft.
Crew: 2-3
Weight Empty: 6,182 lbs.
Weight Loaded: 9,862 lbs.

Power Plant: One 900 hp. Pratt and Whitney R-1830-64 Twin Wasp Radial.
Armament: One .50-caliber or two .30-caliber machine guns in the rear and one .50-caliber machine gun in the nose.
Ordnance: One torpedo or up to 1,000 pounds of bombs

Top Speed: 206 mph
Range: 916 miles
Ceiling: 19,500 ft.
Climb Rate: 700 ft./min.
Maneuverability: Fair
Firepower: Poor
Durability: Good

TBD-1 Devastator



DOUGLASS SBD DAUNTLESS

USN, USMC and USAAF Dive Bomber

The SBD was a solid, unexciting aircraft that performed its job faithfully. It was stable and forgiving to fly with fairly responsive controls. Early versions could not extend the dive brakes at its maximum speed. This meant that in combat the Dauntless pilots had to throttle back to begin an attack dive. The plane was well constructed and could handle sustained dives of up to seventy degrees.

Courtesy National Air and Space Museum, Smithsonian Institution

★ An SBD carrying two small 100-pound bombs.

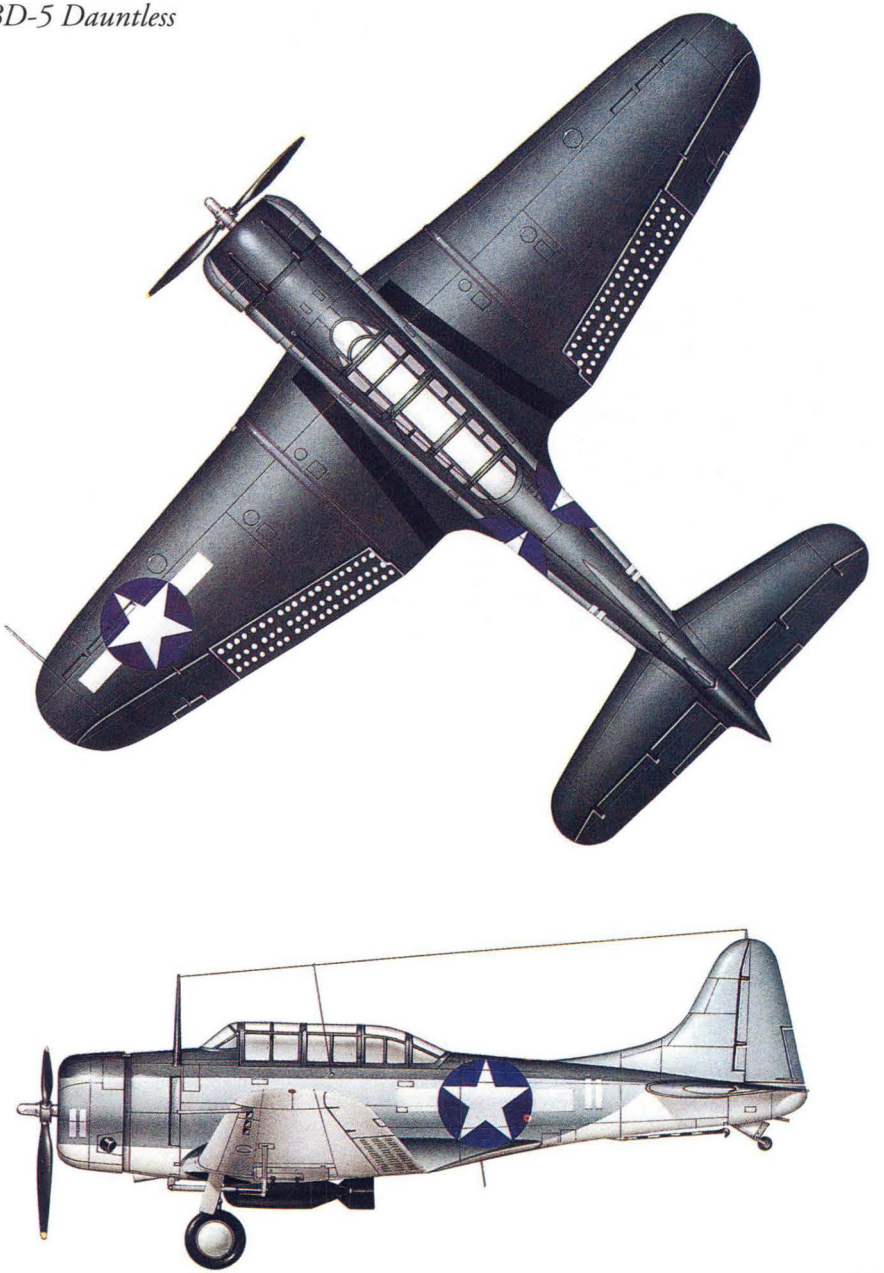
Being fairly maneuverable, the SBD was occasionally pressed into service as an anti-torpedo bomber interceptor. It played this role well at Coral Sea.

The SBD was the Navy's most successful dive bomber, and was preferred by pilots over its successor, the Curtiss SB2C Helldiver.

Specifications for the SBD-3

Type: Dive bomber
Introduced: June 1940
Nickname: Slow But Deadly, Speedy D
Length: 32.7 ft.
Wingspan: 41.5 ft.
Crew: 2
Weight Empty: 6,345 lbs.
Weight Loaded: 10,400 lbs.
Power Plant: One 1,000 hp. Wright-Cyclone R-1820-52 Radial
Armament: Two .50-caliber machine guns in the nose and two .30-caliber in the rear seat.
Ordnance: Up to 1,000 pounds of bombs
Top Speed: 250 mph
Range: 1,580 miles
Ceiling: 27,000 ft.
Climb Rate: 1,200 ft./min.
Maneuverability: Fair
Firepower: Poor
Durability: Good

SBD-5 Dauntless



GRUMMAN TBF AVENGER

USN and USMC Torpedo Bomber

The TBF Avenger became the standard Navy torpedo bomber in WWII after the Battle of Midway in June 1942. It was a slow, lumbering and large airplane that had extraordinarily insensitive controls. At the same time, it was a docile, easy plane to fly that could take enormous amount of damage and still stay in the air. Literally hundreds of holes could be gouged into the airframe and it would remain airworthy.

Courtesy National Air and Space Museum, Smithsonian Institution

★ An Avenger passing a small carrier.

Despite its size, it was well-suited for carrier duty as it possessed a very low stalling speed. It was used successfully throughout the war as both a torpedo bomber and a level bomber.

Future U.S. President, George Bush was shot down in a TBF in 1944 during one of the numerous carrier task force raids into the IwoJima area.

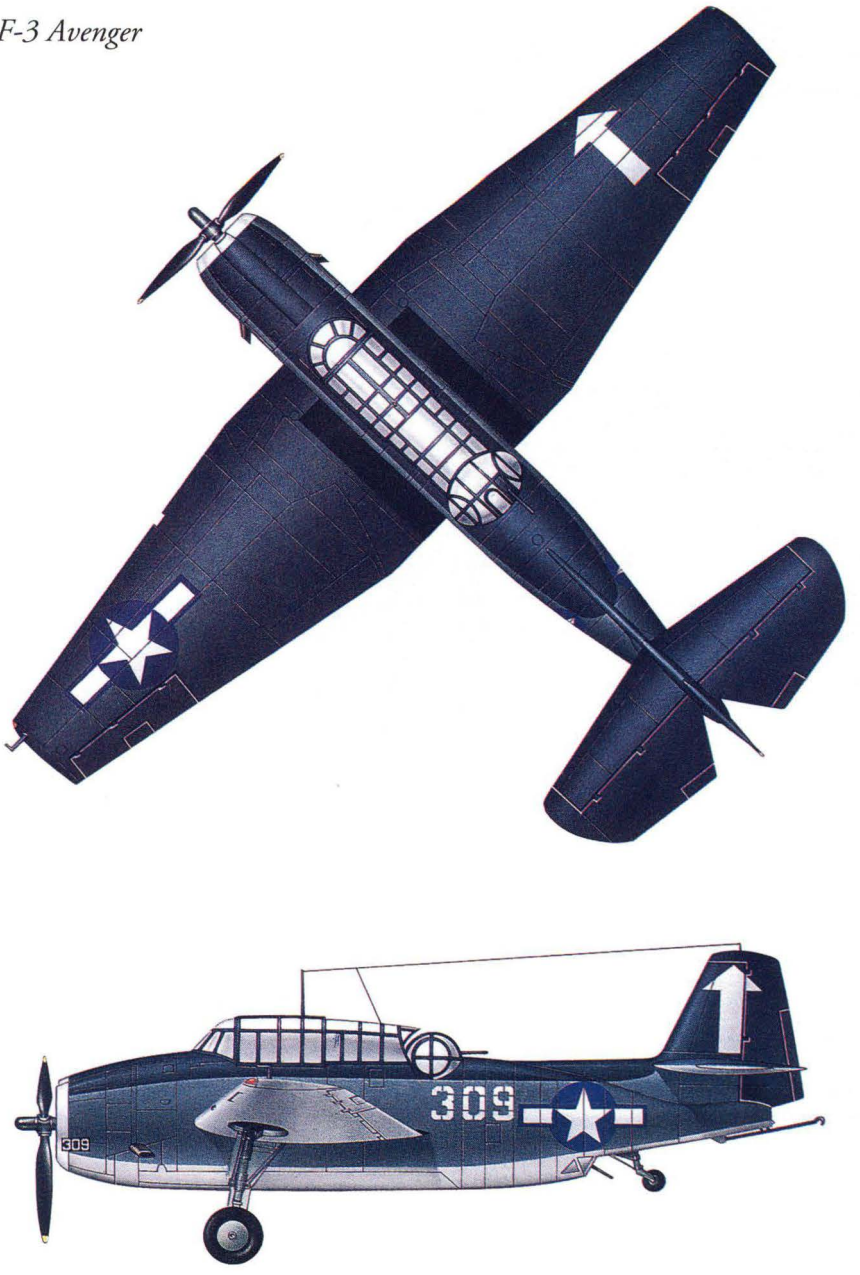
Specifications for the TBF

Type: Torpedo bomber
Introduced: June 1942
Nickname: Turkey
Length: 40 ft.
Wingspan: 52.2 ft.
Crew: 3
Weight Empty: 10,080 lbs.
Weight Loaded: 13,667 lbs.

Power Plant: One 1,723 hp. air-cooled radial.
Armament: One .50-caliber machine gun firing forward, one .30-caliber in the ventral tunnel, and one .30-caliber in the rear dorsal turret.
Ordnance: One torpedo or up to 1,500 pounds of bombs

Top Speed: 271 mph
Range: 1,215 miles
Ceiling: 22,400 ft.
Climb Rate: 700 ft./min.
Maneuverability: Poor
Firepower: Poor
Durability: Excellent

TBF-3 Avenger



CURTISS SB2C HELLDIVER

USN Dive Bomber

The SB2C, or "son of a bitch, 2nd class," was probably the worst aircraft deployed to U.S. carriers during WWII. It was slow and ungainly to fly. In steep dives, the SB2C was an unstable bombing platform. Correcting onto the target in a dive was made even more difficult by the unresponsive and heavy controls, especially the rudder and elevators.

While it could carry a bigger load than the SBD, it was only marginally faster, far less maneuverable, and possessed a shorter combat radius than its predecessor.

All and all, most pilots preferred the SBD to the Beast. It entered service in late 1943, and completely replaced the Dauntless just after the Battle of the Philippine Sea.

Courtesy Tailhook Photo Service

★ A late war photo of an SB2C. Note the hardpoints on the wings for rockets.

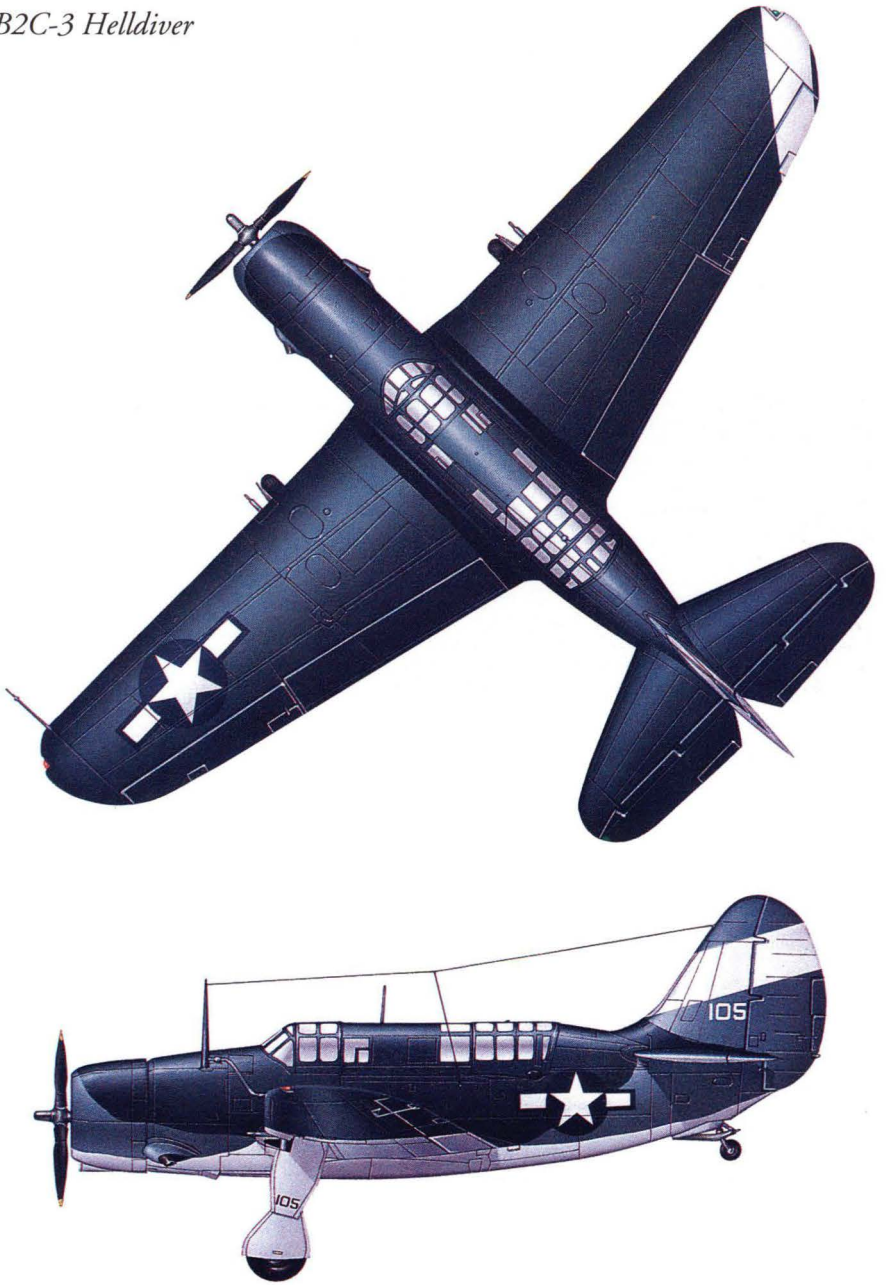
Specifications for the SB2C

Type: Dive bomber
Introduced: Fall 1943
Nickname: The Beast
Length: 36.8 ft.
Wingspan: 46.8 ft.
Crew: 2
Weight Empty: 10,547 lbs.
Weight Loaded: 14,189 lbs.

Power Plant: One 1,700 hp. Wright-Cyclone R-2600 Radial.
Armament: Two 20mm cannon in the nose and two .30-caliber in the rear.
Ordnance: Up to 2,000 pounds of bombs or two 500-pound bombs and six rockets

Top Speed: 295 mph
Range: 1,165 miles
Ceiling: 29,000 ft.
Climb Rate: 1,800 ft./min.
Maneuverability: Poor
Firepower: Average
Durability: Good

SB2C-3 Helldiver



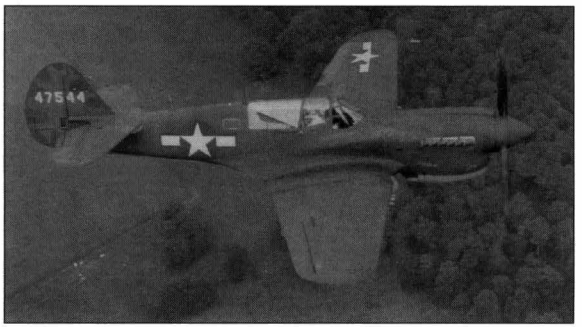
CURTISS P-40 WARHAWK

USAAF Fighter

The P-40 was the standard USAAF fighter used from the outbreak of the Pacific War until early 1944. The E version formed the backbone of the USAAF squadrons until they were re-equipped with later model P-40s, and P-38s. In the Southwest Pacific, the P-40 saw service in limited numbers in the Philippines and Pearl Harbor, and extensive service in Australia, the Dutch East Indies and New Guinea.

Above 15,000 feet the P-40 was slow and sluggish. Below 15,000 feet, it was an average aircraft at best. It had a fairly good rate of roll, but could not turn inside any of its opponents. In steep dives the airplane experienced compressibility, and it took several thousand feet to pull out of the dive. The P-40 was also prone to enter a spin when it stalled. The best tactic with the P-40 was to climb above the target aircraft, dive through the formation, then run for home. There was usually not enough time for the P-40 to climb back above the target before being bounced by enemy fighters.

All in all, it was a mediocre plane whose main attribute was its rugged construction.



Courtesy Tailhook Photo Service

★ A late model P-40 in flight. P-40s served well into 1944 in the Pacific, despite their obsolescence.

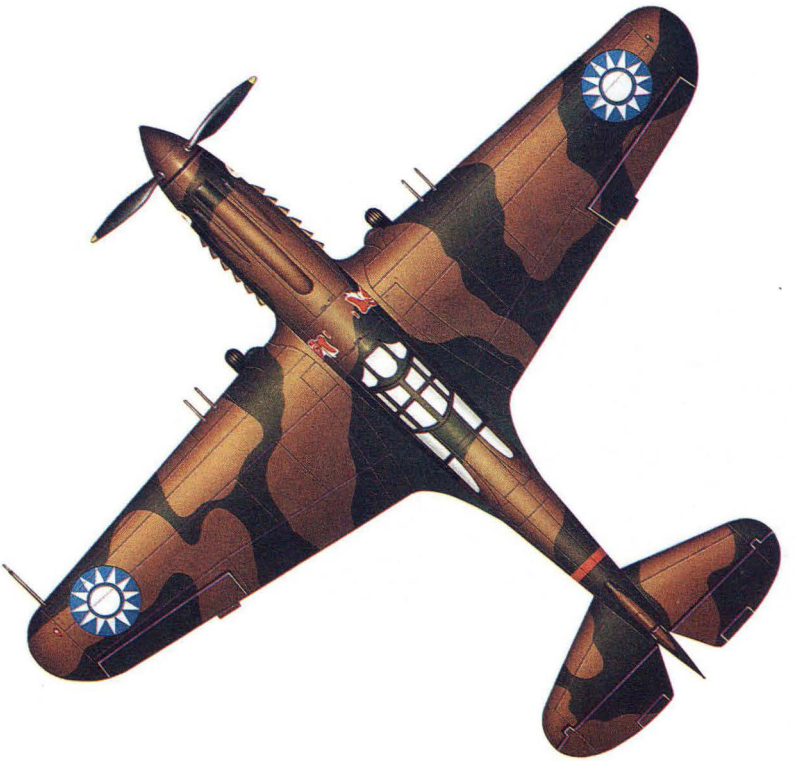
Specifications for the P-40E Warhawk

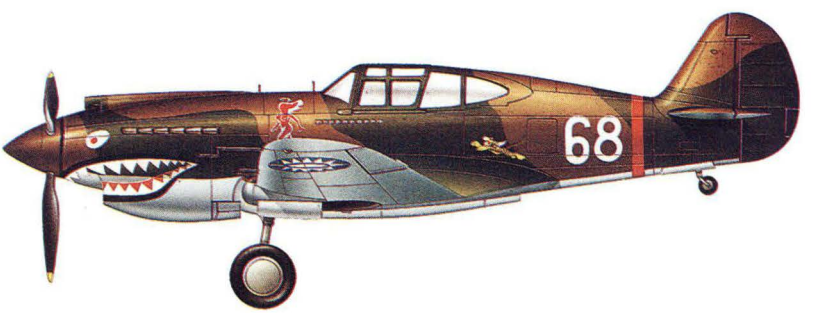
Type: Fighter/fighter-bomber
Introduced: Spring 1940
Length: 33.3 ft.
Wingspan: 37.3 ft.
Crew: 1
Weight Empty: 7,500 lbs.
Weight Loaded: 8,100 lbs.

Power Plant: One 1,300 hp. Liquid cooled Merlin.
Armament: Six .50-caliber machine guns in the wings.
Ordnance: Up to 500 pounds of bombs

Top Speed: 360 mph
Range: 700 miles
With drop tanks: 1,500 miles
Ceiling: 29,000 ft.
Climb Rate: 2,050 ft./min.
Maneuverability: Average
Firepower: Good
Durability: Good

P-40C Warhawk



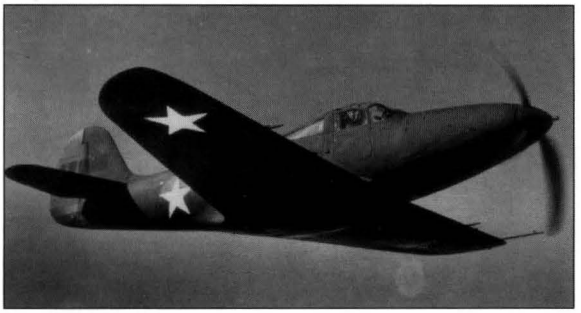


BELL P-39 AIRACOBRA

USAAF Fighter

The P-39 was one of the most advanced fighters of its day. It was the first fighter to be equipped with tricycle landing gear, having one wheel forward of the wing wheels. It was designed around one of the largest airborne weapons of the day, the powerful 37mm cannon. In early tests, the P-39 achieved an impressive speed of 390 mph at 20,000 feet. For this reason it was initially deployed as an interceptor.

Despite all of the early indications that the P-39 would be one of the finest fighters in service, it was plagued by some serious problems and would go down in history as a failure. The greatest defect of the plane was the lack of a supercharger, making the plane entirely unsuitable for use at high altitude. Above 15,000 feet it was sluggish and slow. Consequently, it was relegated to ground attack duties.



Courtesy Tailhook Photo Service

★ The Iron Dog, a P-39 Airacobra in flight. Most pilots despised this tricky, quirky plane.

The P-39 was detested by most of its pilots, who referred to it as the "Iron Dog." Its 37mm cannon was inaccurate due to its low muzzle velocity. This plus the fact that it usually jammed after one or two shots made the weapon ineffective.

The P-39 remained in service as a reconnaissance and ground attack aircraft well into 1943.

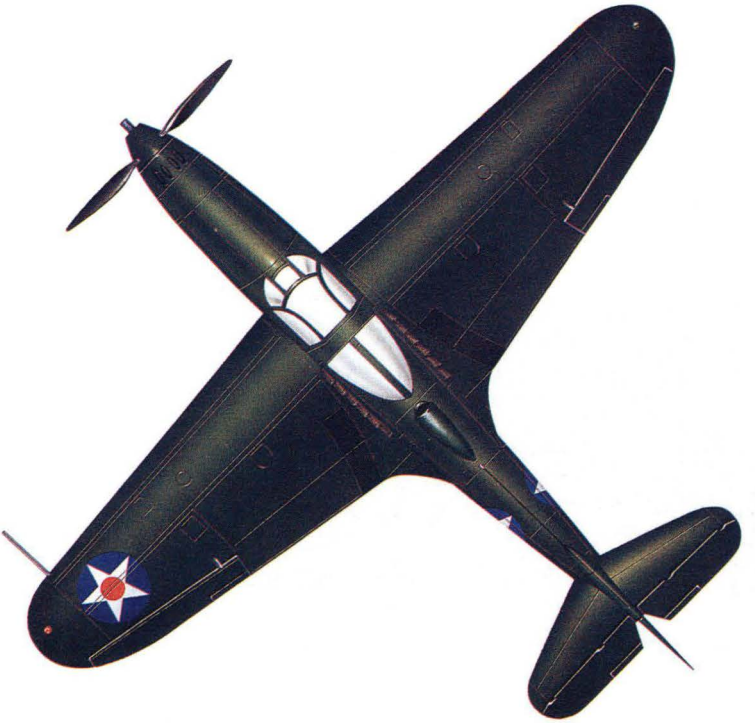
Specifications for the P-39D

Type: Interceptor/ground attack fighter
Introduced: Jan. 1941
Nickname: Iron Dog
Length: 30.2 ft.
Wingspan: 34 ft.
Crew: 1
Weight Empty: 5,462 lbs.
Weight Loaded: 7,650 lbs.

Power Plant: One 1,150 hp. Allison in-line, liquid cooled.
Armament: One 37mm cannon, four .30-caliber machine guns in the wings and two .50-caliber machine guns in the nose.
Ordnance: Up to 500 pounds of bombs

Top Speed: 360 mph
Range: 600 miles
With drop tanks: 1,100 miles
Ceiling: 29,000 ft.
Climb Rate: 2,600 ft./min.
Maneuverability: Average
Firepower: Average
Durability: Good

P-39 Airacobra



LOCKHEED P-38 LIGHTNING

USAAF Fighter

The P-38F was one of the first models of the Lightning to see combat in the Pacific Theater in late 1942. Although smooth and stable, the major foible it did have, was often fatal. In steep dives, the P-38 experienced compressibility problems. When one entered such a dive, the stick became seemingly rooted in cement and nothing the pilot could do would effect a pull-out. The heavier air at lower altitudes allowed the pilot to finally pull out of the dive. The J model entering service in 1944, corrected this problem with dive flaps. Because the propellers rotated in opposite directions, it did not spin when stalled and there was no significant amount of torque either way in level flight. In high speeds stalls, it would flick out of the turn and lose altitude without spinning.

Courtesy Tailhook Photo Service

★ Two of the hundreds of Lightnings that helped gain control of the air over New Guinea.

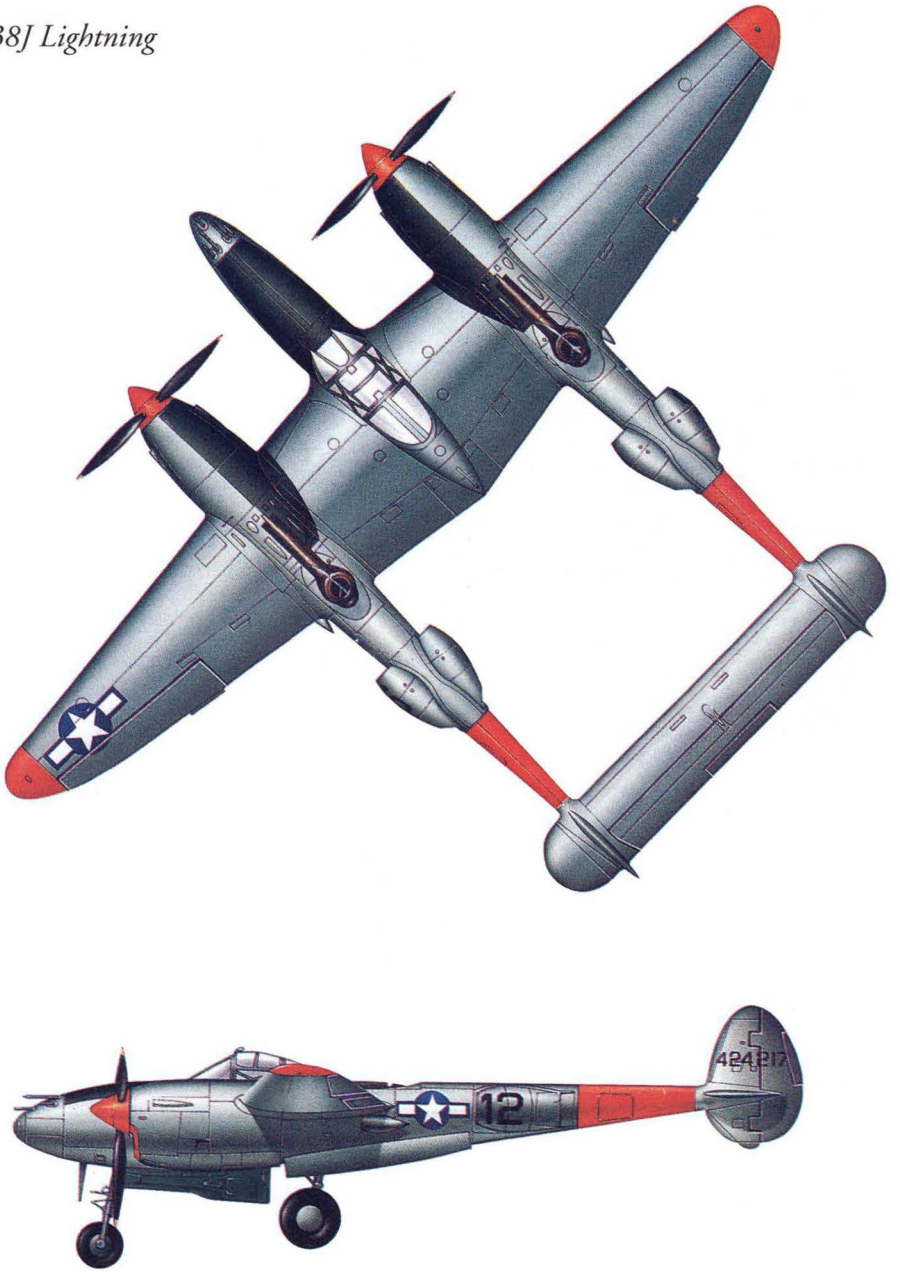
The Lightning performed very well at high altitude. It was equipped with extremely effective turbochargers that made it very fast in the thinner air above 20,000 feet. It was also more maneuverable at these heights than many other aircraft.

The main strength of the P-38 was its high speed. It was over 50 mph faster than the Zero. And although it could not climb as steeply as the Zero, it could climb faster at higher speeds. This was the plane that turned the tide against the Japanese in the air over New Guinea in 1943.

Specifications for the P-38F, P-38J Lightning

Type: Fighter-bomber
Introduced: October 1942
Nickname: Peter Three-Eight
Length: 37.8 ft.
Wingspan: 52 ft.
Crew: 1
Weight Empty: 12,264 lbs. (P-38F),
12,780 lbs. (P-38J)
Weight Loaded: 15,900 lbs.(P-38F), 17,400 lbs. (P-38J)
Power Plant: Two 1,225 hp. liquid-cooled Allisons (P-38F), two 1,425 hp. liquid-cooled Allisons (P-38J).
Armament: One 20mm cannon and four .50-caliber machine guns, all in the nose.
Ordnance: Up to 2,000 pounds of bombs or two 500-pound bombs and ten rockets.
Top Speed: 395 mph (P-38F), 414 mph (P-38J)
Range: 475 miles
With drop tanks: 2,260 miles
Ceiling: 44,000 ft.
Climb Rate: 2,500 ft./min. (P-38F), 3,200 ft./min. (P-38J)
Maneuverability: Good
Firepower: Excellent
Durability: Excellent

P-38J Lightning



REPUBLIC P-47 THUNDERBOLT

USAAF Fighter

The P-47 was probably the most durable and rugged single seat fighter of WWII. While it did not climb steeply or quickly, it could dive out of the sky like a brick. Some Thunderbolt pilots claim to have nearly reached Mach One in steep dives. Although it was not as nimble a fighter as its prime opponents, the Zero, Tony and Oscar, it could out-dive anything in the air.

Courtesy Tailhook Photo Service

★ Late war P-47Ds with the bubble canopies. These canopies dramatically improved the pilot's rearward vision.

Later, when more maneuverable fighters became available, the P-47 was increasingly used as a ground attack fighter. This was a role to which the plane was well suited. It served in the Pacific from 1943 until the end of the war.

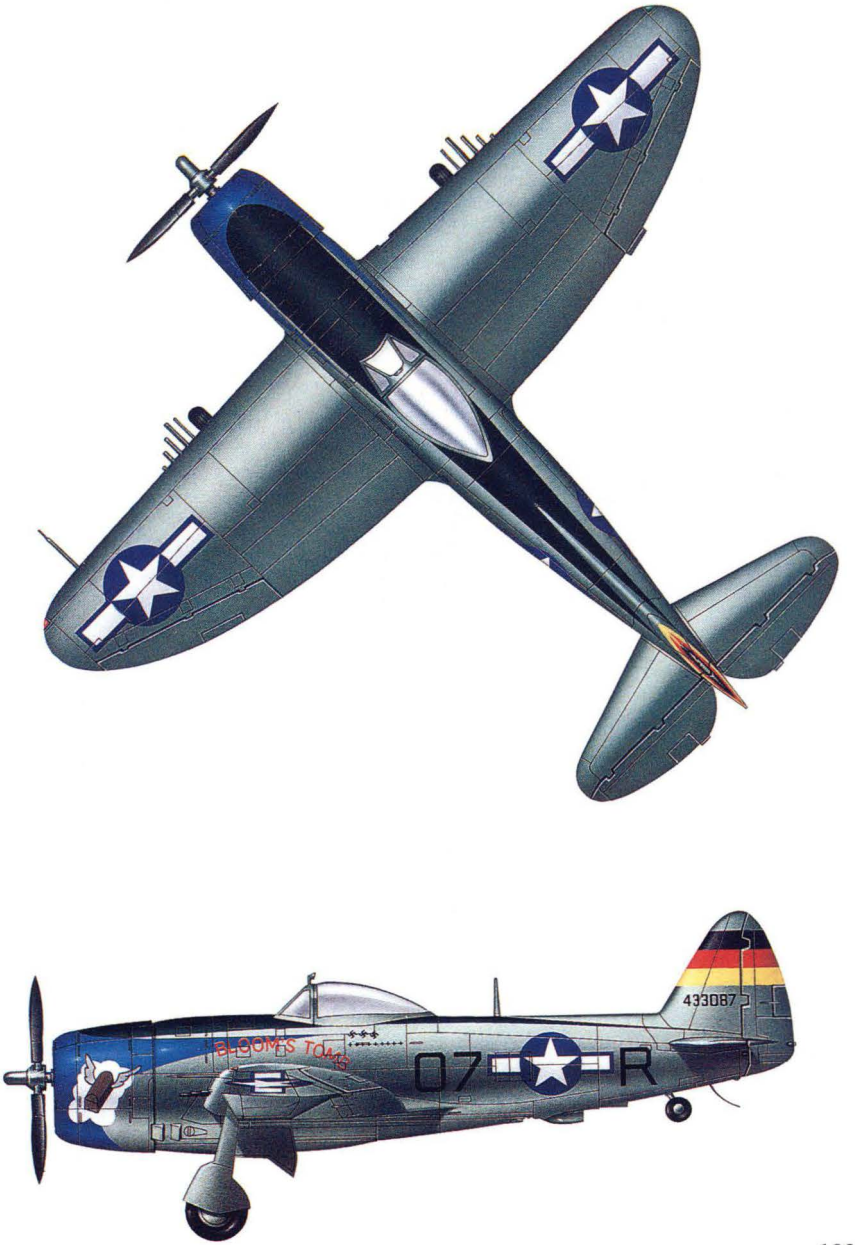
Specifications for the P-47D

Type: Fighter-bomber
Introduced: April 1943
Nickname: The Jug
Length: 36 ft.
Wingspan: 40.8 ft.
Crew: 1
Weight Empty: 9,900 lbs.
Weight Loaded: 13,500 lbs.

Power Plant: One 2,535 hp. Pratt and Whitney R-2800-9 Radial.
Armament: Eight .50-caliber machine guns.
Ordnance: Up to 2,500 pounds of bombs or 1,500 pounds of bombs and 10 rockets

Top Speed: 429 mph
Range: 700 miles
With drop tanks: 1,500 miles
Ceiling: 29,000 ft.
Climb Rate: 2,050 ft./min.
Maneuverability: Average
Firepower: Excellent
Durability: Excellent

P-47D Thunderbolt



NORTH AMERICAN P-51 MUSTANG

USAAF Fighter

The Mustang was the outstanding USAAF fighter of WWII. Its long range performance ensured the continuation of the strategic bombing campaign in Europe and concomitantly dealt the death blows to the Luftwaffe. In the Pacific, the P-51D saw service in relatively small numbers at the end of the war.

In the last months of the war, the P-51D was based off Iwo Jima and Okinawa and flew escort missions for B-29s over Japan.

Courtesy Foto Consortium

★ A Mustang with rocket hardpoints on the wings. It was a mediocre fighter-bomber since its liquid-cooled engine was highly vulnerable to enemy ground fire.

Because of the laminar flow wing, the Mustang had very little drag. This made it very fast and gave it the ability to accelerate quickly to its maximum speed. In the Pacific, only the George, the Frank and the Ki-100 could even come close to matching the performance of the P-51D.

Later, just as the war was winding to an end, the P-51H was introduced. This variant proved to be even faster and more maneuverable than the D model. A total of 555 H models were produced.

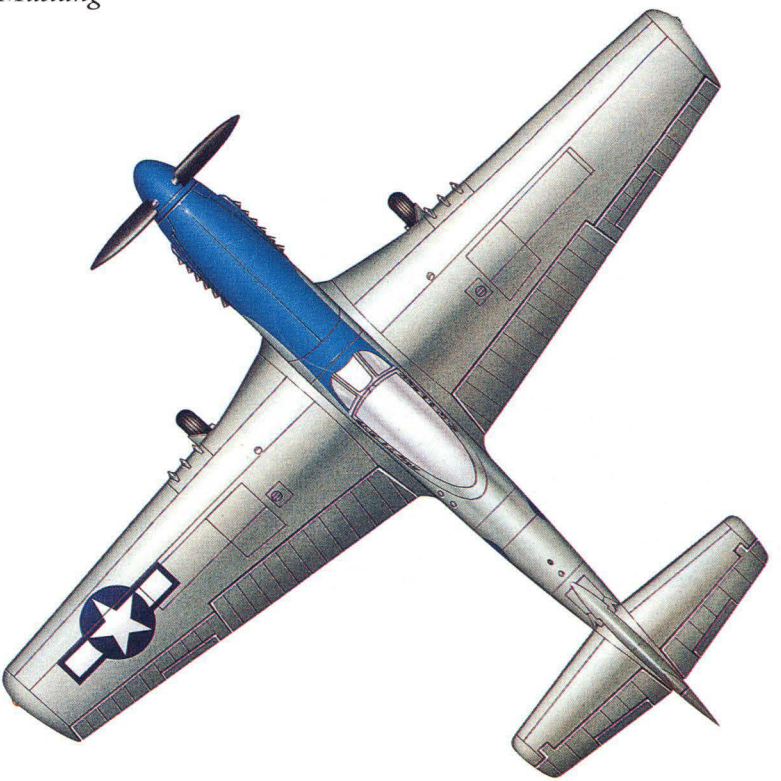
Specifications for the P-51D

Type: Long range escort fighter/ fighter-bomber
Introduced: Mid 1944
Length: 32.3 ft.
Wingspan: 37 ft.
Crew: 1
Weight Empty: 7,125 lbs.
Weight Loaded: 10,100 lbs.

Power Plant: One 1,510 hp. Rolls Royce Merlin (Packard) liquid-cooled.
Armament: Six .50-caliber machine guns.
Ordnance: Up to 2,000 pounds of bombs or two 500-pound bombs and six rockets

Top Speed: 437 mph
Range: 950 miles
With drop tanks: 2,080 miles
Ceiling: 41,900 ft.
Climb Rate: 3,150 ft./min.
Maneuverability: Excellent
Firepower: Good
Durability: Good

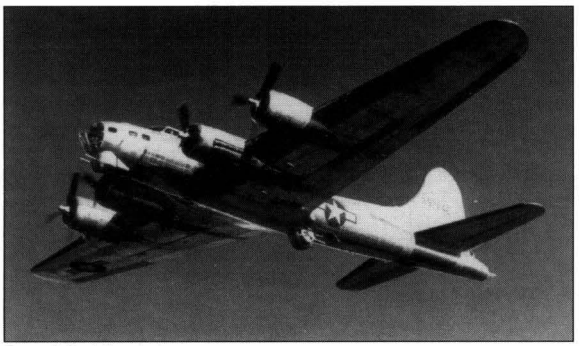
P-51D Mustang



BOEING B-17 FLYING FORTRESS

USAAF Bomber

The B-17D was the only version of the B-17 available to the USAAF in the Pacific at the outbreak of the war. Most of these aircraft, initially based at Hickam Field in Hawaii and Clark Field in the Philippines, were wiped-out in the first few months of the war. Those that survived the initial onslaught in the Far East were evacuated first to Mindanao (an island in the southern Philippines) and then later to the Dutch East Indies.



Courtesy Tailhook Photo Service

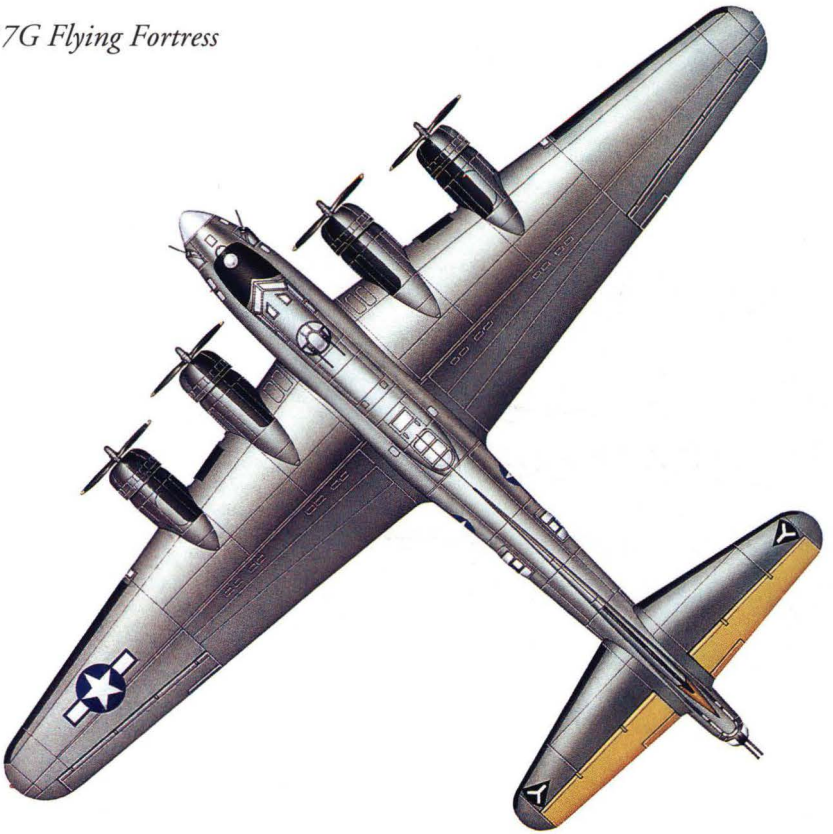
On March 1, the surviving B-17s fled to Australia where they formed the core of several new bombardment units. By early summer of 1942, no B-17Ds remained in front-line duty. Their replacements, the B-17Es, would be used extensively against Rabaul in both day and night attacks.

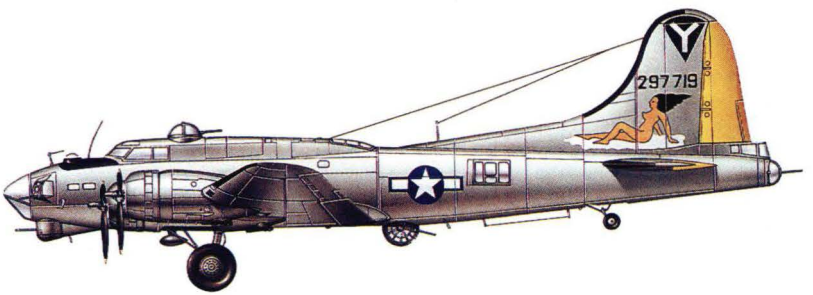
★ B-17G, used exclusively in Europe. Most B-17s deployed in the Pacific were Es and Fs.

Specifications for the B-17D and B-17E

Type: Heavy bomber
Introduced: 1939-40
Length: 68.4 ft. (B-17D) 73.8 ft. (B-17E)
Wingspan: 103.8 ft.
Crew: 6-8
Weight Empty: 29,021 lbs. (B-17D), 34,000 lbs. (B-17E)
Weight Loaded: 47,242 lbs. (B-17D), 55,000 lbs. (B-17E)
Power Plant: Four 1,000 hp. Wright R-1820-65 air-cooled radials.
Armament: Seven .50-caliber machine guns. (B-17D), eight .50-caliber machine guns, one .30-caliber machine gun(B-17E).
Ordnance: Up to 4,000 pounds of bombs.
Top Speed: 323 mph (B-17D), 229 mph (B-17E)
Range: 1,377 miles
Ceiling: 30,600 ft.
Maneuverability: Poor
Firepower: Good
Durability: Good

B-17G Flying Fortress

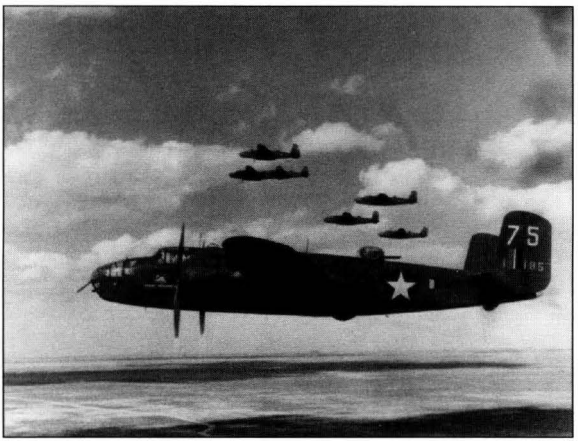




NORTH AMERICAN B-25 MITCHELL

USAAF Bomber

The B-25 was one of the most common medium bombers in the Pacific Theater throughout the entire war. Early versions had a Plexiglas nose with one to two .50-calibers mounted there for defense against fighter attack. Later, the Plexiglas was removed and eight .50-calibers were mounted in the nose. An additional four 50s were bolted to the side of the fuselage. These twelve forward-firing machine guns gave the B-25 incredible firepower.



Courtesy Tailhook Photo Service

★ The versatile B-25. This version, a B-25D, has a glass nose. B-25s were often field-modified to carry up to eight machine guns in the nose.

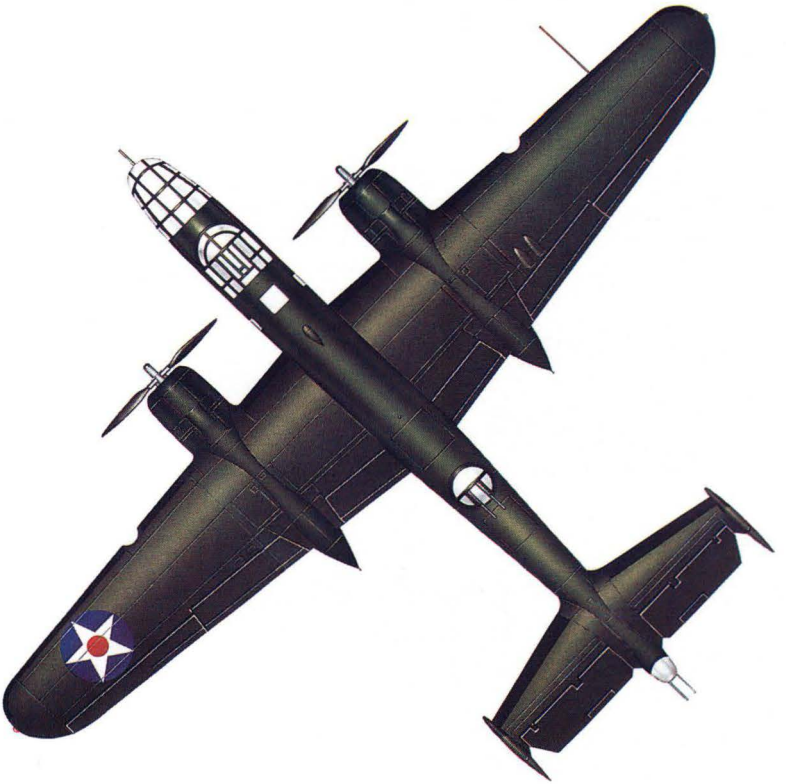
Used for anti-ship strikes, airfield attacks and ground support, the gunship version of this aircraft could blow holes in destroyers, buildings and covered emplacements with its guns.

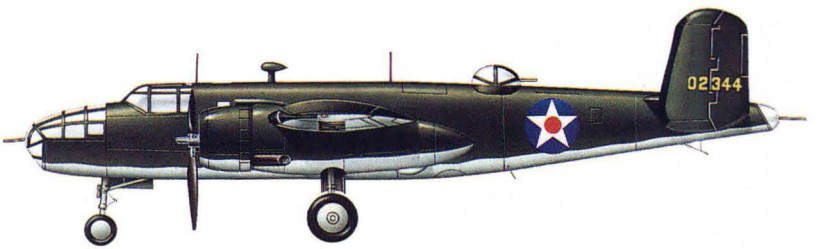
The B-25 stayed in service with the 5th Air Force until the end of the war.

Specifications for the B-25D and B-25J

Type: Medium bomber/ground strafer
Introduced: 1941 (B-25D), 1943 (B-25J)
Length: 52.9 ft.
Wingspan: 67.6 ft.
Crew: 8-10
Weight Empty: 21,100 lbs.
Weight Loaded: 33,500 lbs.
Power Plant: Two 1,700 hp. Wright-Cyclone air-cooled radial.
Armament: Six .50-caliber machine guns (B-25D); Twelve .50-caliber machine guns in the nose, six in turrets (B-25J).
Ordnance: Up to 3,000 pounds of bombs
Top Speed: 275 mph
Range: 1,275 miles
Ceiling: 25,000 ft.
Climb Rate: 1,100 ft./min.
Maneuverability: Poor
Firepower: Excellent
Durability: Excellent

B-25B Mitchell

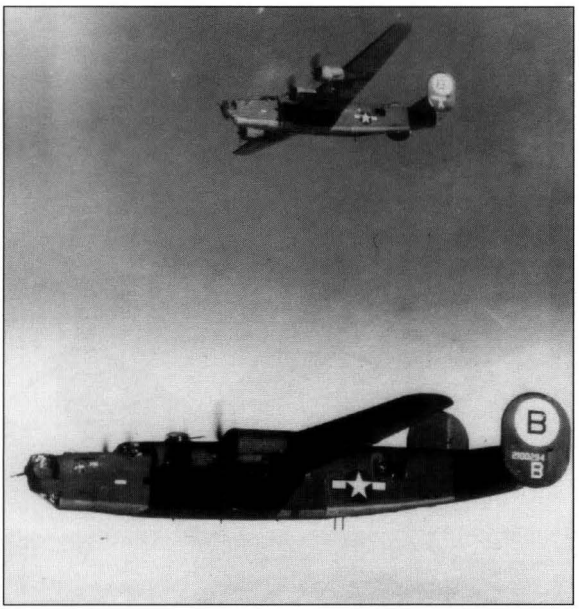




B-24 LIBERATOR

USAAF and RAF Bomber

The B-24 was the standard USAAF heavy bomber in the Pacific from1943 through the end of the war. Used extensively as anti-ship bombers, the Liberator pilots would often employ skip-bombing tactics on their targets.



Courtesy Tailhook Photo Service

★ The workhorse of the 5th Air Force's heavy bomber units, the B-24.

While not as durable or maneuverable as the B-17, the B-24 could carry a larger bomb load over a longer distance at a higher altitude. It was said that the wings on the Liberator were so thin that in flight they bowed slightly from the weight of the fuselage.

Initially, the B-24D equipped most of the B-24 units throughout1942 and1943. Later, when the J model became available, the groups converted to the newer type and used them until the end of the war. The main difference between the two models was the addition of a nose turret to the J model. The Ds had "greenhouse" noses with one or two hand operated machine guns. The J's nose turret served to discourage head-on attacks which usually were very effective against the earlier D model.

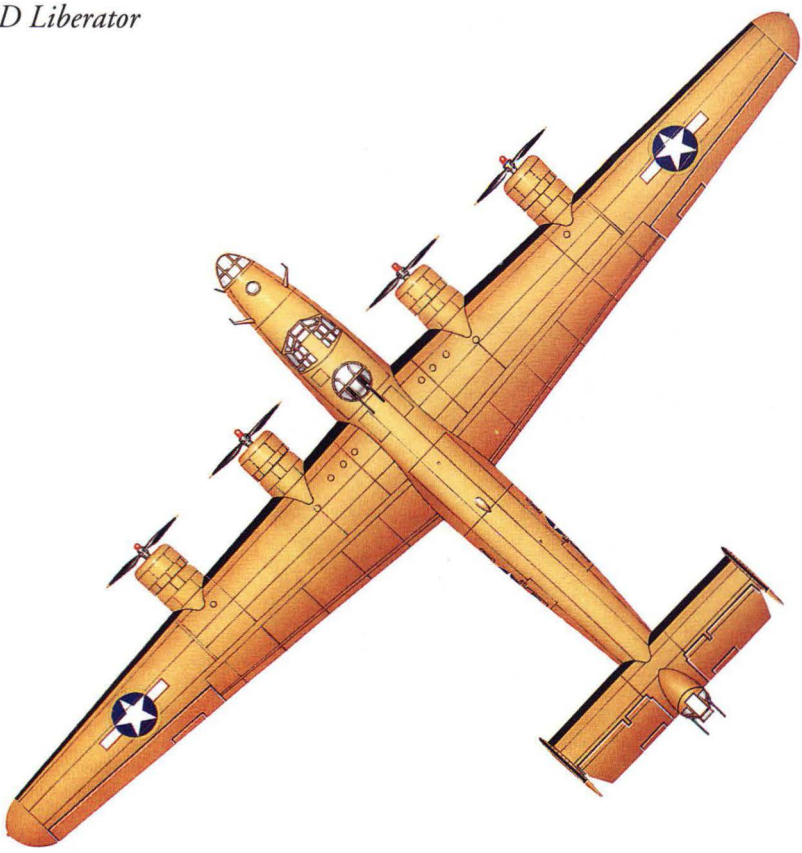
Specifications for the B-24J

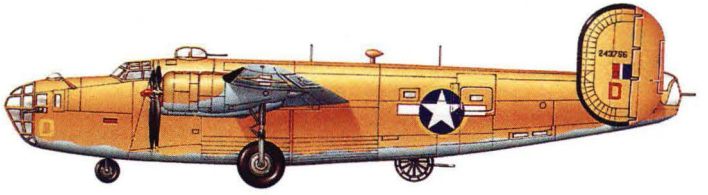
Type: Heavy bomber
Introduced: Late 1943
Length: 66.4 ft.
Wingspan: 110 ft.
Crew: 8-10
Weight Empty: 38,000 lbs.
Weight Loaded: 56,000 lbs.

Power Plant: Four 1,200 hp. Pratt and Whitney R-1830-43 air-cooled radials.
Armament: Ten .50-caliber machine guns.
Ordnance: Up to 5,000 pounds of bombs

Top Speed: 278 mph
Range: 1,700 miles
Ceiling: 28,000 ft.
Maneuverability: Poor
Firepower: Good
Durability: Good

B-24D Liberator





Boeing B-29 Superfortress

USAAF Bomber

The B-29 was the ultimate strategic bombing weapon developed during WWII. It incorporated a myriad of totally new systems in the design, making it the most revolutionary aircraft of the war.

Initially, the B-29 was sent to fly out of China and India in early 1944. The logistics of basing these planes in such remote areas caused this first deployment to be a total failure. Later, after the capture of the Marianas, the bomber was redeployed to Tinian, Saipan and Guam.

Courtesy Tailhook Photo Service

★ The awesome, deadly B-29 was responsible for the destruction of dozens of Japanese cities.

It was soon discovered that high altitude precision bombing was not possible over Japan due to adverse weather conditions and the Jet Stream. Instead of flying at extremely high altitude, the B-29s switched to flying low level at night. Rather than trying to hit specific targets, the planes would simply drop hundreds of incendiary bombs in order to create a firestorm. Tokyo was virtually burned-out as a result of one such raid. B-29s were used in this manner from early 1945 until the end of the war.

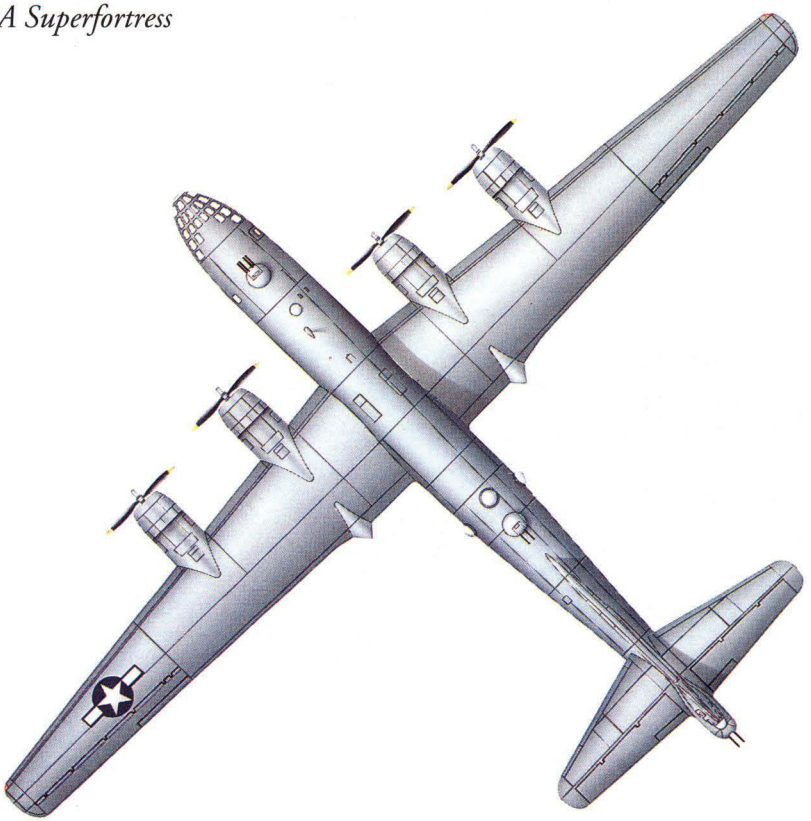
Specifications for the B-29A

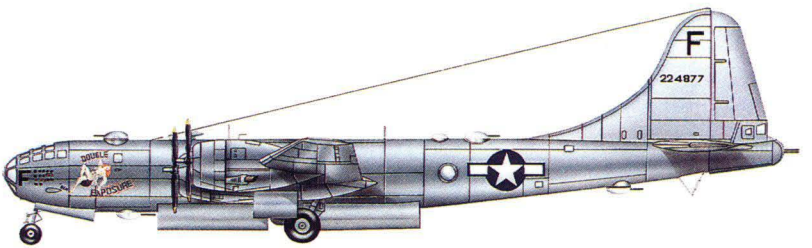
Type: Heavy bomber
Introduced: Early 1944
Length: 99 ft.
Wingspan: 141 ft.
Crew: 10
Weight Empty: 74,500 lbs.
Weight Loaded: 120,000 lbs.

Power Plant: Four 2,200 hp. Pratt and Whitney R-3350 air-cooled radials.
Armament: Ten to twelve .50-caliber machine guns and one 20mm cannon.
Ordnance: Up to 16,000 pounds of bombs

Top Speed: 363 mph
Range: 2,650 miles
With drop tanks: 3,250 miles
Ceiling: 33,600 ft.
Maneuverability: Poor
Firepower: Excellent
Durability: Excellent

B-29A Superfortress



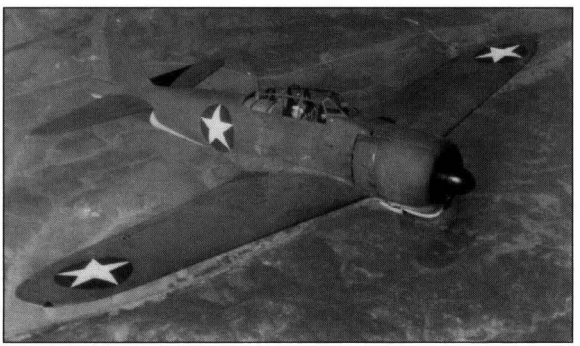


MITSUBISHI A6M ZERO

JNAF Fighter

The A6M Zero was the standard Japanese Navy fighter throughout the war. In the early portion of the war, the Zero was nearly invincible. It swept the skies of all Allied aircraft and pilots, who foolishly tried to dogfight it. It was not until the middle of the war when faster, more powerful American planes arrived that the Zero lost control of the skies. The Hellcat and Corsair were Zero-killers, and the Zero could not compete with their superior speed and firepower.

With its extremely tight turn radius, the Zero was the best dogfighter of the war. Its lightweight construction made it fast and gave it an exceptional rate of climb. It was well armed with two 20mm cannons and two 7.7mm machine guns. However, it was not nearly as durable as the American aircraft it faced. With its light construction and lack of self-sealing fuel tanks, it went down easily once hit. It did not dive very quickly. It also lost its maneuverability at speeds above 250 mph.



Courtesy Tailhook Photo Service

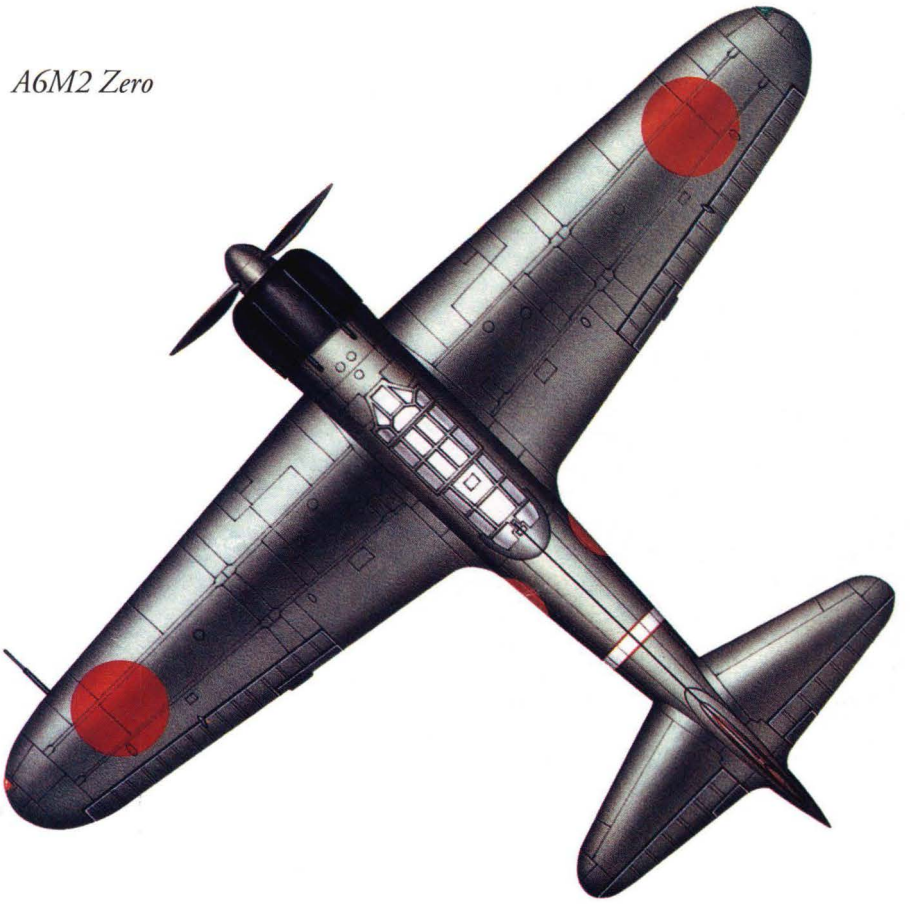
★ A captured Zero being tested in the United States.

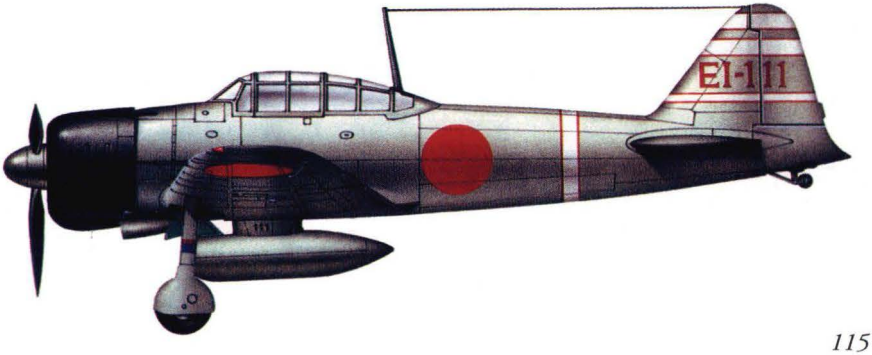
Throughout the war, the design was routinely modified and updated, but after five years of service little of consequence had changed.

Specifications for the A6M2, A6M3 and A6M5

Type: Fighter
Introduced: Aug. 1940
Length: 29.7 ft.(A6M2, A6M3), 29.9 ft. (A6M5)
Wingspan: 39.3 ft. (A6M2, A6M3), 36.1 ft. (A6M5)
Crew: 1
Weight Empty: 3,704 lbs. (A6M2), 3,984 lbs. (A6M3), 4,117 lbs. (A6M5)
Weight Loaded: 5,313 lbs. (A6M2), 5,609 lbs. (A6M3), 5,941 lbs. (A6M5)
Power Plant: One 950 hp. Sakae air-cooled radial (A6M2, A6M3), one 1,130 hp. Sakae air-cooled radial (A6M5).
Armament: Two 20mm cannons in the wings, two 7.7mm machine guns in the nose.
Ordnance: Two 132-pound bombs (A6M2, A6M3). One 551-pound bomb (A6M5).
Top Speed: 336 mph (A6M2), 338 mph (A6M3), 353 mph (A6M5)
Range: 1160 miles
With drop tanks: 1,930 miles
Ceiling: 32,810 ft.
Climb Rate: 4,500 ft./min.
Maneuverability: Average to excellent, depending on speed
Firepower: Good
Durability: Poor

A6M2 Zero

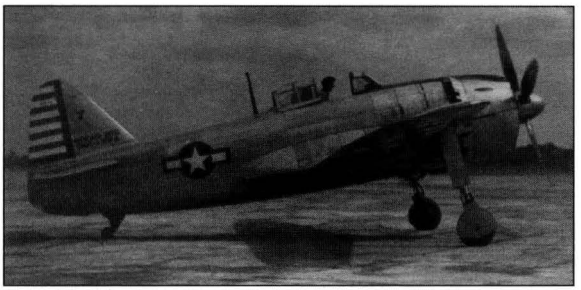




KAWANISHI N1K1 GEORGE

JNAF Fighter

The Shiden and its variant, the Shiden Kai were probably the most outstanding designs put into production for the JNAF during the war. Though it was fairly slow for 1944-45 standards, it could turn inside anything the Americans had deployed as well as outclimb and outroll them at any speed. Its heavy armament seemingly made it a good choice for intercepting B-29s, but the George did not turn out to be adequate in this role as its high-altitude performance deteriorated rapidly above 20,000 feet.



Courtesy Tailhook Photo Service

★ A George in U.S. markings. Many consider this aircraft the best Japanese Naval fighter in the war.

The best units in the JNAF were given the George to fly, including the 343 Kokutai "The Squadron of Experts." In combat, this plane could run rings around the Hellcat, Mustang and Corsair. There are several instances in which one George pilot took on 8-12 American fighters and came out the victor.

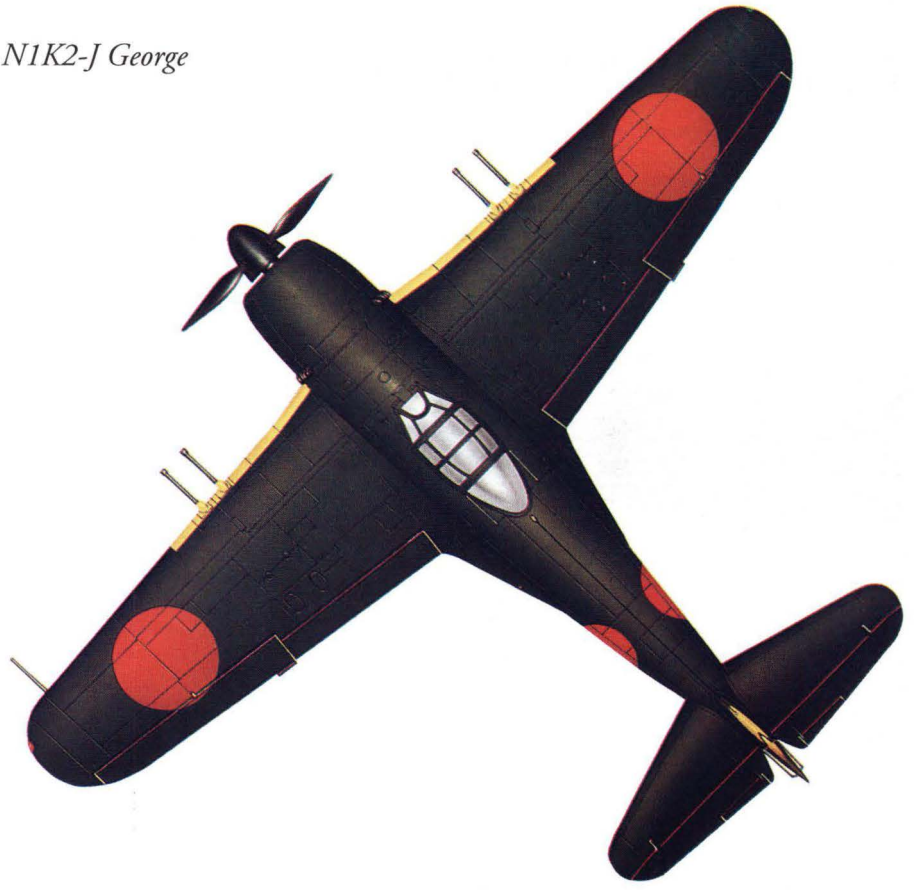
Specifications for the N1K1-J

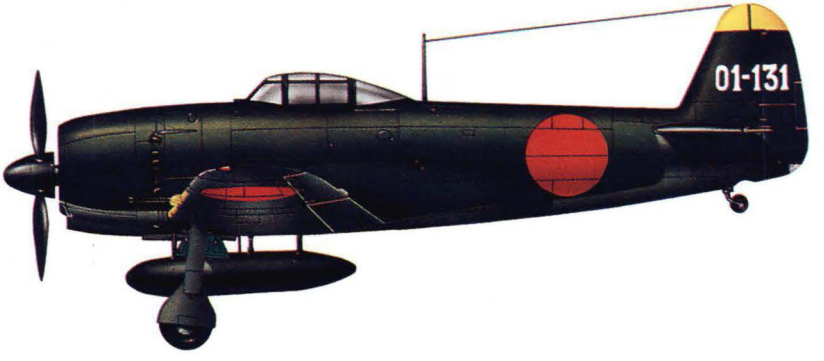
Type: Fighter
Introduced: Mid 1944
Japanese Designation: Shiden-kai
Length: 29.1 ft.
Wingspan: 39.3 ft.
Crew: 1
Weight Empty: 5,598 lbs.
Weight Loaded: 8,598 lbs.

Power Plant: One 1,440-1,990 hp. Nakajima NK9H Homare 21.
Armament: Two 7.7mm machine guns in the nose, four 20mm cannon in and under the wings.
Ordnance: Up to 2,200 pounds of bombs

Top Speed: 363 mph
Range: 890 miles
With drop tanks: 1,581 miles
Ceiling: 41,000 ft.
Climb Rate: 2,950 ft./min.
Maneuverability: Excellent
Firepower: Excellent
Durability: Good

N1K2-J George

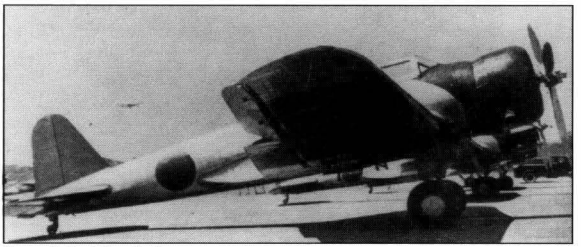




NAKAJIMA B5N KATE

JNAF Torpedo Bomber

At the outbreak of WWII, Japan possessed the finest carrier-based torpedo bomber in the world. In the attack on Pearl Harbor, over 100 Kates took place and contributed to the success of the mission by doing heavy damage to U.S. battleships. Armed with the deadly Type 95 torpedo, the Kate continued to be used successfully in the first half of the war. Kates fatally damaged the *USS Hornet*, *Lexington*, and *Yorktown*.



Courtesy Tailhook Photo Service

★ The Kate served well as a torpedo bomber despite its slow speed and vulnerability to enemy fire.

As American airpower grew, however, the plane showed itself to be terribly underarmed and underpowered. With no armor or self-sealing tanks, it was an easy plane to shoot down. Without fighter escort, the Kate was a sitting duck. They were gradually replaced by the B6N Tenzan, though some Kates continued to see service late in the war. In 1945, like most other Japanese planes, they were converted to kamikaze use.

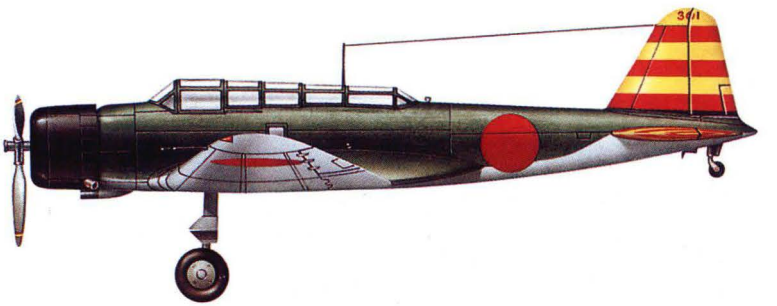
Specifications for the B5N1

Type: Torpedo bomber
Introduced: 1938
Japanese Designation: Type 97
Length: 34 ft.
Wingspan: 48.8 ft.
Crew: 2-3
Weight Empty: 4,830 lbs.
Weight Loaded: 8,360 lbs.

Power Plant: One 1,000 hp. air-cooled radial.
Armament: One 7.7mm machine gun.
Ordnance: One torpedo or 1,650 pounds of bombs

Top Speed: 235 mph
Range: 634 miles
With drop tanks: 1238 miles
Ceiling: 25,200 ft.
Climb Rate: 1,550 ft./min.
Maneuverability: Fair
Firepower: Poor
Durability: Poor

B5N2 Kate

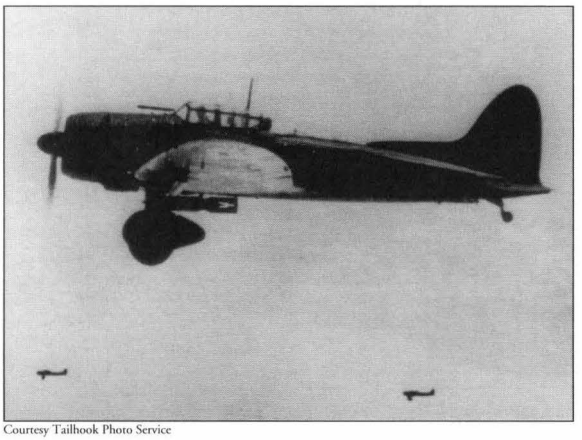


Aichi D3A1 Val

JNAF Dive Bomber

On December 7, 1941, during the attack on Pearl Harbor, the Val became the first aircraft to drop bombs on American targets. Six squadrons of Vals participated in the attack, and succeeded in doing extensive damage to the U.S. battleships in the harbor.

The Val was a very stable bombing platform with surprisingly good maneuverability for a fixed-gear dive bomber. Like most Japanese planes, however, the Val was inadequately supplied with armor and lacked self-sealing tanks. This made them very easy to blow up with a short burst from heavy machine guns.



Courtesy Tailhook Photo Service

★ Lugging a 551-pound bomb, this Val plods on toward its target.

Entering service before Pearl Harbor, its design traced its roots back to the early 1930s. After the middle of 1943, most Vals were replaced by Judys in front-line units. Due to the desperation of the JNAF in 1944 and 1945, however, many Vals continued to see combat in land-based units. By this time, they were hopelessly obsolete and proved to be easy prey for the US Navy's Hellcats and Corsairs.

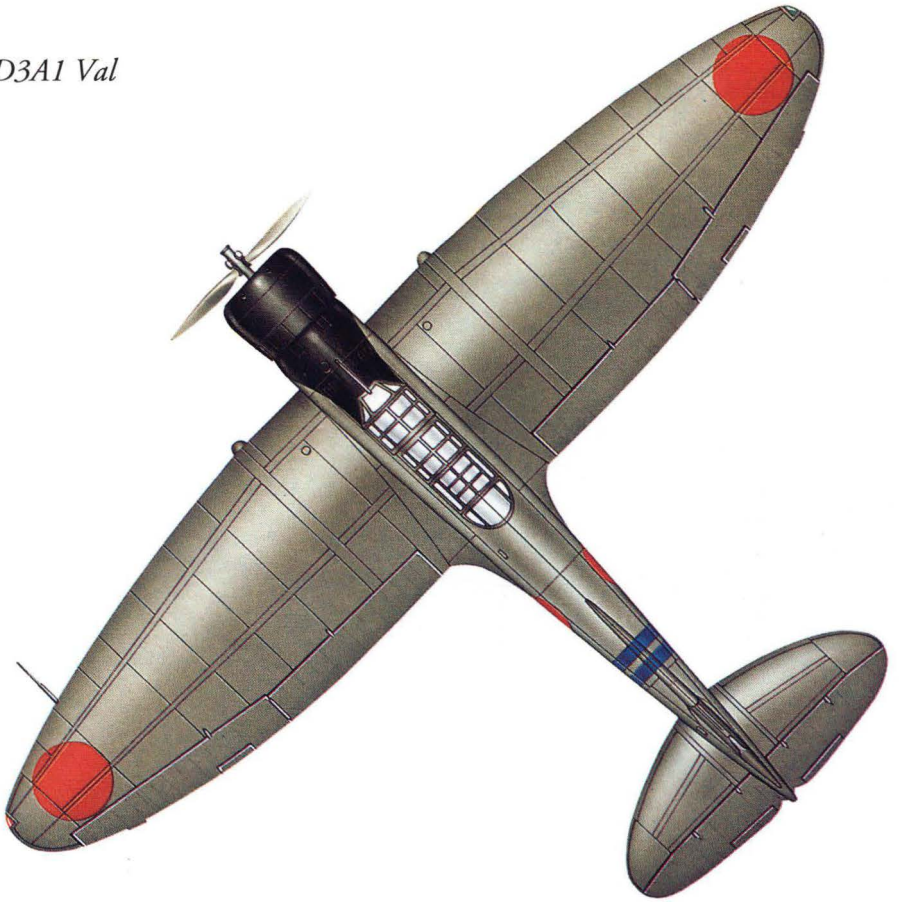
Specifications for the D3A1

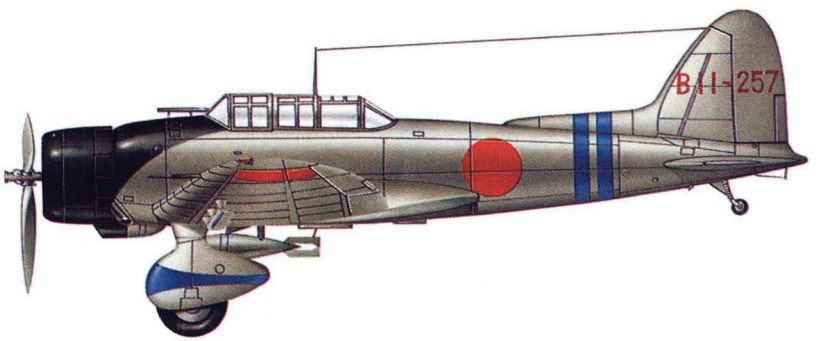
Type: Dive bomber
Introduced: Late 1940
Japanese Designation: Type 99
Length: 33.4 ft.
Wingspan: 47.1 ft.
Crew: 2
Weight Empty: 5,309 lbs.
Weight Loaded: 8,047 lbs.

Power Plant: One 1,080 hp. Mitsubishi Kinsei 44 air-cooled radial.
Armament: Two 7.7mm machine guns in the nose and one 7.7mm machine gun in the rear seat.
Ordnance: Up to 800 pounds of bombs

Top Speed: 268 mph
Range: 915 miles
Ceiling: 30,050 ft.
Climb Rate: 1,950 ft./min.
Maneuverability: Average
Firepower: Poor
Durability: Poor

D3A1 Val





YOKOSUKA D4Y2 JUDY

JNAF Dive Bomber

The Judy was an extremely nimble and fast dive bomber that would have been much more effective had it been flown by competent pilots and given adequate fighter cover. By the time it entered service in large numbers in late 1943, the Americans had captured air superiority just about everywhere. The Judy suffered stiffly at the hands of skilled Hellcat and Corsair pilots. While it was fast, it was lightly armored and thus proved to be fairly easy to bring down with solid bursts.

Courtesy Tailhook Photo Service

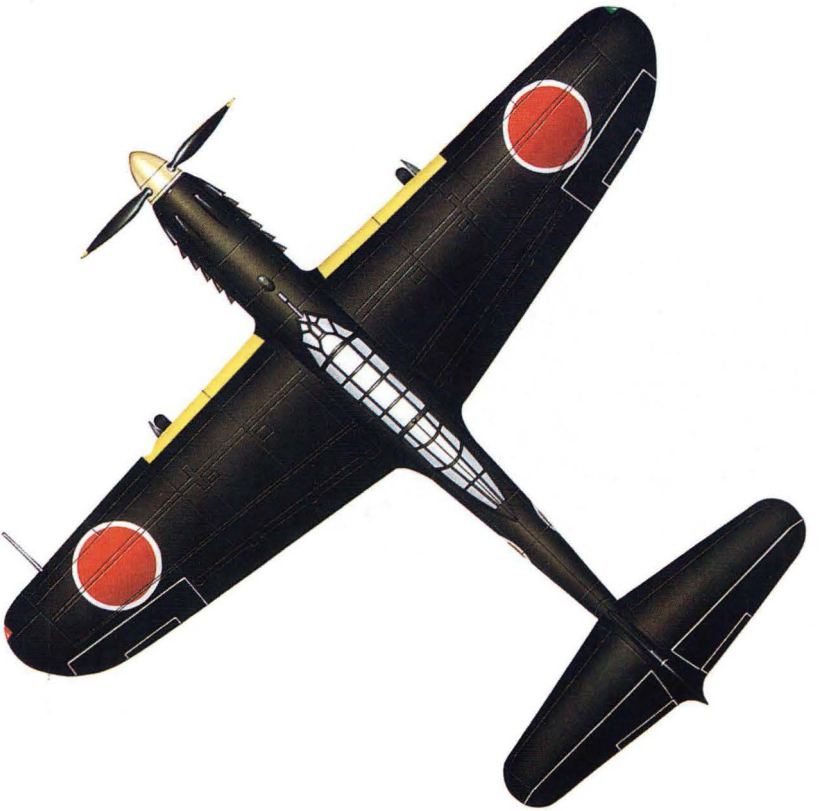
★ The Judy was a surprisingly fast and agile dive bomber.

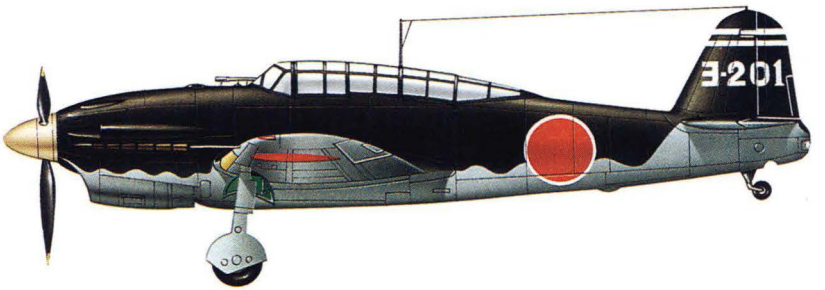
They were used in a variety of roles, including as night fighters for a short period. In the end, they were modified to carry much larger bomb loads and sent into combat as mounts for the kamikaze pilots.

Specifications for the D4Y2

Type: Dive bomber
Introduced: Late 1942
Japanese Designation: Suisei (Comet)
Length: 33.5 ft.
Wingspan: 37.7 ft.
Crew: 2
Weight Empty: 5,809 lbs.
Weight Loaded: 8,455 lbs.
Power Plant: One 915-1,200 hp. Aichi AE1A Atsuta liquid-cooled.
Armament: Two 7.7mm machine guns in the nose and one 13mm rear-firing machine gun.
Ordnance: Up to 1,000 pounds of bombs
Top Speed: 368 mph
Range: 909 miles
With drop tanks: 2,239 miles
Ceiling: 35,105 ft.
Climb Rate: 2,600 ft./min.
Maneuverability: Average
Firepower: Poor
Durability: Fair

D4Y2 Judy

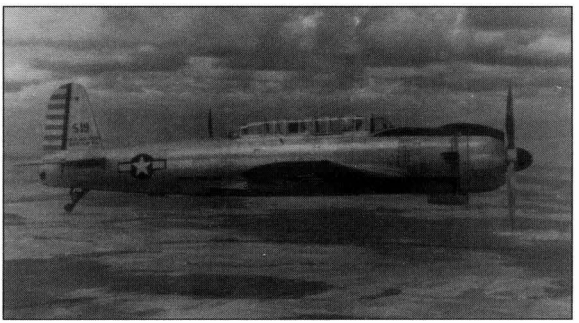




NAKAJIMA B6N JILL

JNAF Torpedo Bomber

The Jill was the long-awaited replacement to the Kate, joining front-line units in 1943. Unfortunately, the Jill was too slow and too underarmed to be much of an improvement over its predecessor. In combat, the Jill repeatedly demonstrated its vulnerability to the Hellcats and Corsairs of the U.S. Navy. Even the addition of a ventral tunnel gun to protect the plane's belly did little good. The controls were reported as sloppy, especially lateral control, thus its handling did not allow for much ability to escape the American fighter.



Courtesy Tailhook Photo Service

★ Virtually obsolete when it entered service, the B6N Tenzan suffered high losses in combat.

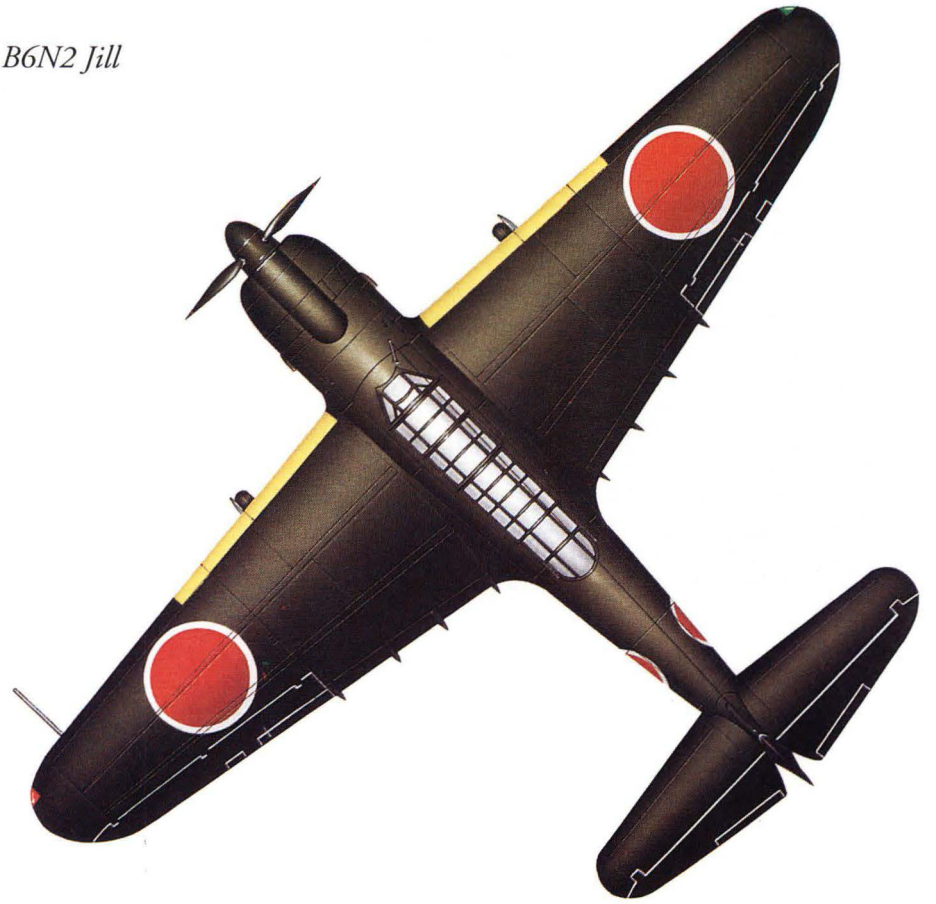
Specifications for the B6N2

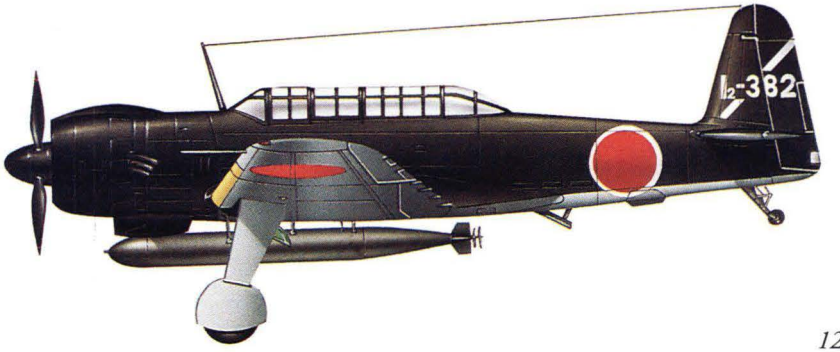
Type: Torpedo bomber
Introduced: Mid 1943
Japanese Designation: Tenzan (Heavenly Mountain)
Length: 34 ft.
Wingspan: 48.8 ft.
Crew: 3
Weight Empty: 6,543 lbs.
Weight Loaded: 11,464 lbs.

Power Plant: One 1,800 hp. Nakajima NK7A Mamoru radial.
Armament: Two 7.7mm machine guns.
Ordnance: Up to 1,650 pounds of bombs

Top Speed: 301 mph
Range: 909 miles
With drop tanks: 2,142 miles
Ceiling: 28,380 ft.
Climb Rate: 1,900 ft./min.
Maneuverability: Fair
Firepower: Poor
Durability: Fair

B6N2 Jill

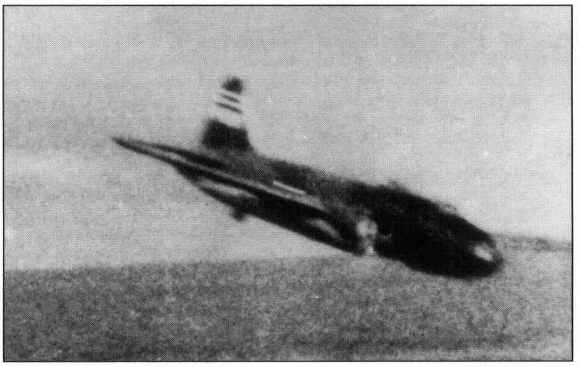




MITSUBISHI G4M BETTY

JNAF Bomber

The Betty was the standard Japanese Navy medium bomber throughout the war. By 1944, new bombers began to enter service, but the Betty continued to remain in front-line units until the end of the war. Called the "Type One Lighter" by its crews, the Betty carried so much fuel in unprotected tanks that the Allies found it easy to explode with only short bursts of gunfire. They almost always carried torpedoes when sent against ships.



Courtesy National Air and Space Museum, Smithsonian Institution

★ The end of Lt. Cdr. Ito's G4M Betty. Ito led the squadron that Butch O'Hare ravaged off Bougainville on February 20, 1942. Ito, in one last act of valor, tried to crash his crippled plane into the *Lexington* (CV-2), but missed. All on board the plane perished.

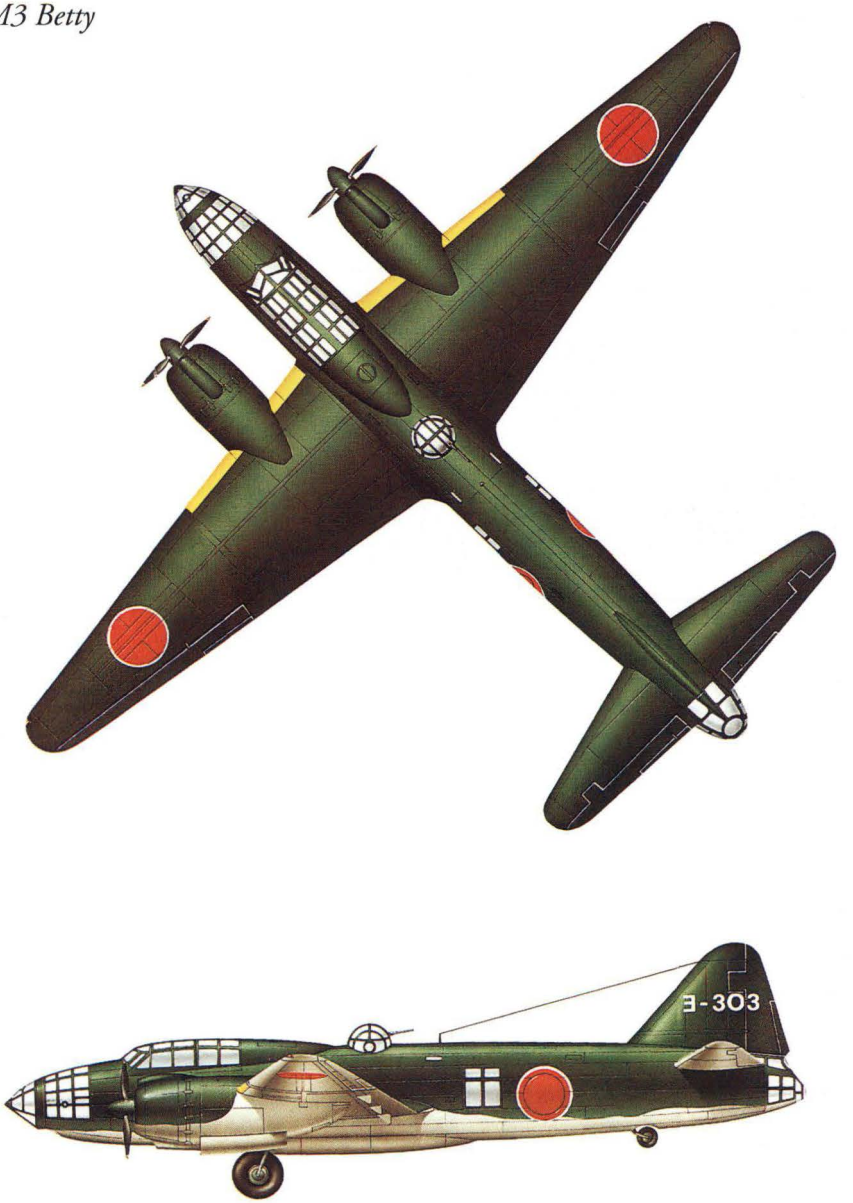
Specifications for the G4M2

Type: Level and torpedo bomber
Introduced: Summer 1941
Length: 65.5 ft.
Wingspan: 81.6 ft.
Crew: 7
Weight Empty: 17,378 lbs.
Weight Loaded: 27,174 lbs.

Power Plant: Two 1,825 hp. Mitsubishi air-cooled radials.
Armament: Two 7.7mm machine guns in the nose and one 20mm cannon in the dorsal turret, two in beam blisters and one in the tail turret.
Ordnance: Up to 2,200 pounds of bombs

Top Speed: 273 mph
Range: 3,041 miles
With drop tanks: 3,506 miles
Ceiling: 29,356 ft.
Climb Rate: 1,300 ft./min.
Maneuverability: Poor
Firepower: Fair
Durability: Fair

G4M3 Betty



Nakajima Ki-27 Nate

JAAF Fighter

The Nate was the standard JAAF fighter at the time of Pearl Harbor. More maneuverable than its JNAF counterpart, the Claude, the Ki-27 was far less rugged and easily destroyed by enemy fire. When faced with modern opponents such as the P-40 and the P-39, the Nate suffered heavily provided the Americans did not dogfight with the more nimble Japanese fighter.

Courtesy National Air and Space Museum, Smithsonian Institution

They remained in service until 1943, primarily in the China-Burma-India theater. In 1944, US Navy pilots encountered some Nates over Philippines and quickly cut them out of the sky. Later in 1944 and 45, the Nate became the JAAF's kamikaze aircraft of choice and almost all the surviving examples were expended in this manner.

★ The Ki-27 remjained the standard JAAF fighter for the first six months of the Pacific war.

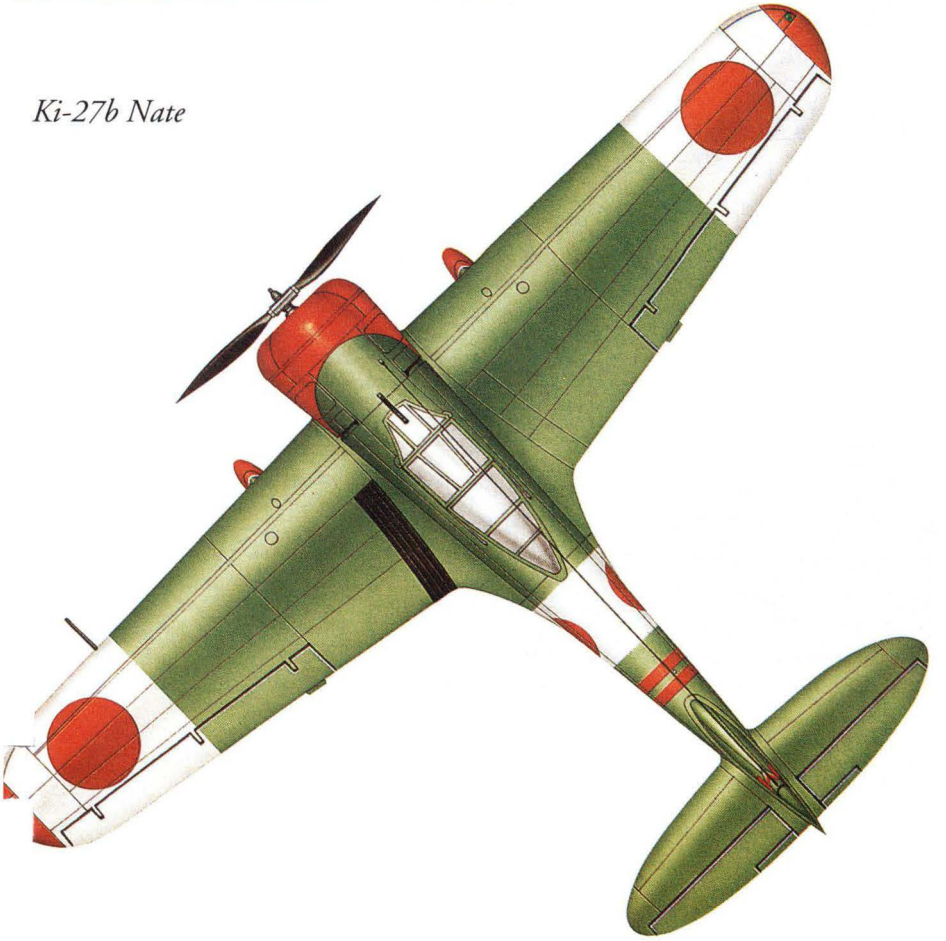
Specifications for the Ki-27

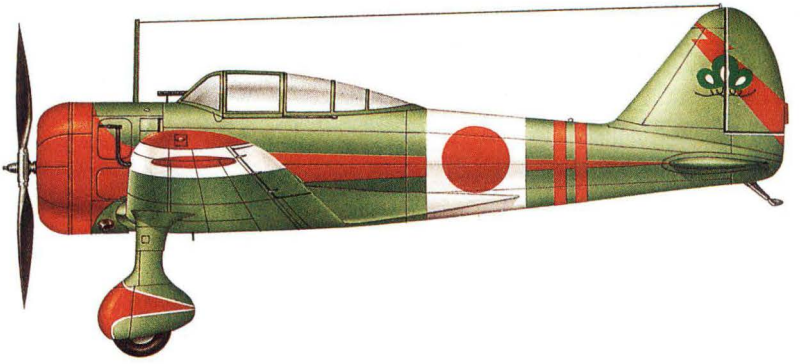
Type: Fighter
Introduced: July 1938
Length: 24.7 ft.
Wingspan: 37.1 ft.
Crew: 1
Weight Empty: 2,447 lbs.
Weight Loaded: 3,946 lbs.

Power Plant: One 740 hp. air-cooled radial.
Armament: Two 7.7mm machine guns.
Ordnance: Up to 220 pounds of bombs

Top Speed: 292 mph
Range: 390 miles
With drop tanks: 1,060 miles
Ceiling: 32,100 ft.
Climb Rate: 3,000 ft./min.
Maneuverability: Excellent
Firepower: Poor
Durability: Poor

Ki-27b Nate

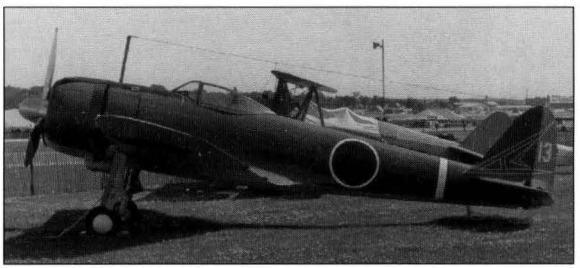




Nakajima Ki-43 Oscar

JAAF Fighter

The Ki-43 was the first model of what would become the standard Japanese Army fighter of World War II. Introduced in late 1941, the Oscar (as the Allies called it) soon could be found fighting on every front where the JAAF was present. The Americans first encountered the Oscar over the Dutch East Indies. It was during the New Guinea campaign that large numbers of these planes were thrown at the American 5th Air Force. They demonstrated incredible maneuverability and a steep, fast rate of climb in combat, but the Ki-43 was also hopelessly vulnerable to enemy fire. One short burst could destroy this type with ease. Further, the two machine guns the plane carried were totally insufficient to bring down the heavily armored American aircraft they faced.



Courtesy Tailhook Photo Service

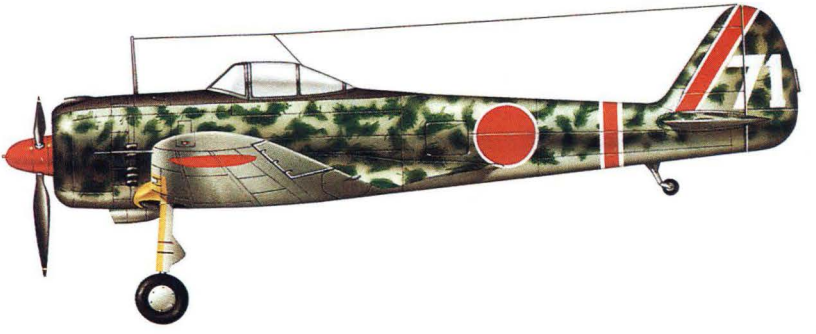
★ A postwar photo of one of the few surviving Ki-43s.

By 1943, when fast new Allied planes began arriving on the scene, the Oscar's slow maximum speed made them easy prey. Nevertheless, improved versions were produced and the design continued to remain in front-line service until the end of the war.

Specifications for the Ki-43

Type: Fighter
Introduced: Late 1941
Japanese Designation: Hayabusa (Peregine Falcon)
Length: 28.9 ft.
Wingspan: 37.5 ft.
Crew: 1
Weight Empty: 3,483 lbs.
Weight Loaded: 4,575lbs.
Power Plant: One 950 hp. Army type 99 air-cooled radial.
Armament: One 7.7mm and one 12.7mm machine gun in the nose.
Ordnance: Up to 1,100 pounds of bombs
Top Speed: 308 mph
Range: 745 miles
Ceiling: 38,500 ft.
Climb Rate: 3,450 ft./min.
Maneuverability: Excellent
Firepower: Poor
Durability: Poor

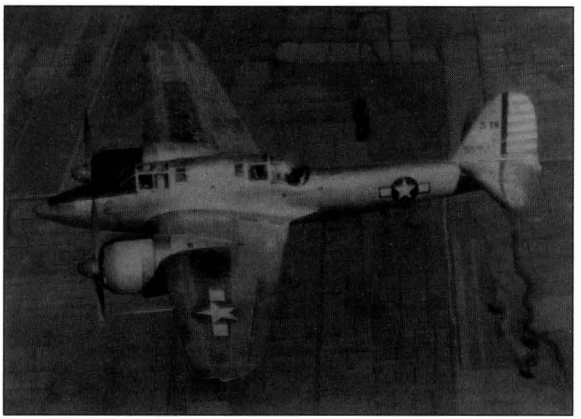
Ki-43-II Oscar



KAWASAKI KI-45 NICK

JAAF Fighter

The Nick was designed as a long-range escort fighter, but never played that role in combat. It has been described as the most maneuverable twin-engine fighter of WWII. In China, where it was first deployed in combat, Allied pilots reported seeing the Ki-45 executing half-rolls, chandelles, Immelmanns, etc. with the ease of a single seat fighter.



Courtesy Tailhook Photo Service

★ The Nick fulfilled a number of roles, making it one of the most versatile planes in the JAAF's inventory.

When the first Toryu units arrived in the New Guinea theater, they were pressed into service as anti-ship aircraft. A later version carried a 37mm cannon to bolster the plane's attack capabilities.

Its dive characteristics were good, though above 383 mph the stick got heavy and the aircraft became hard to control. It was a very easy airplane to fly. It had no vices, and its stall characteristics were very honest. It was one of the first Japanese airplanes to have self-sealing fuel tanks and armor protection for the crew.

Specifications for the Ki-45

Type: Fighter, interceptor, ground attack fighter-bomber, night fighter
Introduced: Summer 1942
Japanese Designation: Toryu (Dragon Killer)
Length: 34.8 ft.
Wingspan: 49.3 ft.
Crew: 2
Weight Empty: 8,146 lbs.
Weight Loaded: 11,632 lbs.

Power Plant: Two 1,050 hp. Nakajima air-cooled.
Armament: Two 20mm cannon, one 37mm cannon, one 7.9mm machine gun in the rear seat.
Ordnance: Up to 1,100 pounds of bombs

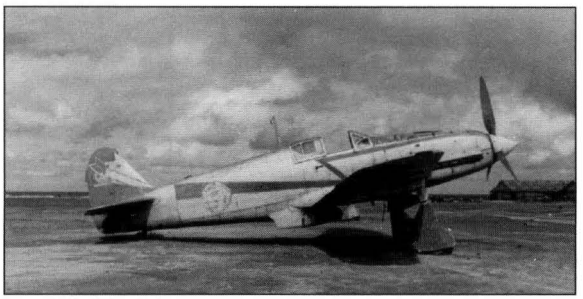
Top Speed: 343 mph
Range: 1,243 miles
With drop tanks: 1,404 miles
Ceiling: 35,000 ft.
Climb Rate: 2,750 ft./min.
Maneuverability: Good
Firepower: Excellent
Durability: Average

Ki-45 Nick

NAKAJIMA KI-61 TONY

JAAF Fighter

When the Tony first entered service in the skies over New Guinea during the summer of 1943, it created quite a shock in Allied fighter units. The Ki-61 quickly proved itself capable of outfighting every Allied aircraft except the P-38. It could outturn, outclimb and outdive the P-40 and the P-39 with ease, and could roll faster than all Allied aircraft.



Courtesy Tailhook Photo Service

★ With its long snout and license-built Daimlar-Benz engine, the Ki-61 was routinely mistaken as a Messerschmitt 109 by Allied pilots.

The traditional American method of diving out of combat when faced with a dogfight against the Japanese was invalidated by the Tony's superior diving characteristics. In addition, the Tony was one of the first Japanese combat aircraft to be equipped with self-sealing fuel tanks and armor protection for the pilot and parts of the engine.

In New Guinea, it's ruggedness and ability to withstand damage surprised the Allies, who were used to more vulnerable fighters like the Oscar.

Specifications for the Ki-61

Type: Fighter, interceptor
Introduced: Mid 1943
Japanese Designation: Hien
Length: 28.7 ft..
Wingspan: 39.3 ft.
Crew: 1
Weight Empty: 4,872 lbs.
Weight Loaded: 6,504 lbs.

Power Plant: One 1,175 hp. Kawasaki inverted V liquid-cooled.
Armament: Four 12.7mm machine guns, two in the nose and one in each wing.
Ordnance: Up to 1,100 pounds of bombs

Top Speed: 368 mph
Range: 373 miles
With drop tanks: 684 miles
Ceiling: 37,730 ft.
Climb Rate: 2,500 ft./min.
Maneuverability: Good
Firepower: Average
Durability: Good

Ki-61-II Tony

NAKAJIMA KI-84 FRANK

JAAF Fighter

The Frank was one of the best Japanese fighters of the war. At 20,000 feet, its war emergency max speed was 427 mph, faster than every American fighter at that height except the P-51D. With its remarkable maneuverability and excellent rate of climb, this design could fight on equal terms with all of its Allied opponents.

Courtesy Tailhook Photo Service

★ One of the best Japanese fighters of the war, the Frank saw service in the Philippines and in the home defense of Japan.

As with most Japanese aircraft, the Frank possessed a very low power-to-weight ratio, in this case 4.0 to 1. This factor probably made it one of the greatest accelerating piston-engine fighter of the war. All in all, the Ki-84 is considered by many to be the best mass-produced Japanese fighter of the war.

It saw limited service in the Philippines in 1944, and extensive service in the defense of Japan the following year.

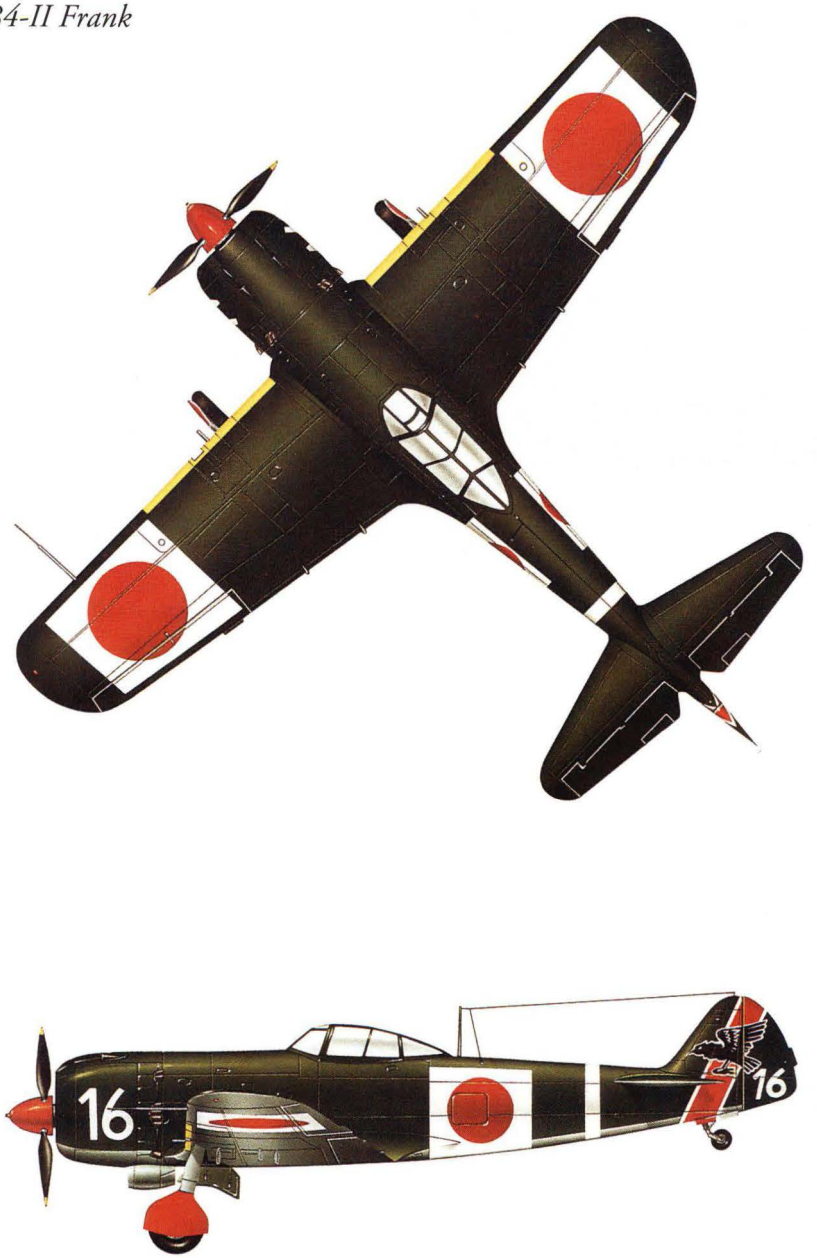
Specifications for the Ki-84

Type: Fighter
Introduced: April 1944
Japanese Designation: Hayate (Gale)
Length: 32.5 ft.
Wingspan: 36.8 ft.
Crew: 1
Weight Empty: 5,864 lbs.
Weight Loaded: 7,965 lbs.

Power Plant: One 1,900 hp. Type 4 air-cooled radial.
Armament: Two 12.7mm machine guns in the nose and two 20mm cannon in the wings.
Ordnance: Up to 1,100 pounds of bombs

Top Speed: 427 mph
Range: 1,025 miles
With drop tanks: 1,815 miles
Ceiling: 34,450 ft.
Climb Rate: 3,300 ft./min.
Maneuverability: Excellent
Firepower: Excellent
Durability: Good

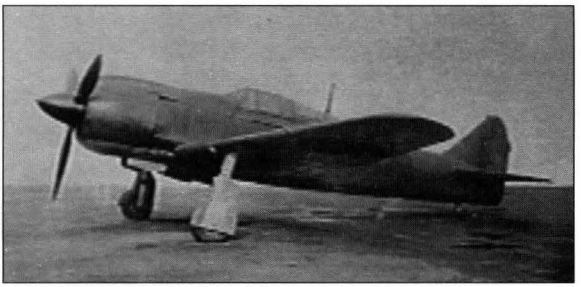
Ki-84-II Frank



KAWASAKI KI-100

JAAF Fighter

The Ki-100 was simply a Ki-61 redesigned to use a radial engine instead of a liquid-cooled one. The new engine greatly enhanced the performance of the aircraft. In early March 1945, a Ki-100 was pitted against a captured P-51 in Japan in mock combat. The P-51 was faster, but the Ki-100 could outturn, outroll and outclimb the American fighter. It could also dive with it, something most Japanese planes couldn't do.



Courtesy National Air and Space Museum, Smithsonian Institution

Production geared-up hastily and several units received this aircraft in early March 1945. They were used with great success against all the latest American fighters, especially the Hellcat which could not outperform the Ki-100 in any way. Above 23,000 feet however, the performance of this aircraft seriously deteriorated, making it an unsuccessful B-29 interceptor. Many aviation historians consider the Ki-100 as one of Japan's best WWII fighters.

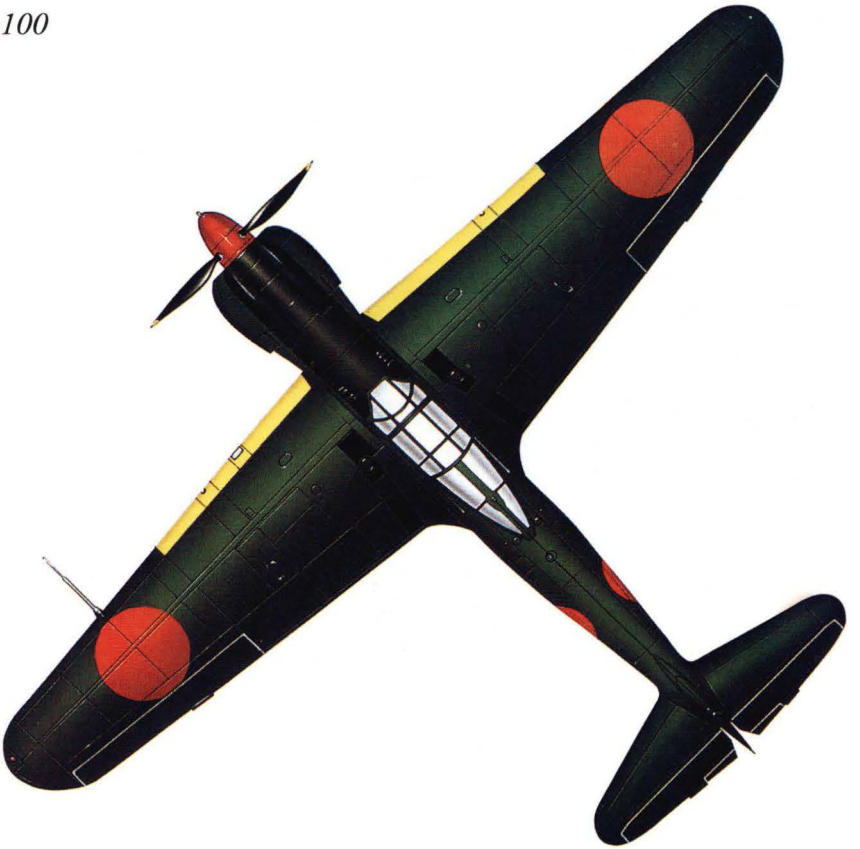
Specifications for the Ki-100

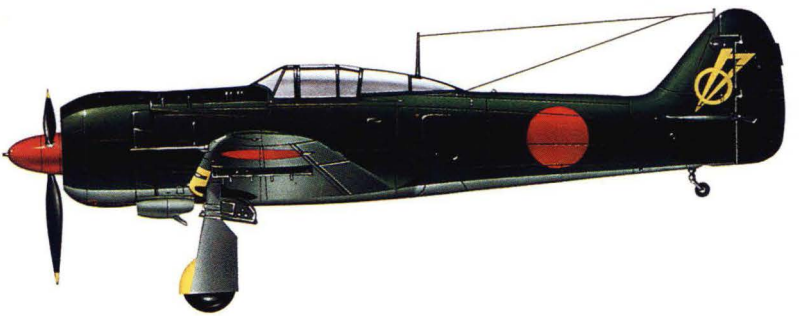
Type: Fighter
Introduced: March 1945
Length: 28.9 ft.
Wingspan: 39.3 ft.
Crew: 1
Weight Empty: 5,567 lbs.
Weight Loaded: 7,705 lbs.

Power Plant: One 1, 500 hp. air-cooled radial.
Armament: Two 20mm cannon and two 12.7mm machine guns.
Ordnance: Up to 1,100 pounds ob bombs

Top Speed: 360 mph
Range: 1,367 miles
Ceiling: 36,090 ft.
Climb Rate: 2,900 ft./min.
Maneuverability: Excellent
Firepower: Good
Durability: Good

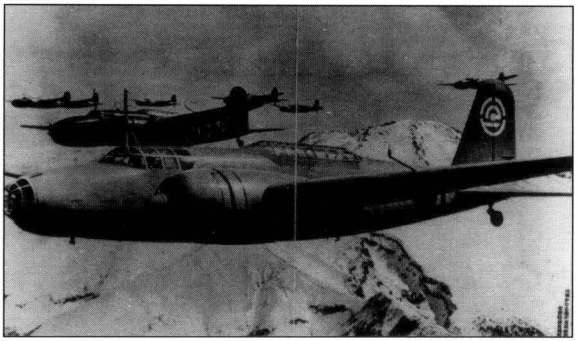
Ki-100





Mitsubishi Ki-21 Sally

JAAF Bomber



Courtesy Tailhook Photo Service

★ Slow , vulnerable and unable to carry a heavy bomb load, the Sally was easy prey for Allied planes.

The Sally was the standard Japanese Army bomber at the outbreak of the Pacific War. By 1945, however, most had been replaced by the Ki-49 and only one unit still flew the Ki-21. In combat, the Sally proved to be easy prey for most Allied fighters, especially if it lacked fighter escort.

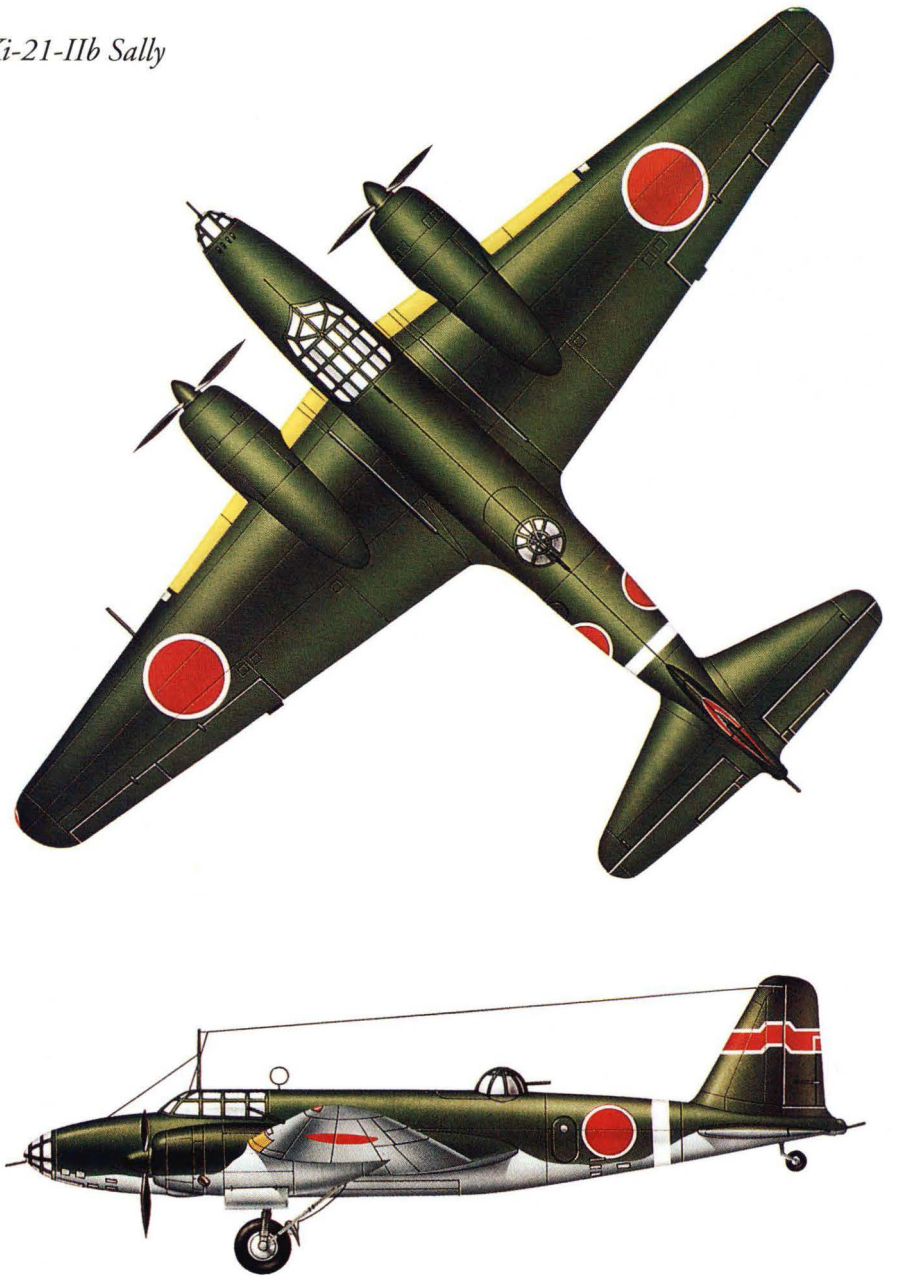
Specifications for the Ki-21

Type: Level bomber
Introduced: Aug. 1938
Japanese Designation: Type 97
Length: 52.5 ft.
Wingspan: 73.8 ft.
Crew: 2
Weight Empty: 10,342 lbs.
Weight Loaded: 16,517 lbs.

Power Plant: Two 1,450 hp. air-cooled radials.
Armament: One 7.7mm machine gun in the nose, ventral tunnel, tail, port and starboard beams, and one 12.7mm machine gun in the dorsal turret.
Ordnance: Up to 1,620 pounds of bombs

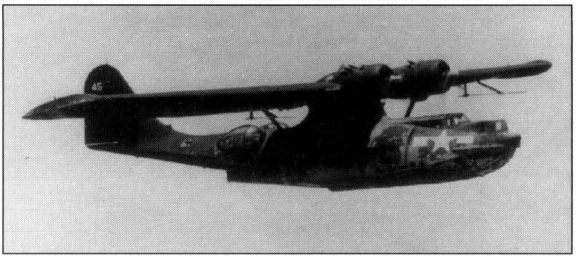
Top Speed: 270 mph
Range: 932 miles
With drop tanks: 1,680 miles
Ceiling: 28,208 ft.
Climb Rate: 1,250 ft./min.
Maneuverability: Fair
Firepower: Poor
Durability: Fair

Ki-21-IIb Sally



RECONNAISSANCE

USN Consolidated PBY Catalina



Courtesy Tailhook Photo Service

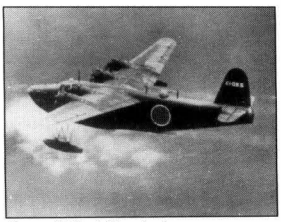
The PBY Catalina served the U.S. Navy as a torpedo bomber, maritime patrol craft and in Air-Sea rescue duties. Legend has it that the PBY flew level, climbed and dived at 90 mph. PBY pilots were quite adept at shadowing Japanese surface units.

JNAF Kawanishi H6K Mavis

The Mavis was the standard Japanese Navy reconnaissance flying boat at the start of the Pacific War. One of the few Japanese aircraft with four engines, the Mavis offered an enormous target for US Navy Wildcat pilots who routinely shot these massive planes out of the sky. They stayed in service throughout the war, being used as transports, level bombers and torpedo bombers.

Courtesy Tailhook Photo Service

JNAF Kawanishi H8K Emily



Courtesy Tailhook Photo Service

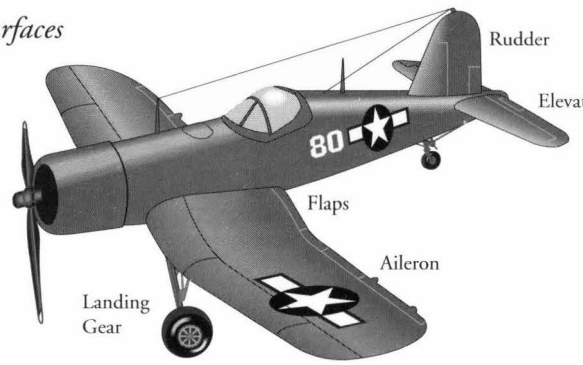
Kawanishi designed the Emily as a replacement for the Mavis flying boat produced in the mid-1930s. This huge aircraft carried heavy defensive armament and proved to be difficult to shoot down as a result. It could absorb a lot of battle damage since it had armor protection and self-sealing fuel tanks. They saw service as recon aircraft, bombers and transports until the end of the war. In 1945, the U.S. Navy sent a captured Emily to Patuxtent River and tested it thoroughly. It remained in the states, and is currently the only surviving example left in the world.

FLIGHT

Airplane control surfaces and airplane movements

The pilot uses his airplane's control surfaces to guide it through the air. When an airplane is in flight, air is flowing quickly over its control surfaces. When a control surface is moved, it causes a pressure difference in the air flow. This difference will change the direction of the airplane.

Control Surfaces



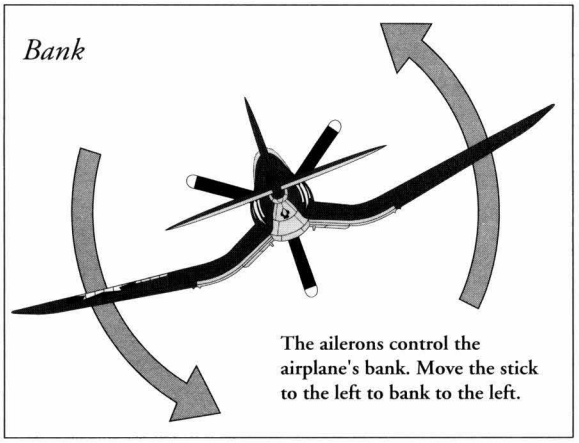
The primary control surfaces are the ailerons, the elevators, and the rudder. With these the pilot can perform three basic movements: bank, pitch, and yaw. Bank is the rolling motion of the airplane to the left or right. Pitch is the rotation up and down. Yaw is rotation in the flat horizontal plane to the left or right.

The ailerons, located on the wings, control the bank of the airplane. When the left aileron is raised, the right wing aileron will be lowered, and vice-versa. The ailerons are controlled by the stick. To bank to the left, move the stick to the left; to bank to the right move the stick to the right.

The elevators, located on the tail assembly, control the aircraft's pitch. When the elevators move down, the nose will

pitch down, and vice-versa. The pilot controls the elevators with the stick. To nose the aircraft down, push forward on the stick. Pulling back on the stick will pull the nose of the aircraft up.

The rudder is located on the tail assembly. It controls the aircraft's yaw. When you move the rudder left or right, your aircraft's nose will yaw in the corresponding direction.

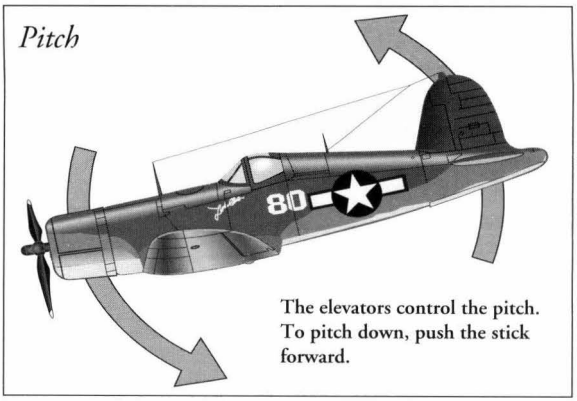


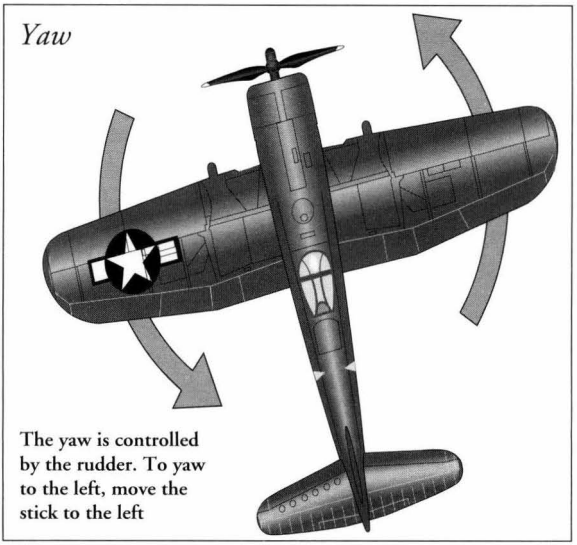
The ailerons control the airplane's bank. Move the stick to the left to bank to the left.

The flaps are located on the wings, inside from the ailerons. When the flaps are lowered, the shape of the wing is changed. The new shape increases the angle of attack of the wing. This will generate more lift. It will also increase the amount of drag on the airplane. Pilots use flaps to assist them in taking off and landing.

Some of the WWII aircraft were equipped with dive brakes. When they are lowered, they cause a large increase in the amount of drag. Dive brakes were used by dive-bombers in steep dives to prevent the airplane from gathering too much speed.

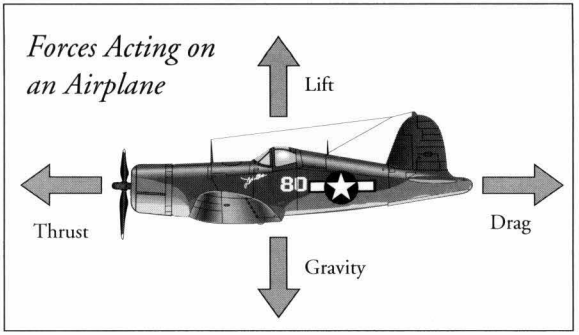
Most WWII aircraft had retractable landing gear. Once airborne, the pilot raises his landing gear to reduce the amount of drag.


Pitch
80
The elevators control the pitch. To pitch down, push the stick forward.


Yaw
The yaw is controlled by the rudder. To yaw to the left, move the stick to the left

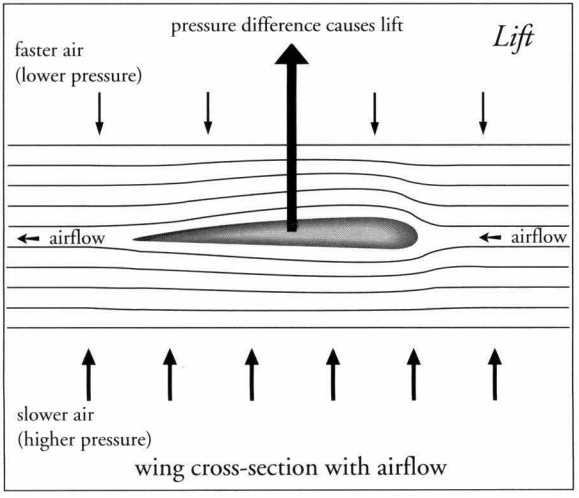
Physics of flight

There are four basic forces that act upon an aircraft in flight: lift, thrust, gravity and drag. While gravity is a constant that the pilot cannot control or alter, he can affect the other three forces.

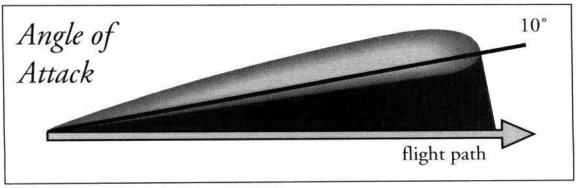


Lift

Lift is achieved through the design of the wing. As an aircraft moves, air flows over the surfaces of the wing. Wings have a special shape that forces the air to move faster over the top of the wing than on the bottom. This creates a low pressure region above the wing. Known as the Bernoulli effect, this air pressure difference pushes up on the bottom of the wing, and lift is generated.



The angle at which the wing meets the airflow also affects the amount of lift generated. As this angle (known as the angle of attack) increases, more lift is created. However, if the angle of attack is too great, the air flowing above the wing will be disrupted, causing a sudden decrease in lift. This condition, a stall, occurs when the aircraft is either flying too slowly, or flying at too steep of an angle. When an aircraft stalls, the sudden loss of lift will force it into a dive. This is especially dangerous if the aircraft is at a low altitude. The aircraft



will recover from a stall when it has regained sufficient airspeed. Increasing airspeed increases lift. The more airspeed, the greater the difference between the air pressure above and below the wing, creating more lift.

Thrust

Thrust is generated by the rotation of the propeller. Propeller blades are shaped in a manner similar to the wings. However, instead of lift being generated (a movement upward), thrust (a movement forward) is created. To create more thrust, increase your throttle. Generally more throttle will increase your airspeed.

Drag

Drag is the friction caused by the aircraft's surfaces moving through the air. The more streamlined an aircraft, the less drag produced. Obviously, extended landing gear, and lowered flaps will increase the amount of drag. Consequently, to achieve more effecient flight, a pilot will raise the landing gear and flaps after take-off.

When an aircraft is in level flight at a constant airspeed, all four forces (lift, thrust, gravity, and drag) are in balance.

Altitude

As a plane climbs to higher altitudes, the air thins out. This will affect the top speed the airplane can achieve. In the thinner air, the propellers cannot generate as much thrust. Furthermore, the thinner air is lower in oxygen, and this will reduce the power output of the engine. These two factors decrease the overall thrust that the plane can generate. However the thinner air has one benefit, it will reduce the amount of drag on the airplane.

Courtesy National Air & Space Museum, Smithsonian Institution

★ Page from a training guide.

These effects combine in such a way that each airplane will have an altitude at which it can attain its best top speed. Below this altitude, the airplane is slower due to the increased drag. Above this altitude, the airplane is slower due to the reduced thrust generated by the engine and propeller.

At some altitude, the thrust generated is not sufficient to generate any additional lift. This altitude is known as ceiling of the airplane. The airplane is simply not capable of sustaining flight above its ceiling.

Some airplanes are equipped with a supercharger. It injects additional oxygen into the carberetor, allowing the engine to perform well at high altitudes. The P-38 Lightning was known for its superb high altitude peformance, thanks to its superchargers.

The thin air at high altitude also decreased the effectiveness of an airplane's control surfaces. Some airplanes were affected more than others, and became very sluggish and unmaneuverable.

G Force

G stands for the force of gravity. One G is the force experienced by a person standing on the Earth. When an airplane changes its orientation rapidly (as in a tight turn, loop, or other violent maneuver), it will experience additional G forces.

Positive G's are generated when the airplane turns quickly or pulls up rapidly (as at the start of a loop). WWII aircraft were capable of generating 7 G's or more. This is a force equal to seven times the force of gravity. These G forces have a physical effect on the pilot. In a high G maneuver, less blood is pumped to the pilot's brain, possibly resulting in a blackout. Occasionally in an extended high G maneuver, WWII pilots did black out.

Negative G's occur when the airplane quickly noses down, as for example, when it first enters a dive. Excessive negative G's can cause a pilot to lose consciousness due to too much blood

in the brain. Known as a red-out, this effect was virtually non-existent in WWII air combat.

Compressibility

When approaching the speed of sound, some airplanes will undergo an effect known as compressibility. Depending on the airplane, this effect will occur somewhere between mach .7 and .9 (520 and 670mph).

Compressibility is caused when the air flows over the wing at speeds greater than the speed of sound (the speed of air flowing over the top of the wing is greater than the speed of the airplane). This transonic airflow creates a shock wave that disrupts the flow of air over the control surfaces. The result is a loss of effectiveness in the control surfaces.

WWII airplanes would experience compressibility only in high speed dives, making the ailerons and elevators virtually useless. Compressiblity was a very dangerous condition. Useless elevators cannot be used to pull the airplane out of the dive. The best course of action is to reduce throttle, and drop the dive brakes if available. If not, dropping the flaps or even the landing gear may help slow the airplane. Once it does slow, the pilot will regain control of the elevators to pull out of the dive.

Aileron Lock

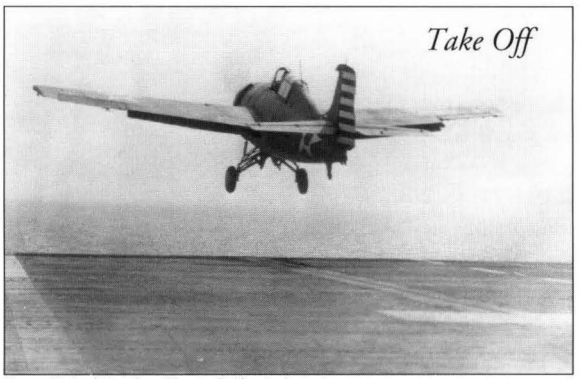
This effect was experienced by only a few WWII airplanes, the most notable being the A6M Zero. The Zero had very large aileron surfaces, and consequently at high speeds they caused a great disruption in the air flow when moved. At high speeds, it became physically very strenuous for the Zero pilot to move his ailerons. Japanese pilots have said that it feels like the stick is made out of cement and cannot be budged.

The result of aileron lock is a loss of maneuverability. At speeds greater than 260mph, the Zero was not very maneuverable. U.S. pilots were willing to dogfight with a Zero until their speed dropped below 250mph.

Basic flight skills

Takeoff

To begin your takeoff, put your flaps halfway down and release the wheel brakes if they're on. Throttle up to about 90% of full. When the airplane has gathered enough speed, the tail will come up off the ground. When your speed reaches 95 mph, gently pull back on the stick. Your airplane will lift off the ground. You're now airborne! Don't climb too steeply or your aircraft will stall, with no room for recovery. Once you've climbed to about 100 feet, retract your landing gear and raise your flaps.



Courtesy National Air & Space Museum, Smithsonian Institution

Climbing

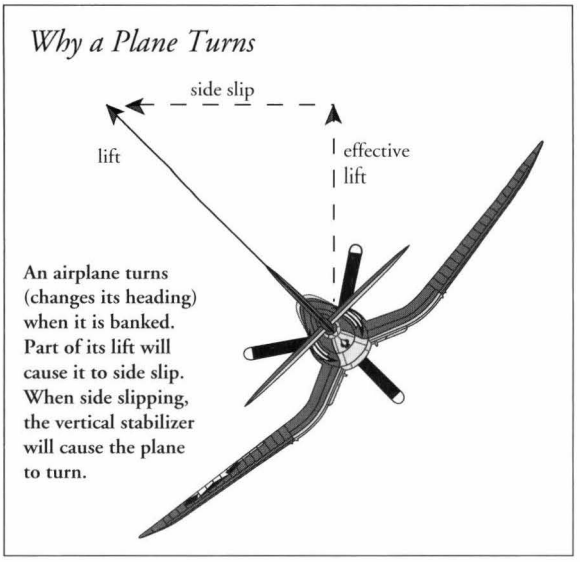
To start a climb, increase your throttle. You will begin gaining altitude gradually. To climb rapidly, increase the throttle and pull back on the stick to bring the nose of the aircraft up. The resulting increase in the angle of attack will generate more lift. Don't bring the nose up too far or your aircraft will stall. To achieve the best climb rate use full throttle with your aircraft's nose about 20 degrees above the horizon.

Descent and Diving

To descend without gaining speed, decrease the throttle. The reduced airspeed will generate less lift, and your airplane will gradually lose altitude. You can also descend rapidly by entering a dive. Push the stick forward to nose the airplane down into a dive. Your airplane will gather speed quickly and lose altitude rapidly. Be careful not to dive too steeply. The resulting high speed may cause your aircraft to experience compressibility or damage your airframe.

Turning

Bank your aircraft with the ailerons by moving the stick to the left or right. The more you bank, the greater the turn rate and the tighter the turn radius. You must also increase the throttle, as turning will bleed off speed. In tight turns, your airplane will lose more altitude, so you'll need to increase throttle more and keep the airplane's nose above the horizon. With the standard or expert flight model selected, you should also apply a little rudder and some back pressure (by pulling back on the stick) to maintain a well coordinated turn.



Recovery from a Stall

Allow your aircraft to nose down. Don't fight the stall by pulling back on the stick. When the aircraft picks up enough speed, it will recover from the stall. Pull back on the stick gently to level out.

Recovery from a Spin

A spin is an aggravated stall that occurs when one wing stalls before the other. Normally this happens when the plane is maneuvering near the critical angle of attack and it stalls, as in a steeply banked turn. The stalled wing will lose lift and drop, while the lift and the drag of the other wing will induce the plane to rotate. The result is a corkscrew descent.

To break the stall, the plane's rotation must first be stopped. The recommended recover procedure is to:

1. Neutralize the ailerons by centering the stick.
2. Apply full rudder deflection opposite to the direction of the spin.

3. Push the stick forward to allow the plane to nose down.
4. Hold these control inputs until the plane stops rotating.
5. When it does, center the rudder and gently pull back on the stick to return to level flight.

Landing on an Airfield

First, line up with the runway. Position yourself about 3 miles out from the runway at an altitude of 500 feet. Reduce your throttle to about 70% of full. Lower your landing gear and drop your flaps all the way. With the flaps lowered your stall speed is reduced and you can approach at a lower speed at a steeper angle. Now, nose your airplane into a gentle descent. Reduce your throttle until you are flying at 10 mph greater than the stall speed. When you are over the runway and 25 feet up, cut your throttle and pull your nose up. If you've properly executed everything up to this point, you will gently settle down onto the runway. The best landing is a three-point landing, when the wing wheels and tail wheel all touch the ground simultaneously.

Carrier Landings

During WW II, the most difficult component of becoming a naval aviator was the ability to land an aircraft on the pitching, weaving deck of an aircraft carrier. Perhaps the hardest element of that exercise was the discipline required to put all the pilot's trust, and indeed his life, in the hands of the Landing Signal Officer, or LSO.

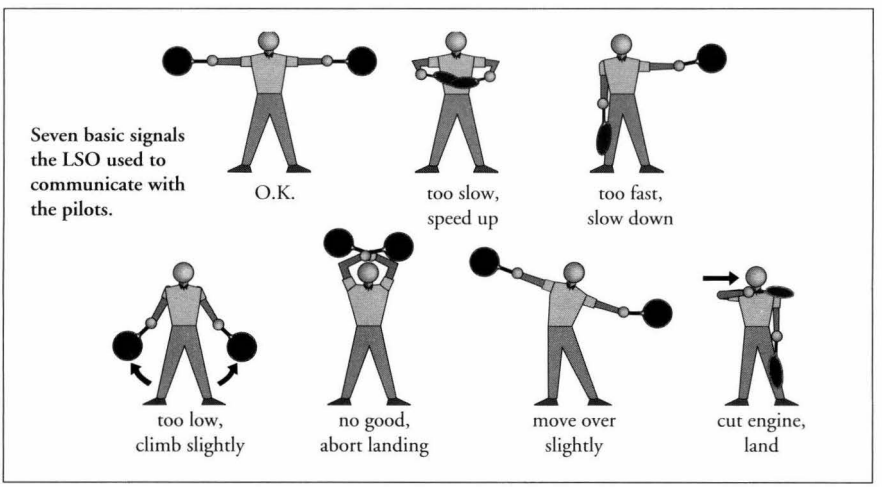
The LSO on any carrier became a pilot's mother and father. He was usually an experienced aviator himself, selected for the job because of his special command presence; a man people automatically listened to and obeyed. He formally critiqued every landing, and although a pilot may have thought his performance to be "4.0," he would find some way for him to improve.

At the end of each mission the flight returned to the carrier and the LSO would shepherd them in.

The flight group approached the carrier on the starboard side, flying in the same direction the carrier was steaming, which would always be "into the wind." The group would fly by in formation almost overhead of the carrier at an altitude between 500 and 800 feet. Members of the Flight Operations Group checked each plane in the flight to be sure that it met three conditions, "hook down, flaps down and wheels down."

About a thousand yards in front of the carrier, the flight leader would begin a gradual 180 degree turn to the left. Each member of the flight would then duplicate his move, passing by the carrier on the port side, again about 500 yards abeam, and flying by in single file. Their elevation would by now have dropped to 150 - 200 feet.

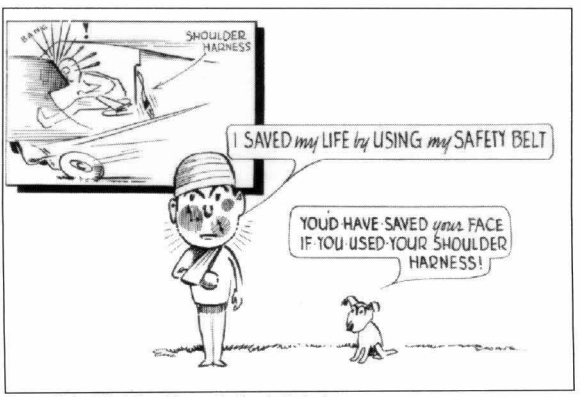
As each plane came about 500 yards aft of the carrier, they completed yet another 180 degree turn. They would now be facing the flight deck, and close to if not directly in line with it. Their elevation would be at about 100 feet. Their power would be between 60% - 70% of full throttle. A pilot's attention then became totally focused on the LSO. His training had overcome his instinct to look at the deck. The LSO instructed him with the use of the two paddles in his hands. His tendency was to come in high and fast. The LSO



wanted him to come in slow and low. Pilots that lived long did not fight him. They did what he signaled for them to do. The highly trained LSO had a far better view of an aircraft's position relative to the flight deck than the pilot did. In fact, in some planes the view of the carrier deck was completely obscured by the engine of the plane. This made the LSO indispensable.

At about 100 yards aft of the carrier, the plane would be 50 - 100 feet above the deck, in perfect landing position, flying about 10 knots above the stall speed. Time seemed to compress for the pilot as he intently watched the LSO. The LSO issued one of two final and mandatory signals. If he raised both paddles above his head and crossed them, the pilot was "waved off." The pilot would immediately give his aircraft full throttle, pulling up and away from the carrier. He would then take last place in the line-up of planes approaching the ship. He would not know until the LSO talked to him later if the wave off was his fault, or the result of a "foul deck," caused by an unexpected movement, or a crewman in the way of his landing.

If the LSO dragged the paddle in his right hand across his neck, in the classic "cut" motion, the pilot immediately cut all his engine power. The plane would plummet the final distance to the deck, and the hook would grab an arrestor cable. Mission completed.



Courtesy National Air & Space Museum, Smithsonian Institution

★ Page from a training guide.

Flight Model Settings

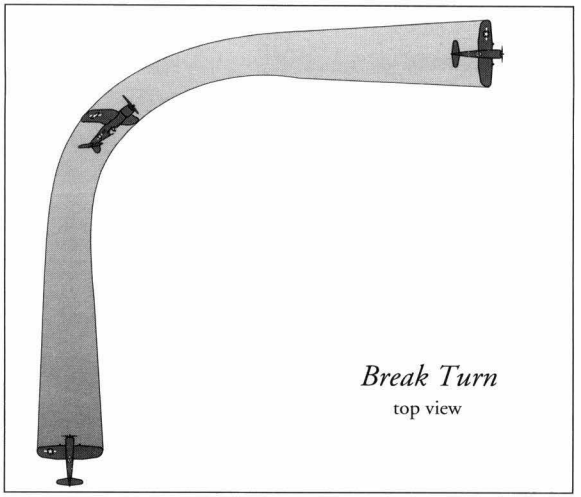
In *Aces of the Pacific*, you can set the level of flight realism to match your flight experience. So if you're a newcomer, you can jump right in to experience the thrill of WWII air combat. If you're a flight veteran, you can fly with a more challenging, realistic flight model. With the Realism Panel, you may set the flight realism among novice, standard, and expert.

On the novice setting, flying is easy. Turns are simplified so that you do not need to use the rudder or apply back pressure. When banked, the aircraft will turn without losing altitude or nosing down. Your landing gear will be automatically lowered when you touch down. Finally, your airplane will perform as if it were clean (carrying no bombs and additional fuel).

On the standard setting, turning is modeled more realistically. You will lose altitude if you don't keep the nose above the horizon by applying back pressure (pulling back on the stick). Some rudder may be needed as well. Without rudder or back pressure, your turn may degenerate into a slow spiral dive. On standard, the requirements for a safe landing are stricter than on novice. High altitude will decrease the maneuverability of your airplane. Unlike novice, bombs and additional fuel will decrease your plane's lift and climb rate. Your landing gear will not lower automatically when you touch down, so you'll have to remember to lower it.

The expert setting will test your flying skill. In addition to the more realistic effects included on the standard setting, the various quirks of certain aircraft are included. Your Zero's ailerons may lock up at high speed, and some airplanes will experience compressibility in steep dives. High speeds may also damage your plane's airframe. Some airplanes are susceptible to spins (a very nasty kind of stall) as well. Safe landing requirements are even stricter, and turning is more difficult.

FLIGHT MANEUVERS



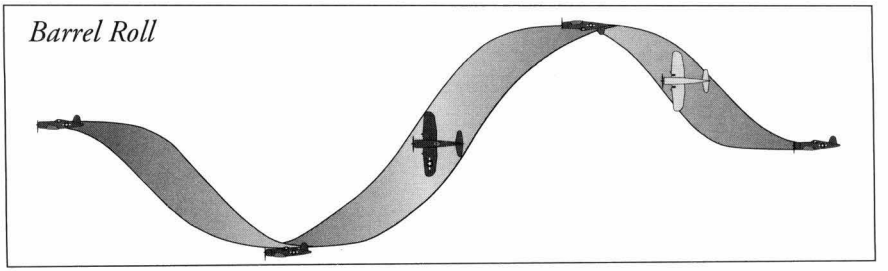
Break Turn
top view

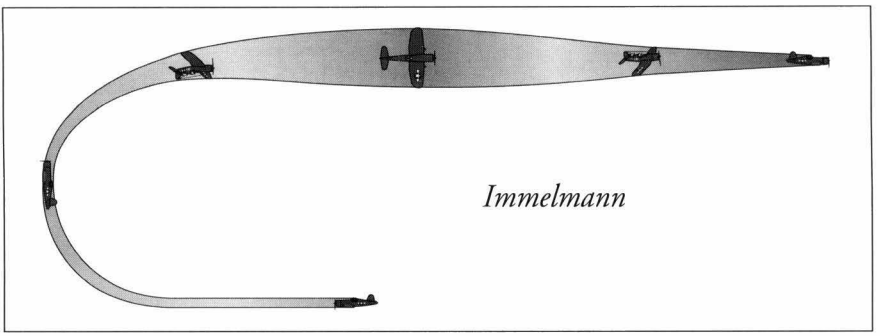
Break

A break is a very tight turn at a high angle of bank, assisted by the elevators. Simply bank hard to one side by moving the stick to the right or left. Once the plane has rolled 45-70 degrees, pull back on the stick to sharpen the turn. If you should start to lose altitude, increasing back pressure on the stick or reducing your bank angle should raise your nose. A break is useful when you want to quickly change direction. It can be used when you see bandits that you wish to attack, or as an evasive maneuver.

Barrel Roll

When performing a barrel roll, your plane will cut a corkscrew path across the sky. To execute a barrel roll, bank sharply in one direction while pulling back slightly to maintain rotation about the roll axis. Maintain this bank as your plane inverts (at top of the roll) and continues along the roll until returning to level flight (at the bottom of the roll). A barrel roll can be used as a defensive maneuver when the enemy is on your tail. A perfect barrel roll can be performed without a loss of altitude, but it is very difficult. Most pilots will lose altitude in a barrel roll.



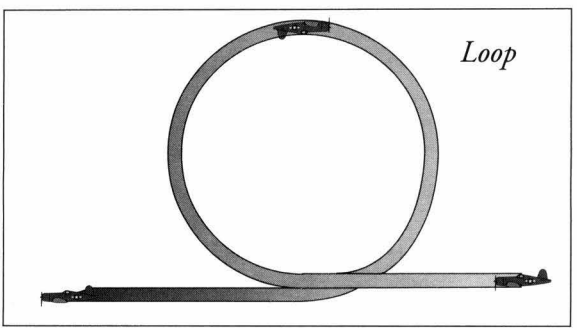


Immelmann

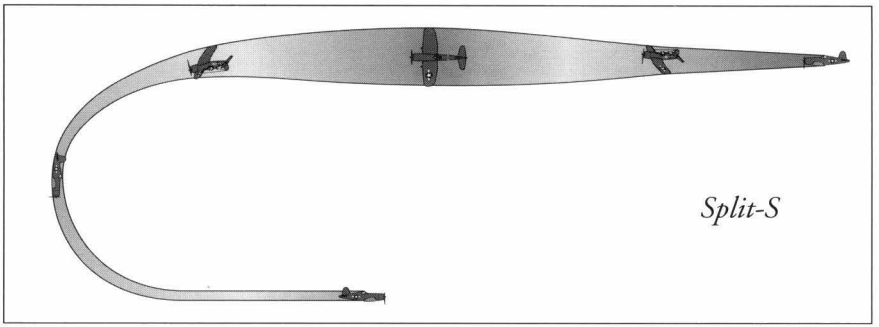
An Immelmann is a climbing half loop combined with a 180 degree roll. The result is reversed direction at a higher altitude. At the beginning of the maneuver, your plane should be flying level at a high speed. Begin by increasing your throttle and pulling back on the stick. As the plane reaches the top of the half loop, it will be inverted. Push the stick to the right or left so that the plane will roll to one side, and maintain the roll until your plane is right side up. Upon completion of an Immelmann, you plane should be at a higher altitude and travelling in the opposite direction from your initial compass heading. The Immelmann can be a useful pursuit maneuver when you pass beneath an enemy travelling in the opposite direction.

Loop

A loop is a full 360 degree rotation in pitch. Gain plenty of speed before beginning a loop (a loop is often preceded by a dive). Increase the throttle to full and pull back on the stick to nose up. The plane should be upside down at the top of the loop. Maintain back pressure on the stick and complete the loop, flying level at the end of the maneuver. The plane should be

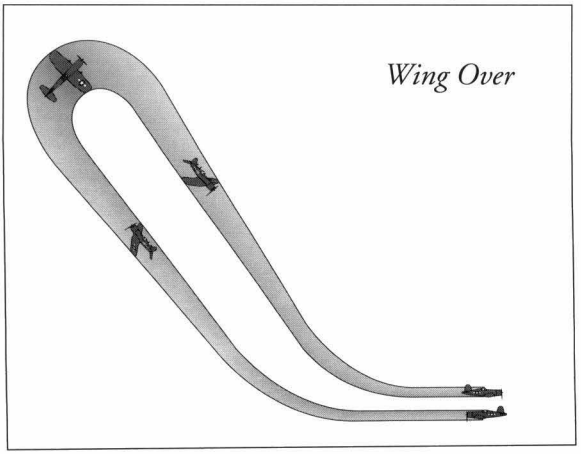


travelling at its initial compass heading, but at a lower altitude. Since the American planes were outmatched in a dogfight by the Zero, US pilots couldn't afford the loss of speed incurred by looping. The more aerobatic Japanese pilots could use a loop as an evasive maneuver.



Split-S

A split-S combines half roll with back pressure on the stick to perform a half loop. First, roll aircraft 180 degrees so that the plane is upside down. Then stop the roll and pull back on stick to execute a half loop, returning the aircraft to level flight. This maneuver reverses the plane's direction while losing altitude. Although it can be used to engage an enemy flying beneath you in the opposite direction, the Split-S will greatly increase your speed. This makes the maneuver ill-suited to planes that easily suffer from compressibility problems (most notably the P-38 Lightning).



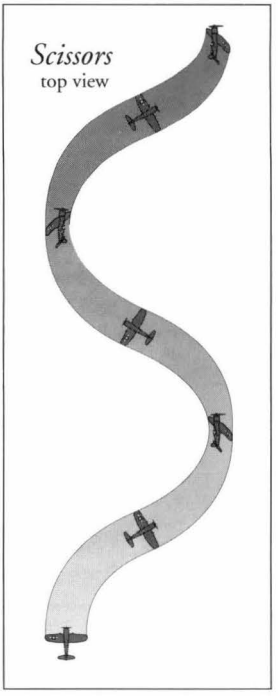
Wing Over

In a wing over, your plane behaves somewhat like a marble rolled up a ramp; gravity draws it back down to where it started. Rather than using ailerons to execute this 180 degree turn, pull

back on the stick to begin a steep climb. As plane nears a stall, use full rudder to yaw the plane over until its nose is pointing down in the opposite direction of the climb. This is a tricky maneuver, but it is useful after a diving attack, allowing a quick return for a second pass.

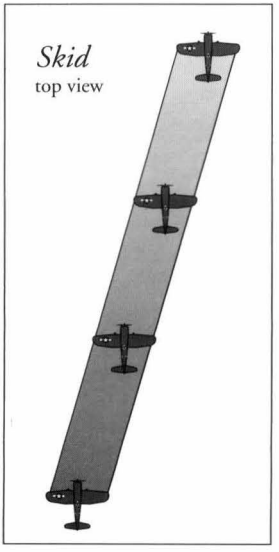
Scissors

The scissors maneuver is composed of a series of extreme banks from side to side. You can perform the scissors maneuver by alternating hard right and left stick (rudder and elevators can be used to tighten the turn). When a target is scissoring, an attacker can't maintain a steady bead; and, if the scissoring plane is more maneuverable than a rear attacker, the scissors can slow the target down and force the attacker to pass him. Thus the scissors can turn the hunter into the hunted. It was a favorite maneuver for Japanese pilots when they were attacked from the rear by a sluggish American plane.



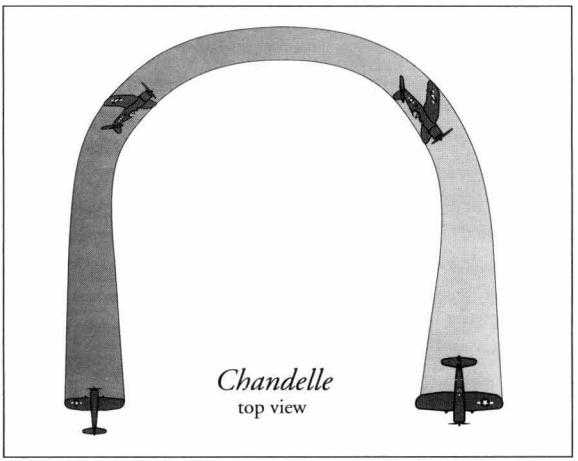
Skid

A skid appears as a lateral slide with a gradual loss of altitude. While dipping one wing, apply opposite rudder to prevent yaw (your compass heading shouldn't change significantly). The plane will "skid" in the direction of the dipped wing as altitude is lost. A skid can be used to lose altitude without incurring a large increase in speed or a drastic change in heading. U.S. pilots would use an extreme form of skidding to throw off the aim of an attacker. When the American plane started to roll to one side, the attacker would turn (rather than skid) to pursue, causing their guns to drift off target.



Chandelle

A chandelle is a slow-climbing turn through 180 degrees. Beginning from level flight, move the stick to the right or left and gently pull back to increase elevation. Don't bank too steeply or you will perform a break turn (and lose altitude). Maintain this rising turn until you have turned 180 degrees. When you have completed this maneuver, you have reversed your direction and gained altitude.



Chandelle
top view

Courtesy National Air & Space Museum, Smithsonian Institution

★ TBFs in echelon right formation.

AIR COMBAT TACTICS

Courtesy National Air & Space Museum, Smithsonian Institution

★ Two pilots discuss tactics in front of a P-38. This photo was taken in the Aleutians.

"Come in on him in a high stern pass. Hold your fire 'til you're within good close range. Let him have it and watch him burn. When they're hit right, they burn like celluloid."

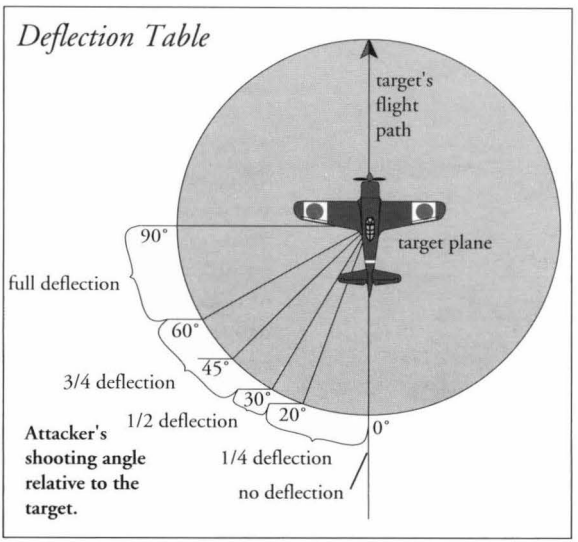
— Major "Pappy" Boyington, giving advise to his squadron's pilots on attacking a Zero.

Gunnery

The goal of air combat is to shoot down the enemy aircraft as quickly as possible with minimum risk to yourself. To this end, your airplane becomes a weapon that must be pointed at the desired target, moved within range and fired. A seemingly simple task, it is complicated by a target that is always in motion.

Deflection Shooting:

If the enemy plane is moving directly toward (head-on) or away from you, you have to close to the distance necessary for your weapon to be effective, take aim and fire. This situation is known as a direct, or **zero deflection shot**- the rare instance when the forward movement of the plane does not affect where you aim. In the more frequent situation where you must fire your shot from an angle, rather than from directly in front of or behind the enemy craft, you must take the enemy's forward movement into account and aim not where he is the instant you fire, but where he will be by the time your bullets reach his craft. This "leading" with your aim to place your bullets in a place that the enemy *will be* is known as deflection shooting.



To determine the correct "lead" in deflection shooting, you must consider how fast the enemy craft is moving and your angle of firing relative to his position. It is a skill that requires enormous practice, learning to visually gauge target speed and estimate the proper lead. The U.S. Navy knew this and began training pilots in the art of deflection shooting in the early 1920's. Using deflection shooting, they could approach an aircraft from nearly any angle with a good chance of hitting the target. As aircraft technology improved, deflection shooting became more than an advantage - it became a necessity. The top speeds of aircraft increased, making it more difficult to set up low deflection, head-on or stern attacks. Bombers increased their rear defensive abilities, making low or zero deflection attacks from the rear incredibly dangerous. These factors made deflection shooting the safest and easiest way to set up a shot.

Gunnery Tactics

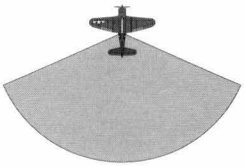
Like all factors in air combat, finding the optimal shot requires that the pilot be acutely aware of his plane's capabilities, his surroundings and the capabilities of the enemy.

A Head-on pass sets you up for a no-deflection shot. However, you will have very little time to aim and you will be flying directly into the enemy's line of fire. If the enemy has superior firepower, trading blows with him in this way is foolish and another tactic should be chosen.

A Stern Attack, like the head-on pass, sets you up for a zero deflection shot. However, since the enemy is not closing on you (or moving away at an angle), you will have ample time to set-up your shot. This is assuming that you can keep on the enemy's six and he doesn't have a rear gunner. Stern attacks on aircraft equipped with rear defenses are extremely dangerous. You may have a near zero deflection shot on the enemy, but the enemy will have the same on you.

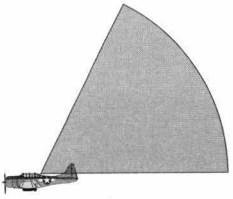
The range at which you open fire is vital. Firing at long range is a waste of ammunition, and may alert the enemy to your presence if detection hasn't already been made. A good pilot will restrain himself from firing until he's closed to close range. Veteran pilots of the war had a simple rule of thumb - don't fire on the enemy plane until you are so close that his plane fills the view within your sight.

Gun Arcs



top view

These gun arcs are representative of most dive and torpedo bombers.



side view

Fighter Combat

While there can be no quick and easy steps to success in aerial combat, there are basic lessons from which to build a solid, and hopefully long lived, combat career. The following rules have evolved from the first days of air combat in WWI to the years of training and battle experience that marked the end of the second World War.

Detection

The first phase of combat engagement is known as **detection**, the instance when the enemy sees you or you see the enemy.

As a combat pilot, it is this initial phase of an encounter that will determine if you will be on the *offensive* or *defensive*. If you spot the enemy first, you will have the opportunity to secure advantages before engaging. Most notably, you can seek height and position advantages and chose if and when to engage the enemy.

While detection encompasses many factors, the foremost element that determines first sighting is AWARENESS- a constant and vigilant watch for the enemy. You must always be looking for the enemy- ahead, to the left side, to the right side, above and behind. Known as rubber-necking, the veteran pilots were constantly scanning the sky for bandits (enemy fighters). Any pilot will tell you that to focus straight ahead at the beauty of the sky is to invite disaster. To this end, there are several factors that should be foremost in the minds of all pilots and gunners.

The seat and fuselage on many aircraft create a blind spot behind the pilot. This is the most likely area from which a flight can be surprised by the a bandit. Some aircraft have a bubble canopy, affording visibility to the rear. However, even in these planes, the inconvenience of constantly rubber-necking and looking to the rear has caused many pilot to relax his guard, and subsequently be bounced from behind and shot down by an unseen enemy. Consequently, it became an essential discipline for pilots to frequently look back. This is known as "checking your six."

In formations of two or more planes, the role of keeping a watch behind- checking the six of the section- was assigned to the wingman. His primary role was defensive, preventing the flight from being surprised by a rear attack. The role of the wingman as watchdog for the vulnerable rear of the flight freed up the flight leader to concentrate on proper navigation to the target and keep a vigilant watch for enemy aircraft ahead.

Larger flight formations and craft (such as bombers) are easier to spot from a distance, and in the instance of bombers, such flights are nearly impossible to conceal. These formations will

rarely make it to the targets undetected and therefore should be given a fighter escort in the likely event that the flight is bounced by enemy fighters.

Visibility decreases as weather conditions worsen. Again, a seemingly obvious note but an important one. Clouds can conceal you (and the enemy), thus making detection much more difficult. For this reason, cloudy weather was favored for bombing missions because it increased the group's chances of making it to the target undetected. While the weather acted as protection, it wasn't without a price. It's can become very difficult to find the target through a dense layer of cloud cover.

Courtesy National Air & Space Museum, Smithsonian Institution

★ Page from a training quide.

At night, detection becomes the single most crucial aspect of air combat. With conventional detection (eyesight), it is virtually impossible to find enemy aircraft. Very little air combat took place at night for this reason. It wasn't until 1943 that large numbers of U.S. planes were equipped with radar and nighttime air combat occurred. Special night fighters, equipped with on-board radar, would roam the skies in search of enemy bombers.

The glare of the sun becomes a natural blind spot. A plane flying into, or out of the sun from your point of view is essentially invisible. Again, the most deadly enemy is the one never seen and flying out of the sun is a common combat tactic.

Once detection is made, the engagement enters the closing phase of combat.

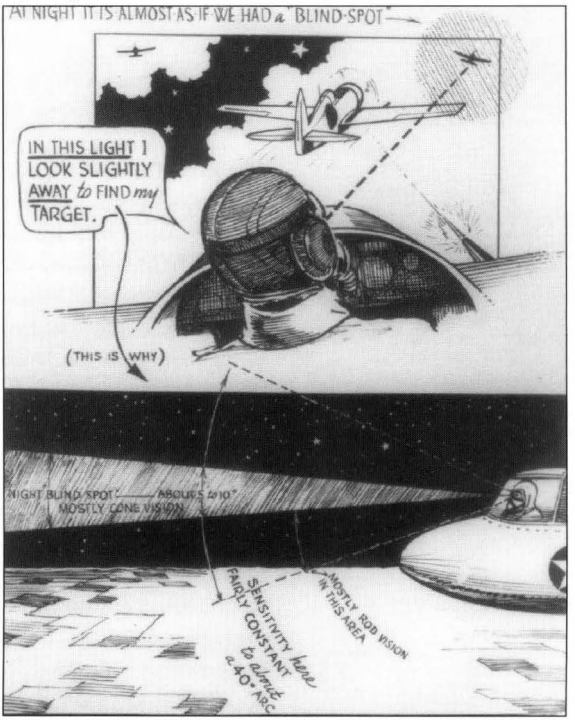
Closing

If you've gained first sighting of the enemy, the next move of combat is in your hands. If you are undetected, you should secure all available advantages before engaging the enemy. These advantages are:

Height. Gaining a vertical, or height advantage on the enemy is key tactic in air combat. With height comes the ability to control when, or if, an attack begins. Height also gives you the advantage of speed, as altitude can be converted into a fast diving attack on the enemy. The speed gained from this dive can then be converted back into altitude by pulling the plane into a climb.

Sun and Weather. Use the elements of nature to your advantage. Position your attack so that you fly out of the sun, thus taking advantage of the sun's blinding effects or utilize cloud cover to mask your approach on the enemy.

Use your position to your advantage. If you're above or behind the enemy when you gain first sighting, choose an approach that maintains your concealment for as long as possible.



Courtesy National Air & Space Museum, Smithsonian Institution

Attack

Once the situation has been analyzed and you've begun closing on the enemy, you must decide on and implement the style of attack that will be used.

★ While most tactics were taught to pilots in the field, by the middle part of the war the latter stages of training in the States included basic tactics in the syllabus.

Attacks Against Fighters

In WWII, there were two schools of thought on air combat tactics. The Japanese Navy favored traditional dogfighting - the circling combat style used by pilots in WWI. Dogfighting is a twisting, turning engagement where moves are met by counter-moves as each pilot attempts to put his guns on the enemy. The dogfighting pilot will try to outmatch the maneuvers of the enemy, positioning himself in the proper position to deliver a lethal volley from his guns. Dogfighting requires excellent aerobatic skills. It also requires a nimble and maneuverable fighter with a tight turn radius. The Japanese fighters, especially the Zero, were extremely maneuverable and pilots of the Japanese Navy pilots were extremely well trained in aerobatic flying. For the Japanese, the dogfighting style was a perfect match for their training and aircraft.

The second school of thought, employed by the U.S. pilots, emphasized speed. Instead of relying on the tight maneuvering and aerobatics used by the Japanese, this style found its strength in the ability to deliver lightning fast dives and then zoom climb to regain altitude superiority. Initially in the war, however, U.S. pilots had yet to discover this tactic and tried to dogfight with the Japanese Zero. The encounters that followed nearly always ended in disaster as the highly nimble Japanese planes chewed up the unmaneuverable U.S. planes. It quickly became common advice from senior pilots to "never dogfight with a Zero!" and "don't turn with a Zero!" Falling back to their own strengths, the American pilots began using high-speed hit and run attacks. Ideally, these runs would begin from a higher altitude than the enemy, with the attacker diving down and opening fire at close range. After the high-speed run is complete, the attacker will simply dive or fly away at high speed. The enemy plane will not have an opportunity to return fire. In the early part of the war, the U.S. planes were incapable of outclimbing the Zero so high-speed runs usually ended with the attacker diving out of combat. However, as better U.S. planes were introduced, this changed. Most notable among these new aircraft were the Hellcat, Corsair and the P-38. These powerful planes changed the tactics available to U.S. pilots, allowing them to dive

down on the enemy, attack, pull-up and then quickly climb to a higher altitude from which the attack could be repeated.

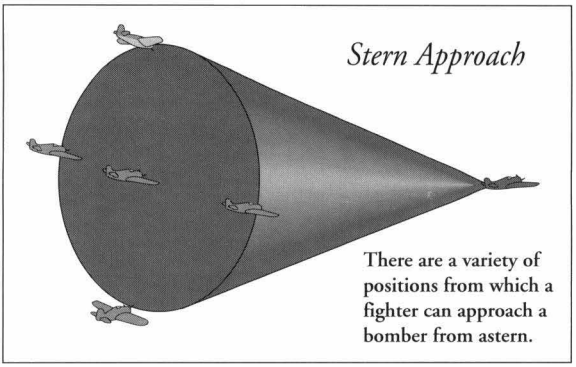
Courtesy Foto Consortium

★ B-25D in formation with an A-36. The A-36 Apache was the early variant of the P-51 Mustang. Equipped with an Allison engine, the A-36 was used as a dive bomber/attack craft in Italy. Later, a British Marlin engine was mated to the airframe, creating the P-51B Mustang.

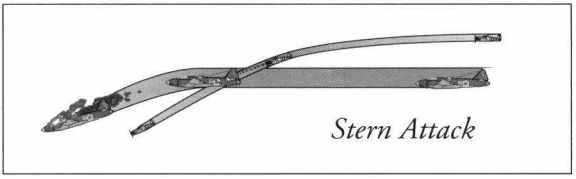
The primary attacking decision a fighter pilot must make is which style of combat to employ. Dogfighting will favor the more maneuverable airplane with the tighter turning radius. Hit and run, or slashing attacks, requires that your airplane can dive faster than the opponent's and capable of zoom climbing more quickly. If you have no altitude advantage and it appears that your plane is outmatched in both speed and maneuvering, the best course of action may be to avoid combat and run. It's not something you'll brag about back at base but it's the smart thing to do if you're outmatched and have the chance to get away.

Attacks Against Bombers

Air combat against bombers differs from that against fighters because bombers are large and have poor maneuvering abilities. This means that your attack can be better planned and implemented as the lumbering bomber will be incapable of the evasive tactics available to the quicker and highly maneuverable fighter. Countering the bomber's weaknesses in speed and maneuvering, they are heavily protected by gunners, especially in the rear. This makes stern attacks on bombers extremely risky. The bomber's gunner can easily target a rear-attacking aircraft, having ample time to line up a shot at a craft that is moving straight into his line of fire. Your attack must take this heavy defensive capability into consideration. Against bombers, five main attack tactics evolved.



There are a variety of positions from which a fighter can approach a bomber from astern.



Stern Attack

Stern Attack

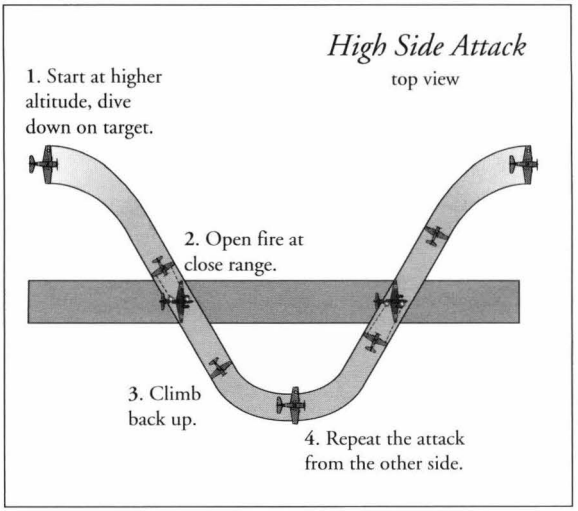
The simplest, and most dangerous tactic to use against a bomber, the stern attack is widely employed by novice pilots because it doesn't require great flying skill. The move has many possible variations but it is essentially an attack from behind the bomber that gives you a straight-on shot at the enemy with nearly unlimited firing time. It is widely used against fighters (where there is no rear gunner) and is not usually recommended as a tactic against bombers due to the extreme danger posed by the aircraft's rear-gunner.

The High and Low Side Attacks

The side attack came in two main variations, High and Low. Both variations use the same technique, but from different beginning altitudes and require a high degree of skill at deflection shooting. The side attack begins from a position above the enemy, moving in the same direction yet slightly ahead and to one side. The move is carried out by performing a turn toward the enemy then swinging the craft around until it is facing the enemy craft at about a 45° angle. When your plane has doubled back so that it reaches a point directly aside the enemy, you reverse your turn until you are heading again heading in the same direction as the target. The tactic quickly brings you into position for a full deflection shot at the side of the enemy plane. As you hold your course, the deflection lessens to the point where a full stern attack is possible. Usually, the attack is broken off before one quarter deflection is reached, the pilot breaking away beneath the enemy.

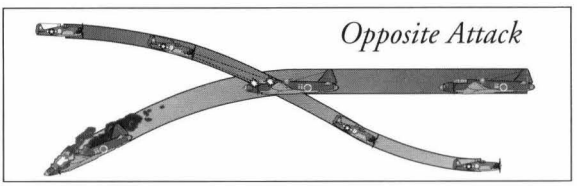
The most effective of the side attacks is the High Side Pass, which is begun from a position 1,200 to 1,500 feet above the

target. The speed gained from a high side pass is sufficient to zoom climb after the attack, therefore allowing the pilot to reposition for another run. The Low Side attack, while not as effective for repositioning the attacker after the initial run, requires less altitude advantage, approximately 400-600 feet. Both forms of side attacks will place you into firing position without greatly risking attack from the enemy's rear gunners. Due to angle and speed of attack, defensive gunners are faced with a rapidly changing rate of deflection and will find it difficult to pin you down.



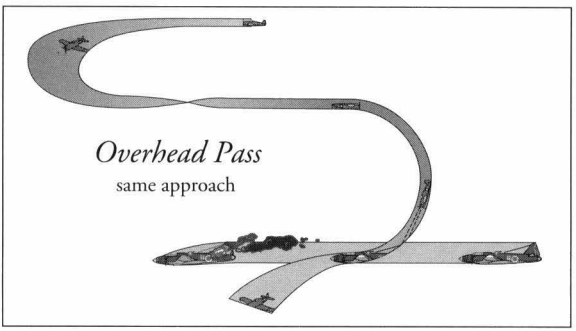
Opposite Attack

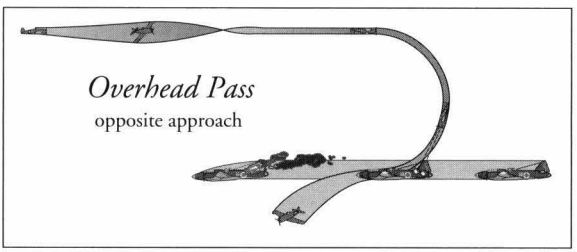
Like the stern attack, the opposite attack requires little deflection shooting because you will be approaching the enemy from dead ahead. There are three approaches to the opposite attack: high, level and low. The high approach is begun from approximately 10 to 15 degrees above the enemy. The level approach is begun from the same level as the enemy and the low approach is begun from 10 to 15 degrees below the enemy. Of the three options, the level approach is the least preferable since it places you directly into the line of fire with the enemy. While the opposite attacks required little skill at deflection shooting, they do have disadvantages. Specifically, the high closing speed between the attacker and target left little time for lining up the shot and once the planes had passed one another, it is very difficult to set up another shot unless both planes turn back toward one another.



Overhead Pass

The overhead pass is the most demanding of the five anti-bomber tactics. It was not widely used by WWII pilots, owing to its great difficulty. It requires an altitude advantage of at least 2,000 feet, a starting position well ahead of the enemy and 2,000 feet of airspace *below* the enemy to allow for recovery and pull-up. It is an extremely difficult move, requiring a great deal of practice to perform smoothly. However, when properly executed, it can be deadly, positioning you for blows on the enemy's engine and fuel tanks and baffling the opposing gunners with a quick moving target.





There are two variations of the overhead pass, depending upon whether you are heading in the same or opposite direction as the enemy. From the same heading, the move is executed by pulling a nose-high 180° turn toward the enemy plane. Because the turn is made from a position ahead of the enemy, you will find yourself pulling around to face your target. The turn is completed when you have pulled yourself into the vertical plane of the enemy's craft, at which point, you flip your plane into inverted flight (making it very easy to keep the enemy in sight). When you are directly over the target, you drop your nose and dive down upon the enemy. The angle of attack should be near 60 degrees, positioning you for a high stern attack. The move is completed by cutting behind and below the target at a 45° angle. With the speed generated from your dive, you should easily be able to pull-up to a higher altitude and set-up for another attack.

To carry out an overhead from the opposite direction, position yourself above and directly in front of the enemy, keeping your craft in the enemy's vertical plane. Drop one wing to the side to keep the enemy in sight and at the right moment, flip over into inverted flight and carry out the move as described above. Performing the overhead approach from opposite direction of the enemy is less complicated than from the same direction but the closing speeds of the two craft make timing your moves more difficult. Great skill is required to execute the dive from inverted flight so that you are properly positioned behind the enemy.

Defensive Tactics

The best defense is a good offense! This old, but true line perfectly describes one of the fundamental rules of air combat.... detect the enemy first. There can be no substitute for a careful and vigilant watch that gives you first sight on the enemy. However, if first detection is lost, you'll find yourself on the receiving end of gunfire and must go on the defensive.

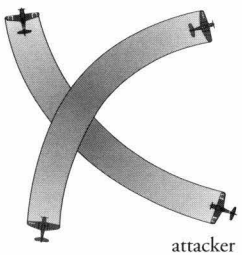
Wingman Defense

One of the preferred defensive tactics of U.S. pilots, especially U.S. Naval pilots, relies upon the use of a wingman. In a two plane fighter unit, called a section, a wingman and wing leader operate to mutually protect each other. If the wing leader is attacked from the rear, he can call for his wingman to "clear my tail" or "clear my six." The wing leader then breaks toward his wingman, bringing the enemy across the path of his wingman's guns. This move can be repeated several times, with the wing leader and wingman *weaving* back and forth, until the bandit breaks or is destroyed. The tactic was essentially developed by Jimmy Thach and over time came to be known as the "Thach Weave."

An alternate move, known as the "Sandwich Maneuver," calls for the wing leader to break away from his wingman, pulling the enemy in between wing leader and wingman and into the wingman's sights.

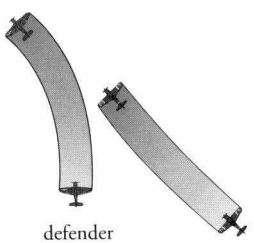
Turning Toward an Attacker

In this situation the defender has correctly chosen to turn toward the attacker. Although he will pass through the line of fire of the attacker, it will only be for an instant. The attacker will not be able to follow the defender through his turn.



Turning Away from an Attacker

The defender has chosen to go with his natural instinct – to turn away from the attacker. The end result is that the attacker ends up on the tail of the defender with a relatively easy shot.



Evasive Tactics

If the wingman is too far away to offer assistance or if the attacker has already opened fire, evasive action is called for. The most common evasive tactic is to *break*- perform a rapid, elevator assisted, turn. This increases the deflection angle for the attacker, making his shot on you more difficult. **Always break toward the attacker!** While breaking away may seem the logical move, it positions you as an easier target for the attacker (see illustration). Breaking is most effective when the enemy is attacking from the side.

Other evasive maneuvers include the Split-S, Immelmann, Loop and Barrel Roll. Climbing or diving out of combat can also be employed, depending upon the strengths of your airplane. In general, each plane type has maneuvers that are best suited to it. The P-47, with its great power and weight, could dive and gather speed like no other fighter in WWII. Hence, diving was a preferred evasive tactic by P-47 pilots. The Japanese planes, and the Zero in particular, were very maneuverable. Therefore, breaking and loops were preferred tactics. Strengths aren't the only guidelines for picking individual plane tactics. The U.S. P-38 experienced compressibility problems (see Physics of Flight) during high speed dives. Because of this weakness, diving or executing a Split-S were considered poor evasive maneuvers for the plane, with veteran pilots informing rookies to "never Split-S in a P-38." The P-38's strength was in it's power and speed. Understanding these advantages, the preferred evasive tactic was performing a shallow climb at top speed, thus moving you out of combat.

In the instance when the attacker is *very close*, climbing, diving or performing a break-turn will often leave you exposed to the enemy's guns for far too long. In this situation, a high-speed skid is the best evasive tactic. Stomping on the rudder and applying reverse ailerons, your plane will be thrown into a side-slip. This will throw off the aim of the attacker. When the high-speed skid is combined with a simultaneous dive, it is extremely difficult for the enemy to maintain his aim.

These tips can be useful but keep in mind that there is no better teacher than personal experience. Let this guide you in discovering which maneuvers you prefer to use with the individual aircraft.

Wingman's Role and the 2-3 Plane Element

The role of wingman is vital in both U.S. and Japanese combat tactics. Operating with a flight leader, the wingman completes a mutually protective unit, with the wingman watching a flight's six so that the flight leader can concentrate on the skies ahead. The two planes also serve as protection for each other, a readily available defensive partner in the event the flight is jumped.

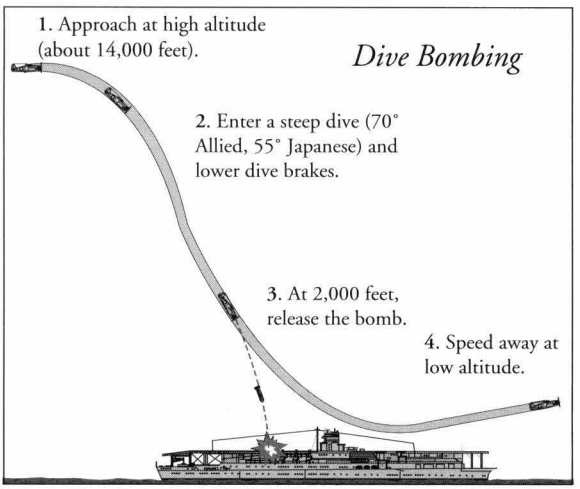
On the U.S. side, the wingman operates in a 2-plane group known as an element or section, led by a section leader. On the Japanese side, the wingman were originally part of a 3-plane group known as a Shotai, with the flight leader called the Buntaicho. In early Japanese flights, three planes formed the group and there were two wingmen. Later, the Shotai was modified to a 4-plane group, composed of two Buntai which are the equivalent to the U.S. element with one wingman and a flight leader. Although the names, aircraft abilities and tactical strategies for the U.S. and Japanese flights are different, the common thread between them is the tactical purpose of a formation composed of a wingman and a wing leader. The teaming provided visual surveillance and defensive capabilities far beyond what was possible from two planes operating separately.

As the rear watchdog for a flight, the wingman follows the lead from the wing leader at each and every turn. Playing a more offensive role, the wing leader selects the targets for his section and determines the tactics of engagement. Once an attack has been launched, both the wing leader and wingman (or wingmen) can engage the enemy. However, the primary responsibility of the wingman is to maintain a watch over the section's six and protect his wing leader. A wingman should NEVER leave his wing leader, even if targets present themselves as easy kills.

Special Tactics

Dive Bombing

The dive bombing run is composed of four parts: the approach, the dive, the release and the pull-up. You *must* begin your approach from an altitude of *at least* 10,000 feet. The higher the altitude of your approach, the more time you will have to line up the enemy. Once the enemy is spotted, push the stick forward, directing the plane into a steep dive at an angle of approximately 70°. Lower the dive brakes on your airplane if it has them. This will prevent your plane from gathering too much speed in the dive. While diving,



Tactical Unit Terminology

Japanese

Buntai:	Two-plane tactical unit. Used from 1943 on.
Shotai:	Three-plane tactical unit. Altered in 1943 to include four planes divided into two Buntai (also known as a Flight).
Chutai:	Two to three Shotai, six to twelve planes.
Buntaicho:	The Japanese term for flight leader.

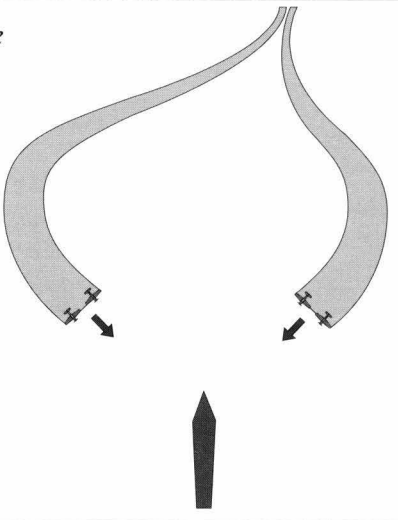
U.S.

Section:	Also known as an Element, or Pair. A two-plane tactical unit, including a section leader and his wingman.
Division:	Two sections, four planes (also known as a Flight).
Squadron:	Two to nine divisions, eight to thiry-six planes.
Group:	Several squadrons.
Wing:	Several groups.
Flightleader:	The term for the leader of a division.

position your aim just slightly ahead of your target and maintain your fix. When you reach an altitude between 2,000 and 1,500 feet, release the bomb and immediately pull up. Do not attempt to release the bomb below 1,000 feet. At such a low altitude it will be nearly impossible to pull up. The ideal bombing run is launched in line with the ship's stern. This will place the greatest target area in your sights for the longest period of time.

Anvil Attack

Known as the Anvil Attack, the torpedo bombers split up and attack the target from opposite sides, each at 45° off the bow of the ship. This way, regardless of which way the ship turns, some of the torpedo bombers can still attack it from the side.

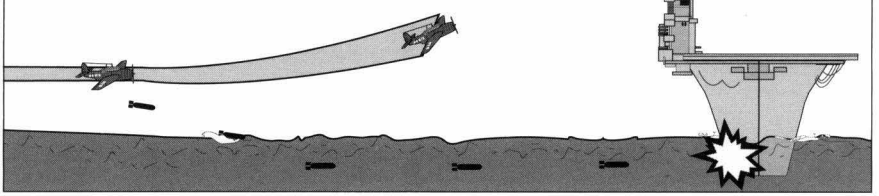


Torpedo bombing

Torpedo bombing is implemented by descending from medium altitude. When you reach 100 feet, level out. Release the torpedo at a distance of about 1,000 yards from the target. The ship will have a difficult time getting out of the way of the torpedo. The classic torpedo attack is the Anvil attack. In it, you approach the target as part of a squadron. Splitting into divisions, the attack would be launched so that 1 division attacked the left side of the ship and the other would attack the right side. Performed correctly, it is devastating because the ship can not evade torpedoes coming from both sides. However, it's a very difficult tactic to pull off successfully due to the precision timing required by the two attacking divisions.

Requirements:	U.S.	Japan
Max. Speed of Plane	110 mph	180 mph
Max. Alt. of Plane	150 feet	350 feet
Effective Range	1000 yards	1500 yards

Torpedo Bombing



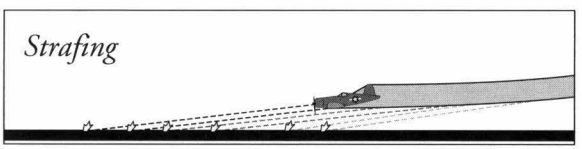
The Japanese excelled at the Anvil attack, especially between 1941 and 1942, when their most talented pilots were still alive.

Glide-bombing

The glide bombing attack is identical to the dive bomb with the exception that the angle of decent is only 20°. The move was much less accurate than dive bombing, but was easier to perform. It was a tactic widely used by inexperienced dive bomber pilots, torpedo planes loaded bombs and fighter-bombers.

Strafing

There are two basic techniques employed for strafing. In practice, frequent combinations of these two styles are employed. The first begins with a high altitude approach near 10,000 feet. When the target is spotted, you implement a steep dive with the enemy in your sights. When you are within weapons range, fire on the enemy and then pull up and around. The speed from the dive will allow you to climb back into position for another attack. The second technique relies upon the speed of your craft and the element of surprise. Closing upon the target from an extremely low altitude, begin firing on the enemy when you are within range. Walk the rudder (alternately depressing the left and right rudder pedals) as you fire to spray your shots in an arc.



Rocket Attacks

The rocket attack uses the same basic approach as the glide bomb attack. From an target distance of 1,000 feet or less, fire the rocket with the ship in your sights and quickly pull up. In the Pacific, rockets were used exclusively by the Americans against ships and ground targets.

Japanese Pilot to new pilots

Servants of the Emperor, you represent the honor, pride and power of the mighty Japanese Empire. Our foe is formidable but you must always remember that it is we who rule in battle! Your skill in combat is unmatched and the Americans will dizzy and fall before you. You are superior pilots, your Zero is more agile than any aircraft the world has seen and your numbers are great. These are your strengths. Honor them and you will be victorious. Listen to me now, and I will share with you the wisdom that time has taught me...

Combat comes quickly. Your response must be equally quick! If you are attacked, break, split-S or loop. The sluggish American craft cannot match your agility in the skies. In his ignorance, your enemy will try to follow as you turn. It is then that you will have him. In the dogfight, maneuverability is everything and the superiority of your Zero will be decisive! To follow you, the American must slow his craft, thus robbing him of his only strength, speed. He will be unable to climb or dive out of battle and will become helpless before you. Remember conservation as you close, using the expendable 7.7mm machine guns to sight your lead and the deadly 20mm cannon for the kill.

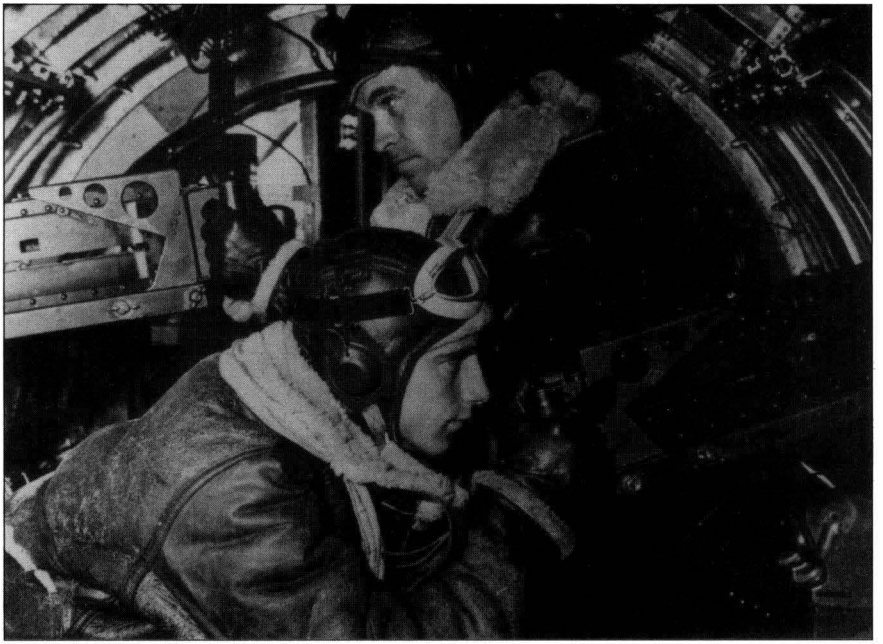
While your strengths are great, you must also come to know your weaknesses. To ignore them would be foolish. Your craft is superior in agility but it is a machine of precision. It will not withstand the abuse of battle as can the American craft. Though slow in maneuvering, their craft are strong and well armed. For this reason, do not engage the enemy head-on in battle. To do so plays into your enemy's strengths. Instead, break off and re-establish combat where you hold the advantage.

American Pilot to new pilots

Let's get right down to business. Your aircraft cannot out-maneuver the Japanese planes. Place yourself into a dogfight with a Zero and you will lose. Whatever crap you've heard about the Japanese pilots, forget it. They're smart, they're well trained and they're organized. Forget that during combat and you're not going to be around long enough for a refresher course.

Now, there are only four things that'll keep you out of the drink. First is aggressiveness. It's something that the Japanese pilots don't seem to have a lot of and it's one of the key elements to staying alive. If you're going in for a shot and you think you're close enough for the kill, get closer. You want to cram your gun down their throats and the only way to do that is to get right up on their tails and hand deliver the message. Likewise, if you're caught off guard and get bounced, taking the time to figure out pretty moves or pulling away is only gonna get you flamed. But I guarantee, you yank that stick so you're screaming right into the enemy's face, he's going to move out of the way. An aggressive counter-move is the surest way to shake your tail of unwelcome visitors. If he's on your on your six and you can't get ahead of him, try a violent, uncoordinated maneuver such as a high speed skid. The Japanese are precision flyers and that kind of move will usually throw them off. The second thing you must know about is teamwork. You've got to temper that aggressiveness with a brain and working as a team is the only way we're going to pull through this war alive. Keep to your flight and watch each other's six. If you get separated from the group, the first order of business is to find friendlies. There's safety and strength in numbers. The third thing I want to tell you is to ALWAYS stay alert. You should be looking out like the Grim Reaper himself was coming for you, because if you aren't constantly alert, the Grim Reaper's who you're going to meet. One undetected plane can end your career in a real hurry. The fourth, and final piece of advice I want to share with you is this: Know the abilities of your craft. Knowing how fast you can pull a climb or how much fuel you'll need to make it home can mean the difference between having a cold one back at base and pushin' up daisies in permanent retirement.

WEAPONS & ORDNANCE



Courtesy National Air & Space Museum, Smithsonian Institution

★ Waistgunners inside B-17 Flying Fortress. It was nearly impossible to hit anything with these hand-held machine guns.

U.S. Guns

.30-caliber Machine gun

After World War I, the Browning .30-caliber was the aircraft weapon of choice, but as aircraft design and construction improved, it could no longer deliver the punch needed to shoot down enemy aircraft The .30-caliber quickly became a secondary gun, being replaced by the more powerful .50-caliber weapon. Firing 1,100 rounds per minute with an initial velocity of 2,880 feet per second, the .30-caliber had a maximum effective range of 1,900 feet.

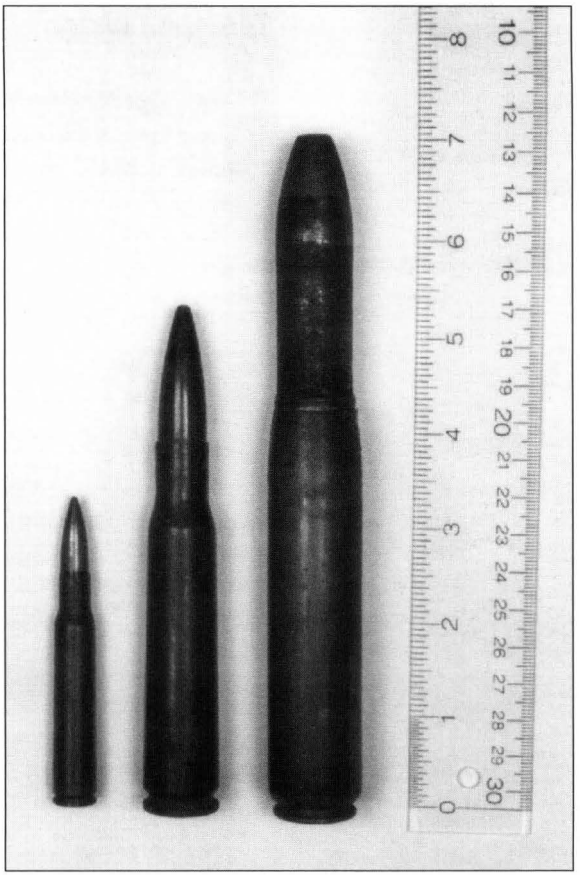
.50-caliber Machine gun

The Browning .50-caliber was the primary American aircraft gun of World War II, seeing widespread use in the

wings, tunnels, turrets, and cowls of American aircraft Possessing greater range and potency than the .30-caliber, the .50-caliber could deliver 800 rounds per minute with a muzzle velocity of 2,880 feet per second.

20mm Cannon

With the never-ending need to increase firepower, the 20mm cannon was seen as the heir apparent to the .50-caliber gun. In comparison to .50-caliber slugs, 20mm projectiles are fired at a slower rate and muzzle velocity, but they were larger and had a greater maximum range. In fact, not only were the 20mm slugs 3 times larger than .50-caliber shells, but their size allowed them to carry an explosive charge, further increasing their damage potential.



★ Comparison of three shell sizes. Scale is approximately 50% of actual size. From left to right: .30-caliber, .50-caliber and 20mm.

37mm Cannon

Although it was not a rapid fire weapon (85 rounds per minute), the 37mm cannon possessed enormous power (with each slug weighing over a pound!). It proved devastating against ground targets and small ships. In air combat, a single projectile could down a plane, but the gun's low muzzle velocity and poor accuracy made aircraft very difficult targets to hit. The 37mm was also notorious for jamming, making it quite unreliable. Its maximum range was greater than the Browning .50-caliber, but fell short of the 20mm cannon.

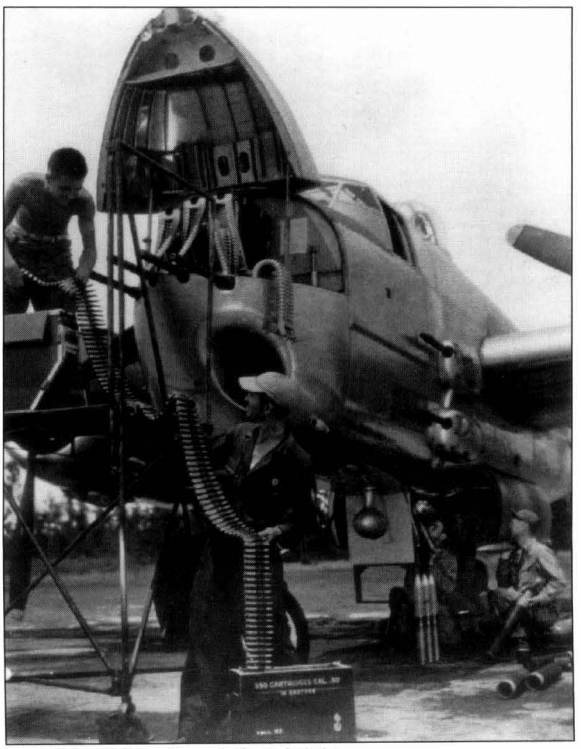
Japanese Guns

7.7mm Type 97 Machine gun

As a standard weapon on Japanese Navy fighters, the 7.7mm gun suffered many of the same shortcomings as the Browning .30-caliber gun (the two shells are the same size). The Americans' use of sealing fuel tanks further reduced the gun's effectiveness. It was best used for rear gunner defense or as a complement to a 20mm cannon.

12.7mm Type 1 Machine gun

Comparable in size to the Browning .50-caliber gun, the Type 1 fired 900 rounds per minute, (r.p.m.) with an initial muzzle velocity of 2,560 feet per second and an effective range of 2,460 feet. Its mounting could be fixed or flexible, and ammunition was fed via a disintegrating metal link belt.



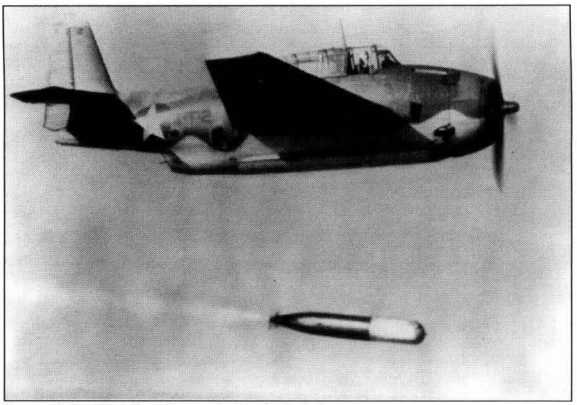
Courtesy National Air & Space Museum, Smithsonian Institution

★ Ground crew loading ammunition in the nose of a B-25H.

Type 99 20mm Cannon

The Japanese used a 20mm cannon (usually in combination with 7.7mm guns) as a long-range weapon of considerable power. The cannon was designated "type 99," and weighed 82 pounds. It could fire 750 r.p.m. at an initial velocity of 2,490 feet per second. Its maximum effective range was 3,280 feet.

Torpedoes



Courtesy National Air & Space Museum, Smithsonian Institution

★ TBF Avenger making a practice drop.

American Mark 13 Torpedo

At the outbreak of war, the Mark 13 was in service with a range of 15,000 feet at 33.5 knots and could be dropped 60 feet from a plane flying at 115 knots. The first months of action showed the weapon to be unreliable at best, prompting a long series of modifications (one remedy involved slapping plywood extensions onto its horizontal vanes). A test of the torpedo in 1943 showed the Navy brass that pilot complaints were more than mere excuses:

Analysis of Mark 13 Torpedo-1943

Of 105 torpedoes dropped at speeds exceeding 150 knots:

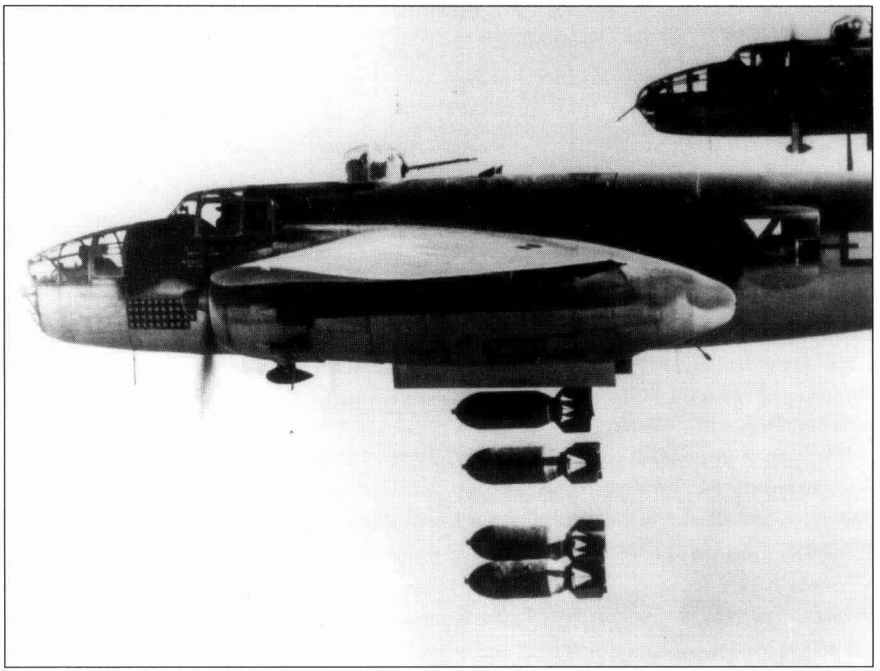
36% ran cold (didn't arm)
20% sank
20% had poor deflection performance
18% had poor depth performance
2% ran on the surface
31% were satisfactory

* Since some torpedoes suffered from more than one problem, total exceeds 100%.

– U.S. Navy Bureau of Ordnance

Japanese Type 91 Torpedo

At the outbreak of war in the Pacific, the Japanese torpedo was vastly superior to the Mark 13. It was not only more reliable, but displayed greater performance. It could be dropped from 200 to 400 feet while flying at 260 knots. When travelling in the water, the type 91 traveled at 40 knots with a maximum range of 2,000 yards.



Courtesy National Air & Space Museum, Smithsonian Institution

★ B-25 Mitchell.

Bombs

Several types of bombs were used in the Pacific. For use on material targets, general purpose bombs were often used. For sinking warships, armor-piercing bombs were prevalent.

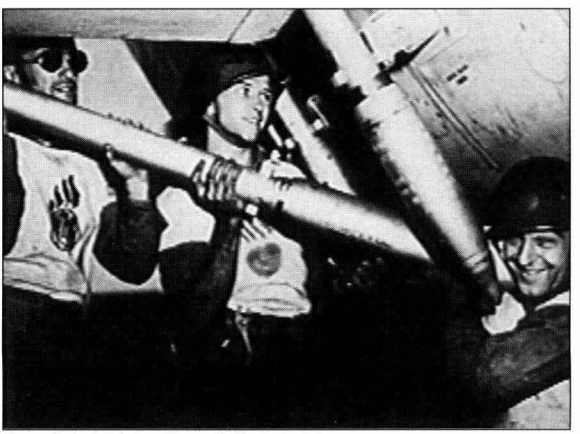
General purpose bombs depended upon the violence of their detonation (rather than fragmentation or flammability) for their destructive capability. Pound for pound, larger bombs could carry more explosives (and less metal casing), so the power of two 100-pound bombs was less than that of one 200-pound bomb.

Armor-piercing bombs were designed to penetrate several inches of steel before exploding; thus, they were widely used against ships. Penetrating power depended largely upon a bomb's weight and its speed upon impact. When imparted with sufficient velocity, the 1000-pound armor-piercing bomb could penetrate more than a half foot of steel before exploding.

Rockets

U.S. 5-inch rocket

In the last years of WWII, the U.S.A.A.F. and the U.S. Navy began to rely increasingly on the 5-inch rocket for ground attack missions. Airmen were quick to dub the weapon "Holy Moses," and it saw action against shipping, tanks and armored pillboxes. With four to eight hard points or six bazooka tubes carrying the 69-inch long, 134-pound rockets, a plane could rival the firepower of a destroyer's salvo.



Courtesy National Air & Space Museum, Smithsonian Institution

★ Loading rockets.

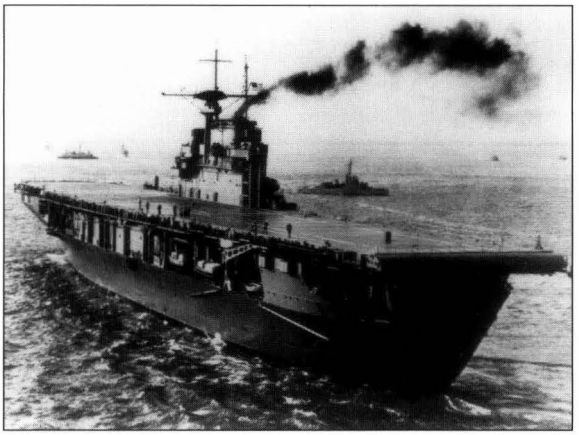
AIRCRAFT CARRIERS

American Carriers

Saratoga Class

Originally the two ships in the Saratoga Class, the *Lexington* and *Saratoga*, were laid down as battlecruisers shortly after World War I. Following the Washington Conference in 1922, the ships were completed as America's first two fleet carriers. During the Pacific War, the *Lexington* participated in the early carrier raids before it was sunk at the Battle of Coral Sea. The *Saratoga* survived the war despite numerous torpedo and kamikaze hits during its four-year combat career. It was destroyed after the war in the Bikini Atoll atomic bomb tests.

Yorktown Class



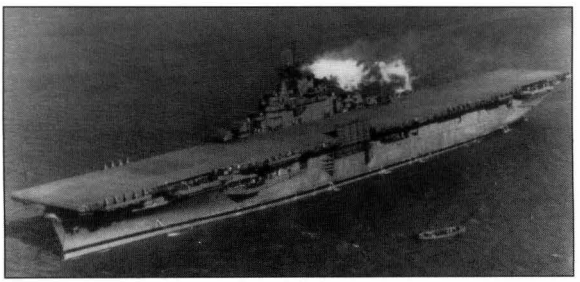
Courtesy National Air & Space Museum, Smithsonian Institution

★ The *USS Hornet* in San Francisco Bay. The *Hornet* was the last Yorktown class carrier built.

Building on previous carrier experience with the Saratoga class and the Ranger, the U.S. Navy constructed the excellent Yorktown class flattops throughout the mid and late 1930s. All three of the class, the *Yorktown*, *Enterprise* and *Hornet* saw extensive combat service in 1942, where all but the *Enterprise* were destroyed. The *Big E* survived the war only to be scrapped in September of 1958.

Independence Class

In March of 1942, the U.S. Navy realized that it would need more carriers in the Pacific to beat the Japanese. The first of the Essex class fleet carriers would not be ready for duty for many months, so a stopgap measure was instituted. 9 light cruiser hulls were redesigned and constructed as small fleet carriers. Known as the Independence Class, these ships saw heavy combat throughout the Pacific. One, the *Princeton*, was sunk during the battle of Leyte Gulf. As they were constructed, little provision was made to offset the weight of the island, causing the carriers to list four degrees to the starboard when fully loaded.



Courtesy National Air & Space Museum, Smithsonian Institution

★ An Essex class carrier under steam. During the last phases of the war, the Essex's wooden decks proved to be highly vulnerable to kamikaze attacks. Many were seriously damaged.

Essex Class

The Essex class carriers were undoubtedly the most successful capital ships of the war. Twenty-three were eventually built, which was more than all the classes the Japanese constructed during the war combined. Fast, agile and capable of carrying over a hundred planes, the Essex class projected American airpower right to the shores of Japan in vast carrier armadas by 1945. Although many of these flattops were badly damaged during the war, not one was sunk by the Japanese.

Courtesy National Air & Space Museum, Smithsonian Institution

★ A late-war Essex class carrier with Helldivers & Avengers on deck. The carrier may have been involved in landing operations, as the aircraft on board are all spotted well forward.

Japanese Carriers

Akagi Class

One of the first Japanese carriers, the *Akagi* was laid down in 1920 as a fast battlecruiser. After the Washington Treaty, the Imperial Navy finished the ship as a carrier. Between 1935 and 1938, the flight deck was redesigned and elongated to 817 feet, an addition of about 200 ft. Through the course of its career, it saw combat off the China coast, at Pearl Harbor, the Dutch East Indies and the Indian Ocean. On June 4, 1942, the *Akagi* was hit by SBD Dauntlesses from the *Enterprise.* It was subsequently scuttled by its destroyer screen.

Ryujo Class

Designed as a light carrier that could carry a large air group, the *Ryujo* was more or less a design failure. In heavy seas it demonstrated dangerous instability, wreaking havoc with flight operations. Nevertheless, it saw much combat in the China Incident and in the opening months of the Pacific War. In August 1942, the *Ryujo* was sunk at the Battle of the Eastern Solomons.

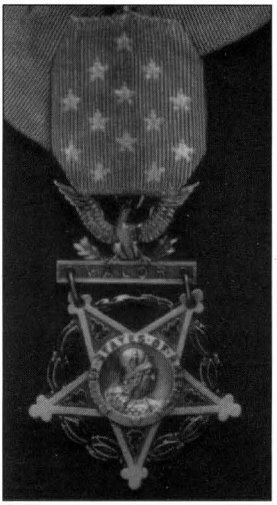
Hiryu Class

Smaller than the *Akagi* and Shokakus, the *Hiryu* and *Soryu* joined the fleet in the final years of the 1930s. Both saw combat in the China Incident before Pearl Harbor. Once the Pacific War had begun, they served as part of the main striking arm of the Imperial Navy, pounding sea and land targets from Wake to Ceylon. They both met their end at the Battle of Midway in June 1942.

Shokaku Class

Perhaps the best pre-war Japanese carrier design, the two Shokaku class ships saw much combat during the Pacific War. One or both were involved in every carrier engagement of the war, except Midway. In combat, they demonstrated a toughness in the design that few other Japanese carriers exhibited. The *Shokaku* was severely damaged on a number of occasions, before finally going down during the Battle of the Philippine Sea. The *Zuikaku* was sunk during the Battle of Cape Engano in October 1944.

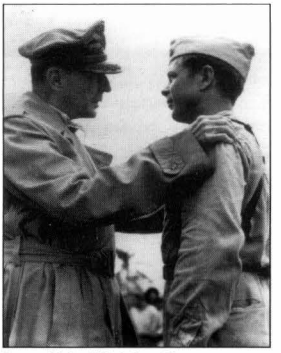
DECORATIONS & MEDALS



★ Congressional Medal of Honor (Army).

American Decorations & Medals

George Washington established the first decorations, the Badge for Military Merit and Honorary Badges of Distinction for soldiers in 1782. A quote from George Washington, referring to the Badge of Military Merit (Purple Heart), describes well the flavor of American decorations. "The General, ever desirous to cherish a virtuous ambition in his soldiers, as well as to foster and encourage every species of Military merit, directs that whenever any singularly meritorious action is performed, the author of it shall be permitted to wear on his facings, over his left breast, the figure of a heart in purple cloth, or silk, edged with narrow lace or binding. Not only instances of unusual gallantry, but also of extraordinary fidelity and essential service in any way shall meet with due reward."

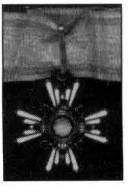


Courtesy National Air & Space Museum, Smithsonian Institution

★ MacArthur decorating Dick Bong with the Congressional Medal of Honor.

Japanese Decorations & Medals

The Japanese Empire has a very long, rich history, but it was not until after the Meiji Restoration when the building of a modern army and navy was commenced, that most of the orders and medals were established. The Order of the Rising Sun was officially established in 1875, as well as the first war medal. Some orders consisted of several classes. A recipient is awarded a particular medal based on his rank or position and length of service according to the unique "Orders of Merit" system. Rather than a crown or coat of arms as with European medals, the Japanese medals use elements such as a sixteen-petalled chrysanthemum, the family "mon" or crest of the recent lineage of emperors, or the rising sun from the national flag.



★ Left to right: Order of the Rising Sun (Kyokujitsusho), Order of the Golden Kite (Kinshi Kunsho), Order of the Sacred Treasure (Zuihosho).

GAME PLAY

Courtesy National Air & Space Museum, Smithsonian Institution

★ An F6F preparing for a catapult launch.

★ Night fighter F4U Corsairs of VF-101, Hellcats, Dauntlesses and Avengers on board the *U.S.S. Enterprise*, early 1944.

Courtesy National Air & Space Museum, Smithsonian Institution

QUICK RUN-THROUGH

Courtesy National Air & Space Museum, Smithsonian Institution

★ Scramble! Pilots running to their planes in the Aleutians.

If you want to acquaint yourself with the game without first reading the gameplay section, follow these instructions to get you up in the air:

1. Follow the **Installation** instructions on the Technical Supplement to get *Aces of the Pacific* installed and running.

2. Press the **spacebar** or wait until the title sequence has ended to view the MAIN MENU. Select **FLY A SINGLE MISSION**.

3. From the FLY SINGLE MISSION Menu, select **TRAINING**.

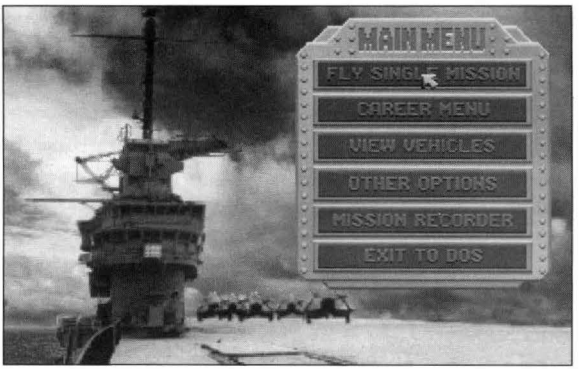
4. You will be asked what service you wish to fly for. Press **ACCEPT** to fly this mission as a U.S. Navy pilot.

5. The Training Mission screen will inform you that you'll be flying gunnery practice in an F4F-4 Wildcat. Press the **START** button to begin your mission. You will start airborne in the cockpit of your Wildcat.

SPECIAL NOTE:
The gameplay section explains the menus and controls used to play *Aces of the Pacific*. For information on broader topics such as tactics, maneuvers, and historical background, refer to the Contents page for the appropriate section.

You will have unlimited ammunition and plenty of drone aircraft to shoot at. To pause the action, press **P**. You can scan the Quick Reference Card for keyboard functions, or refer to this chapter for more detailed gameplay information.

Main Menu



Fly Single Mission

Choose from a variety of missions and set up the mission conditions.

Career Menu

Enlist in the Pacific War as an Air Force or Navy pilot for the U.S. or Japan.

View Vehicles

See close-ups and descriptions of the airplanes and ships of the war.

Other Options

Set preferences, view credits and demos.

Mission Recorder

View and edit taped recordings of your missions.

Exit to DOS

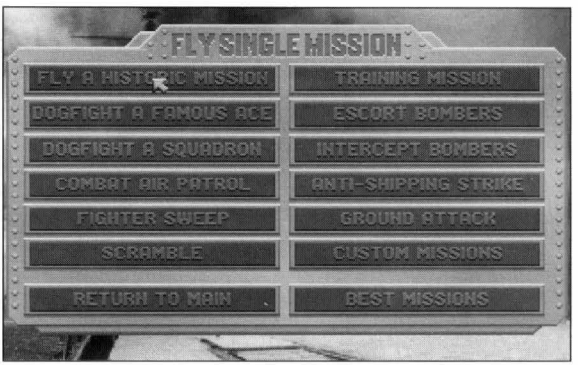
Return to the DOS prompt.

★ Passing time, Aleutian Islands.

Courtesy National Air & Space Museum, Smithsonian Institution

FLY SINGLE MISSION

Fly Single Mission is the fastest, easiest way to play *Aces of the Pacific*. It also gives you complete control of the mission's setup. You first pick a mission type, then you determine the conditions of the mission. Once you've made these choices, you're ready to fly. Upon completion of your mission, your performance will be evaluated, and a score assigned. This score is based upon the difficulty level of the conditions you chose for the mission, whether or not you achieved the mission's objective, and how many targets were destroyed.



Mission Types

Training Mission

Learn the basics by flying these novice level missions. Choose the training mission type that teaches the skill you wish to improve. For tips, see the appropriate Reference Section.

Aerial Gunnery – Try to shoot drone aircraft as they fly a constant pattern. This is a good way to practice deflection shooting.

Dive Bombing – Practice your dive-bombing technique on a derelict tanker.

Torpedo Bombing – Attack a derelict tanker with a torpedo run.

Carrier Landing – Practice your carrier landings, a tricky skill to master.

Ground Attack – Attack the abandoned compound.

Fly a Historic Mission

To fly a Historic Mission, you must select a campaign and service. Press the SERVICE button to select the service you will fly for. Then press the button labelled CAMPAIGN to view a different campaign's historic missions for your selected service. You can choose a mission by using the up and down arrow buttons to move the highlight bar. Make your selection by pressing the SELECT button.

Dogfight a Famous Ace

Challenge one of the war's greatest pilots to head-to-head combat. Select the service of the Ace you wish to fight against. Then scroll through the menu of aces and select one as your opponent.

Dogfight a Squadron
It's your flight against an enemy flight in deadly combat.

Combat Air Patrol
Patrol friendly airspace to check for enemy intrusion.

Fighter Sweep
Clear the skies of all fighters over an enemy target.

Scramble
Get airborne and repel attacking fighters.

Escort Bombers
Protect your bombers as they wing toward their intended target.

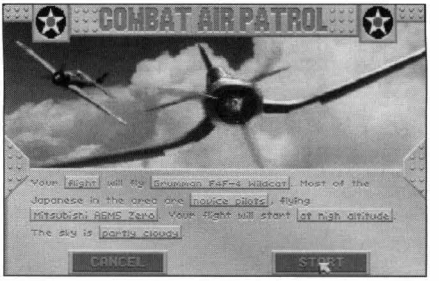
Intercept Bombers
You must prevent enemy bombers from dropping their payload. Note: when choosing the type of bomber to intercept, you can choose to intercept Kamikazes (while they do not drop bombs, they can produce the same devastating results). You are automatically assumed to be an American pilot as you try to stop their desperate mission.

Anti-Shipping Strike
Try to sink enemy shipping, usually with bombs or torpedoes.

Ground Attack
Take out key enemy ground targets with bombs, rockets, and strafing.

Best Missions
Lists the highest recorded mission scores.

Mission Conditions



Once a mission type has been selected, you will be asked to choose a service to fly for. Depending on the type of mission selected, you are also allowed to determine some or all of the following specifics of the mission:

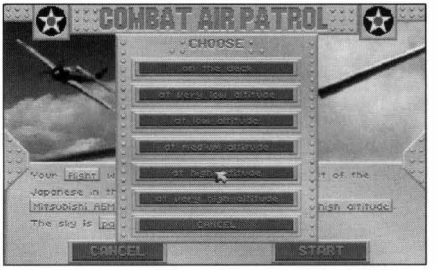
Number of Planes

By pressing the button labelled FLIGHT, you can specify the number of friendly aircraft. When dogfighting a squadron, you can specify the composition of the enemy flight as well.

Pilot Abilities

To adjust pilot ability, press the FLIGHT button. You can choose the greenest novices or the greatest aces to fly with you. When choosing enemy pilots, you can always select a novice, regular, veteran, or expert pilot, but only on Dogfight an Ace or Dogfight a Squadron missions can an enemy Ace be specified.

Aircraft Type



You can always select the type of planes that your flight will fly. You will be able to select the type of planes flown by the enemy when Dogfighting a Squadron or Famous Ace. On Bomber missions (Escort/Intercept) you can specify their plane type as well.

Starting Altitude

You can specify your flight's starting altitude from "On the Deck" to "Very High."

Surprise

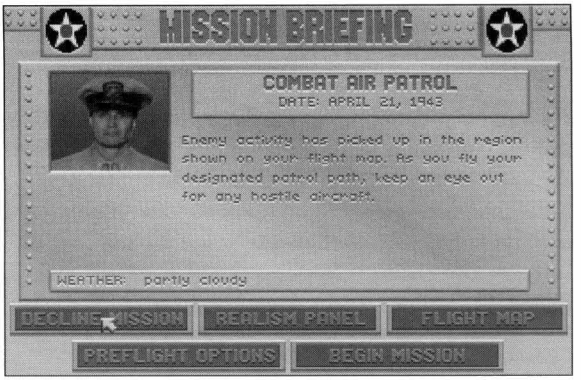
When dogfighting an enemy squadron or Ace, you can confer the advantage of surprise to your flight, the enemy flight, or no one.

Cloud cover

You can set the amount of cloud cover present during the mission from "Clear" to "Overcast."

Note: Some of these settings are interdependent. For example, the plane type can be affected by the type of training mission selected. If you make a choice that invalidates another setting, the invalid setting is changed.

PREFLIGHT INSTRUCTIONS



Briefing

For most mission types, you will receive a Mission Briefing (the exceptions are Dogfight an Ace, Training, and Historic missions). This briefing gives you the information you need to complete your assignment. For further mission information and options press the PREFLIGHT OPTIONS button.

Preflight Options

Configuration

Plane Type – Lists the plane you are flying on this mission.
Armament – Lists any guns or cannons your plane carries and the number of rounds in each. The armament is standard for each plane and cannot be changed.
Ordnance – Knowing your mission goal, you now can arm your forces appropriately. Your planes will be automatically armed with weapons suited to your mission, but you can choose a different weapon load by pressing the ORDNANCE button. Each button press shows you a different available combination of bombs, torpedoes, external fuel tanks, and rockets. Each weapon type has its strengths – torpedoes are excellent ship sinkers, bombs and rockets can devastate ground targets. Some long range missions require an external fuel tank.

Flight Roster

Position and Pilot – Lists the members of your flight and their skill level.
Formation – If you are leading the flight, pressing this button will show you the formations you can fly in. The numbers beside each plane correspond to their position in the flight.

Other Buttons:

DECLINE MISSION – can be pressed if you do not wish to fly this mission.
REALISM PANEL – lets you adjust the realism settings before starting the mission.
FLIGHT MAP – Displays a map of the region and your flight path (See Navigation and the Flight Map for a description).
BEGIN MISSION – puts you in the cockpit.

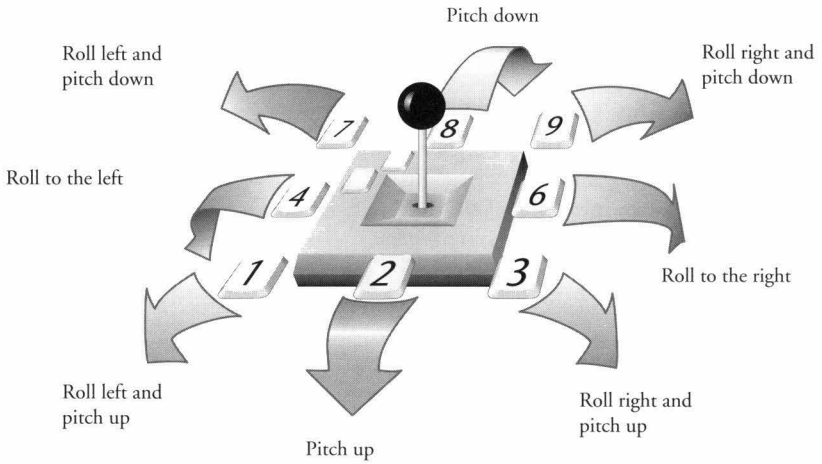
FLIGHT INSTRUCTIONS

Note: The following controls refer to DOS systems with inset references for the Amiga and Macintosh.

You can choose your method for controlling flight on the Preferences Panel. This panel lets you specify the method of control for three aspects of flight: Flight Stick control (moving ailerons and elevators), Rudder control, and Throttle control. Pressing one of these three buttons produces a menu of controller options.

Flight Stick Control

You can use a variety of controllers to imitate the plane's flight stick.



Keyboard only

Use the keypad to control flight. See the graphic above for the function of each key.

Joystick 1

Use a standard joystick in the first joystick port. See the graphic above.

Yoke

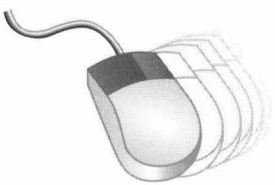
You can use a flight yoke. If you wish to use the yoke's throttle slider, you should make the corresponding selection on the Throttle Control Menu.

Thrustmaster® FCS

Please refer to the Thrustmaster® section.

Mouse

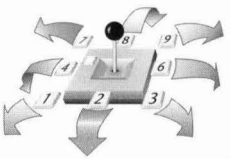
When using a mouse, remember that it is self-centering, and will recenter automatically after each movement.



Macintosh

Use the numeric keypad or the mouse to simulate the flight stick.

Amiga



Use the numeric keypad or joystick to simulate the flight stick.

Rudder Control

The rudder indicator found in the cockpit shows your rudder's orientation. If the tick mark is centered, then your rudder is centered.

Keyboard only

Use the < and > keys to apply left and right rudder. Your rudder will remain in a specified left or right position until you recenter it by pressing the / key.

Amiga

<	left rudder
>	right rudder
/	center rudder

Joystick 2

If you have a second joystick, move the stick left or right to apply left or right rudder. If your stick is self-centering, releasing the stick will recenter the rudder.

Macintosh

<	left rudder
>	right rudder
/	center rudder

Rudder Pedals

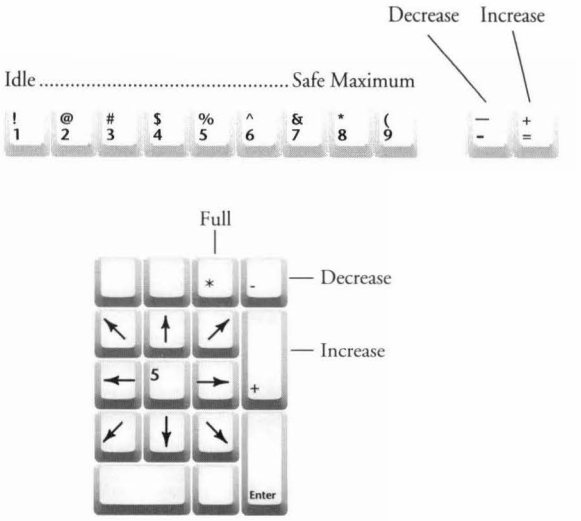
Press the left or right rudder pedal. Center the pedals to recenter the rudder.

Throttle Control

Keyboard only

From any view:

Use the numeric keys **1...9** to go from idle to safe maximum throttle. Pressing the + key increases the throttle and pressing the - key decreases the throttle. Pressing the * key provides full (100%) throttle (note: don't maintain full throttle for an extended time or you will burn out the engine).



Joystick 2

If you use a second joystick, pushing it forward and back will increase and decrease the throttle from idle to full throttle (note: maintained full throttle will damage your engine).

Slider on Joystick 1

If you have a joystick or yoke with a throttle slider, you can use it to control your engine speed.

ThrustMaster® WCS

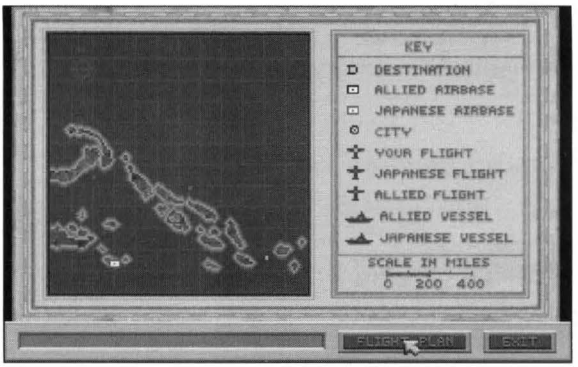
Please see the section that discusses the ThrustMaster® Weapon Control System.

Macintosh	
1...9	throttle control
+	increase throttle
-	decrease throttle
*	full throttle

Amiga	
1...9	throttle control
+	increase throttle
-	decrease throttle
*	full throttle

Navigation and the Flight Map

M View map during flight.



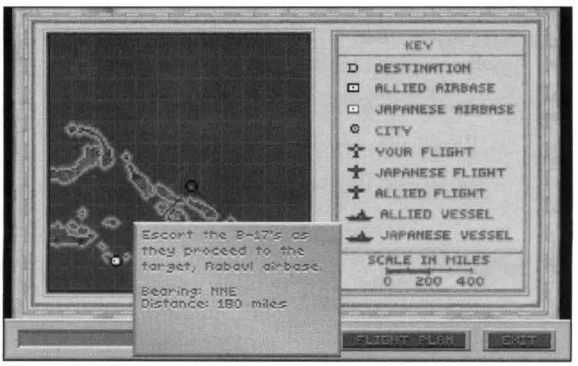
With the map, you can review your mission path and see any objects and places of importance. Use the map key beside the map to distinguish the flights, ships, and ground features shown. By moving the cursor, you can also get information on each map feature:

Spacebar or Controller button 1
Supplies information on the ground-based items found at the cursor location.

Enter or Controller button 2
Supplies information on the aircraft group found at the cursor location.

Press any key to close a map feature information box.

Flight Plan



Pressing the Flight Plan button produces a step-by-step description of your flight path. You are to fly to each map point shown on your flight plan in the order they appear. If you wish to travel to a point other than the next point on your flight path, pressing the **D** key will select the current cursor location as your autopilot destination. Note that if you skip a point on your path, the Autopilot will bring you back to the point you skipped.

Exit or **Esc** Closes your map

Autopilot

A — Activate autopilot (compress time)

Whenever you engage the Autopilot, you will travel to the next point designated on your flight plan (see previous page). Autopilot cuts the action until you reach your destination or you need to be given an alert (enemies spotted, low on fuel, etc.).

Communication and the Radio

S — Send a message.

Incoming messages from your wingman or flight will appear at the bottom of your screen. You can send radio messages by pressing S. A menu of possible messages will appear. You can choose from this list by pressing the number key that appears beside the message. The types of messages that you can send depends upon your status in the flight, the type of mission you are flying, and whether or not you are in combat.

Brakes, Landing Gear & Flaps

B — Raises and lowers the dive brakes. Few airplanes have dive brakes. They are used when dive-bombing.

W — Applies the wheel brakes (only useful when you are on the ground).

L — Raises or lowers the landing gear.

F — Moves the flaps to the up, halfway or down positions.

Droptanks

D — Releases the external fuel tank.

On some aircraft, droptanks provide an additional fuel reserve to extend the plane's flight range. Carrying droptanks reduces maneuverability, so if you get into a dogfight, release them immediately.

Weapon Selection and Firing

Weapon selection varies according to the type of aircraft.

Spacebar or	Fire the selected guns.
Controller Button 1	Fire the selected guns.
G	Change the selected guns (primary, secondary or all).
U	Try to clear jammed guns by repeatedly pressing U (unjam).
Backspace	Release bombs or torpedo.
R	Fire a salvo of rockets.

Machine Guns — All aircraft are equipped with at least one machine gun. On the instrument panel, ammo counters display how much ammunition remains in the primary and (if present) secondary guns. A light is located beside each counter. If lit, the light indicates that the corresponding guns are selected.

Torpedoes — Torpedoes are only effective against ships.

Bombs — Bombs are effective against ships or ground targets.

Rockets — Rockets are most effective against ground targets and light shipping. Remember, these rockets have no type of guidance system.

Rear Gunner — When flying a two-seater, a rear gunner will accompany you. The rear gunner operates independently from you and cannot be controlled. The gunner can be wounded or killed. By looking back, you can see if he's OK.

Courtesy National Air & Space Museum, Smithsonian Institution

★ Loading .50 caliber machine gun rounds into an AAF fighter.

Instrumentation

Altimeter

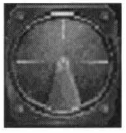
The altimeter indicates the altitude of your plane. The long needle indicates 10's of feet, and the short needle indicates 100's of feet. The two-digit readout indicates thousands of feet.

Airspeed Indicator

Airspeed is measured in miles per hour.

Vertical Speed Indicator

The V.S.I. measures your plane's rate of change in altitude (hundreds of feet per minute).



Bank Indicator

Use the bank indicator to keep track of your aircraft's bank (position relative to horizon).

Compass

When used together with the flight map, the compass is an indispensable navigational tool.

Tachometer

The Tachometer displays your engine's R.P.M.'s

Temperature Gauge

If flying at full throttle or with a damaged engine, keep an eye on the temperature gauge to avoid burning out your engine. Reduce the throttle to bring the temperature down.

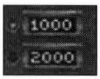
Note: Twin engine aircraft will have *two* tachometers, temperature gauges and oil pressure warning lights.

Oil Pressure Warning Light

If the oil lines are damaged, the pressure will drop, raising the engine temperature.

Stall Warning Light

If the stall warning light comes on, level out the plane or increase the throttle to avoid stalling.



Ammunition Counters

For each set of guns, this display shows the number of remaining rounds. Most planes have two counters: one for primary guns, and another for secondary guns.

Fuel Gauge

Monitor the aircraft fuel supply by using this gauge's two needles. The left needle indicates fuel in your main fuel tank, the right needle shows fuel remaining in your plane's external tank. If the Fuel Warning Light is lit, your main fuel tank is dangerously low on fuel.

Dive Brake Indicator

This toggle switch indicates whether the dive brakes are on or off.

Flap Indicator

Flaps may be up, halfway or down as shown by the flap indicator.

Landing Gear

This toggle switch, labelled "GR," shows the landing gear position, either up or down. Note: Some planes have fixed landing gear that may not be retracted.

Rudder Gauge

The rudder gauge shows the rudder orientation. When the tick mark is centered, the rudder is centered.

View Control

Controlling viewpoint with the keyboard.

Enter Switch between cockpit and external view.

From within the cockpit

F1 Look forward (your instrument panel will be visible)

F2 Look back

F3 Look left

F4 Look right

F5 Look up and forward

From outside your aircraft

F1 View the front of your aircraft

F2 View the rear of your aircraft

F3 View the left side of your aircraft

F4 View the right side of your aircraft

F5 Look up at your aircraft from a lower altitude

F6 Look down at your aircraft from a higher altitude

[Zoom in the view

] Pull back the view

Special views

F7 Chase plane view

F8 Weapon view follows launched weapon (bomb, torpedo, rocket).

Amiga

Use the identical keys to control the viewpoint.

Macintosh

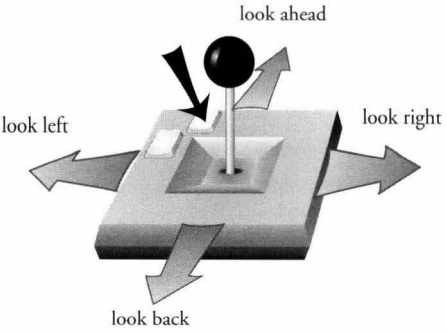
View Key Equivalents

Forward	**F1** or ⌘-**1**
Back	**F2** or ⌘-**2**
Left	**F3** or ⌘-**3**
Right	**F4** or ⌘-**4**
Up	**F5** or ⌘-**5**
Down	**F6** or ⌘-**6**
Chase	**F7** or ⌘-**7**
Weapon	**F8** or ⌘-**8**

Controlling viewpoint with the joystick or mouse.

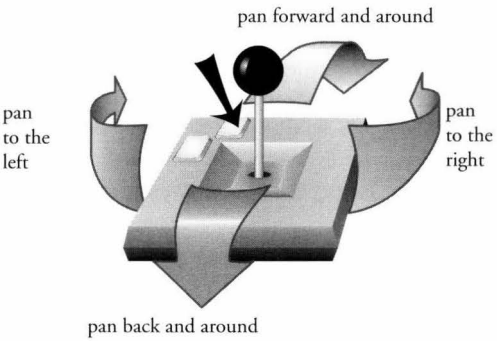
From within the cockpit:
Hold down **flight controller button 2**, then move the joystick to look left, right, ahead, and back.

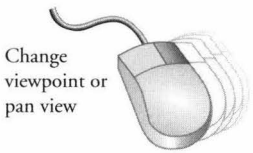
*Note: With the flight controller centered, pressing and releasing **button 2** will switch from the cockpit to the outside rear view.*



From outside your aircraft:
Hold down **flight controller button 2**, then move the joystick to smoothly pan around the aircraft. To zoom the view in or out, hold down both buttons, then move the joystick or mouse forward or back.

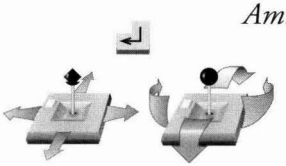
*Note: With the flight controller centered, pressing and releasing **button 2** will switch to the cockpit front view.*





***Note:** In an external view, hold down both buttons and move forward or back to zoom viewpoint in or out.*

Amiga



Hold down the enter or return key to move the viewpoint.

Landing

On land — If necessary, you can land anywhere, but landing at your own airbase is ideal. Landing in enemy territory will result in capture, putting an end to your mission and your career.

On a carrier — To land on a carrier, you must first request landing clearance via the radio. Wait for clearance before attempting to land. Then, follow the signals from the Landing Signal Officer (LSO) to help you come in safely (for tips, see section on Carrier Landings).

Note: It is not necessary to land to complete the mission. You will receive a higher score, however, if you land. You can end the mission by pressing the **ESC** key; but, if your plane is damaged and you quit before landing, you will crash.

Bailing Out

CTRL - B

If damage is too great, you may opt to bail out. Make sure you have enough altitude (approximately 1,000-2,000 feet). Bailing out over enemy territory will result in capture.

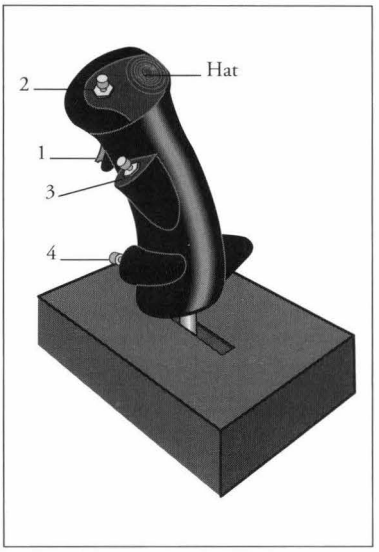
Macintosh

⌘-B Bailing Out

Thrustmaster®

Aces of the Pacific supports both the Thrustmaster® Flight Control System and Weapon Control System. They can be selected from the Preference Panel.

Flight Control System Mark 1



The flight stick of the Thrustmaster® FCS behaves like a standard joystick, but its additional buttons offer unique features.

Button 1 (Trigger) - Fires currently selected guns.

Button 2 (Thumb button) - Changes your view between external and cockpit.

Button 3 (middle of the stick) - Drops bombs or torpedo.

Button 4 (pinky button) - Change the currently selected guns.

The FCS also has a miniature thumb stick or "hat" beside button 2. Moving this hat will change your view in the cockpit.

Neutral position:	look straight ahead
Forward position:	look forward and up
Right position:	look to the right
Left position:	look to the left
Back position:	look to the rear

Note: The FCS hat will only work if you are using the "Keyboard only" or "Thrustmaster® WCS" method of controlling your throttle.

Thrustmaster® Weapons Control System

The Thrustmaster® WCS supplies throttle control in addition to many controls normally controlled from the keyboard. To properly set your WCS for play with *Aces of the Pacific*, set the 1,2, and 5 dip switches on.

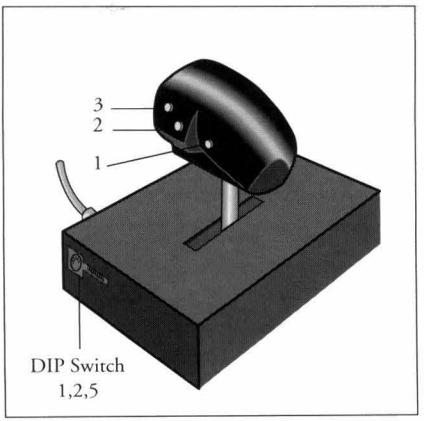
Throttle control

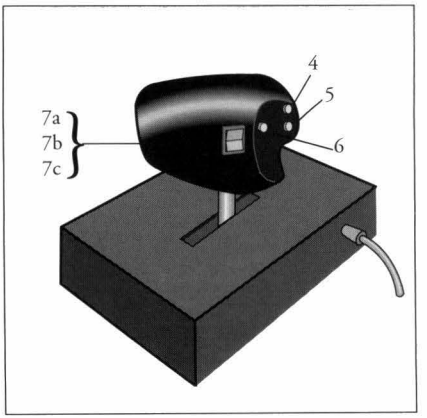
Move the WCS throttle forward to increase the throttle, back to decrease it. Pushing the throttle forward into the first detent delivers full safe throttle. The second detent delivers maximum throttle.

Weapons Control

Each button on the FCS has a function:

Button 1	Send Radio Message
Button 2	Unjam guns
Button 3	Engage autopilot
Button 4	View map
Button 5	Drop external fuel tank
Button 6	Air brakes
Toggle 7a	Moves flap through up, halfway, and down positions.
Toggle 7b	Neutral position
Toggle 7c	Moves landing gear up and down





Preferences

F10 Access the Preferences panel.

After you change your preferences settings, ACCEPT or ESC will save your changes.

The preferences panel allows you to tailor some of the technical aspects of *Aces of the Pacific* to your own tastes and computer configuration. Changes to the preferences panel are saved to disk.

When you access the Preferences Panel from outside the Simulation, you can make the following changes:

Macintosh

⌘-O Access the Preferences panel.

Plane Controls

Aces of the Pacific supports all flight peripherals currently available. With the Flight, Throttle, and Rudder Control Preferences, you can tailor the Simulation to your set up.

Flight Control — Choose from Keyboard only, Joystick 1, Yoke, Thrustmaster® FCS, or Mouse.
Rudder Control — Choose from Keyboard only, Joystick 2, or rudder pedals.
Throttle Control — Choose from Keyboard only, Joystick 2, Joystick slider, or Thrustmaster® WCS.

Menu Controls

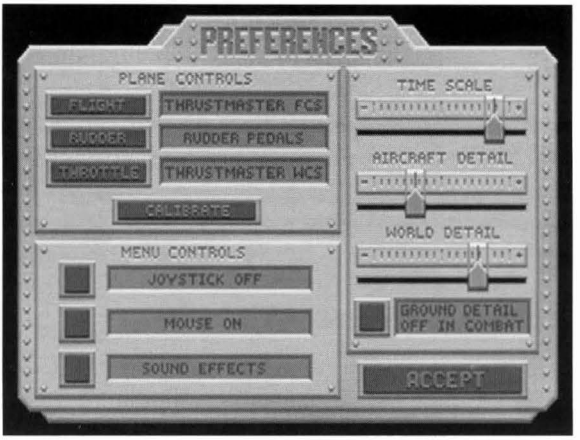
Choose which controllers will move the menu cursor.

Joystick On/Off — Turn this on if you wish to use your joystick controller on menus. You can always disable your joystick by pressing Alt-J.
Mouse On/Off — Turn this on if you wish to use your mouse on menus. You can always disable your mouse by pressing Alt-D.
Calibrate — Recalibrates your joystick for use on menu screens.

Sound Effects on/off

Music on/off

When you access the Preferences Panel from within the Simulation, you are given these additional options:



Calibrate

You can choose which device to calibrate. Follow the prompts given.

Detail Levels

The smoothness of animation play is dependent on the speed of your computer and the amount of graphic detail displayed. The speed of your computer cannot be changed, but you can control the smoothness of the animation by adjusting the amount of graphic detail displayed. You may adjust the balance between smoother animation and more detailed graphics according to your own taste. When you first install *Aces of the Pacific*, the detail sliders will be set according to the speed of your computer.

World Detail — Control the amount of ground detail shown.
Aircraft Detail — Adjust the amount of aircraft detail shown.
Time Scale — Adjust the pace of the action by allowing the game to take larger or smaller "steps.". If the simulation feels difficult to control, try reducing the time scale. If it feels slow even with reduced graphic detail, try increasing the time scale.
Ground on/off during combat — Reduce ground detail during combat.

Note: Since no music is played during missions, the Music On/Off option is not offered.

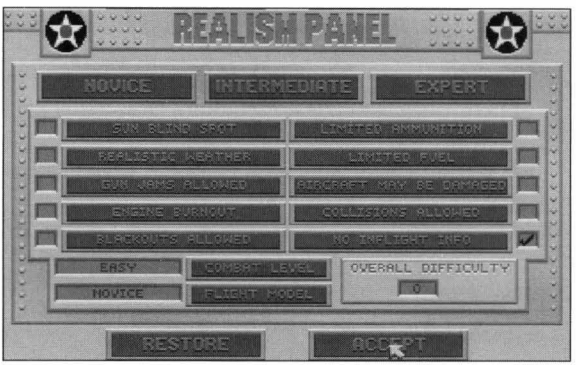
Realism Panel

ALT-R Brings up the Realism Panel.

The Realism Panel lets you turn parts of the flight simulation on or off. Press ACCEPT or ESC to confirm your changes and exit. RESTORE selection to cancel.

Default Realism Settings – Novice, Standard, Expert

With these three defaults, you can set the level of simulator realism to match your experience. Select Novice if you're a newcomer to flight. Use expert if you're a veteran pilot.



Realism Settings

There are ten realism settings. A checkmark next to the selection indicates that the setting is activated. The effects of activating each setting is listed below:

Sun Blind Spot — Airplanes coming out of the sun are very difficult to see.
Realistic Weather — The weather will vary. Otherwise, there will always be clear skies.
Gun Jams Allowed — Your machine guns can jam. Hit the **U** key repeatedly to unjam the gun.
Engine Burnouts Allowed — If a high engine temperature is maintained, the engine may be damaged. A damaged engine will reduce maximum speed.
Blackouts Allowed — Pulling excessive G's may cause you to black out.
Limited Ammunition — Running out of ammunition is possible.
Limited Fuel — Running out of fuel is possible.
Aircraft May Be Damaged — Your aircraft can be damaged. When not activated, your aircraft will be invincible, but the score factor will be set to zero, so no points will be scored.
Collisions Allowed — Mid-air collisions can occur.
No Inflight Info — you will not receive any special instructions to help you in your mission.

Combat

Easy — Enemy planes are easy to hit and shoot down. Your plane is hard to hit and can sustain more damage than enemy planes.

Standard — You are still more likely to hit and shoot down the enemy but your advantage is reduced.

Hard — You have no advantage in your chance to hit or shoot down the enemy.

Flight Model

Novice — Your plane is easy to fly; it won't nose down when you turn.

Intermediate — As you turn your plane, it will tend to nose down. Correct this by applying back pressure on the stick.

Expert — The flight quirks of different planes become more evident.

Note: for more information on the differences between settings, see the section on Flight.

Scoring Factor

Selections on the realism panel affect scoring for the mission. The easier the realism settings, the lower the score factor. When "Aircraft May Be Damaged" is not activated, your aircraft will be invincible, but the score factor will be set to zero, resulting in no points scored.

Grace Period

Once the mission begins, there is a 30 second grace period to change realism settings with a related change in score factor.

POSTFLIGHT

ESC	End Mission
ALT-X	Exit to DOS

Macintosh

⌘-Q Quit

Note: If you exit to DOS, the status of the current mission and current settings on the preferences and realism panels will not be saved.

Ending the Mission

You may end the mission at any time (**ESC** key) except during combat. You will receive more points for landing at your base or carrier at the end of your mission. A message will be displayed asking if you want to stop or continue flying. **If you quit when your plane is damaged, it will result in a crash! If you stop before the mission is complete, you'll leave any friendly aircraft and ships at risk!**

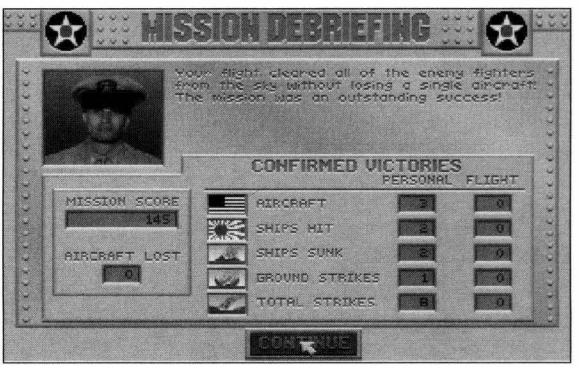
Other Possible Endings

Prison — If you land or crash (and survive) in enemy territory, you will end up in an enemy prisoner of war camp.

Crash — If you survive, it's likely you will be hospitalized until you recover from your injuries.

Killed in Action — If you take too many hits or crash too severely, you will pay the price.

Bail Out — Bail out of a damaged aircraft by pressing **CTRL-B**.



Debriefing

When the mission is over, the debriefing recaps the mission's results.

Mission Objective Results

This text message describes success or failure of the mission.

Planes Shot Down/ Targets Destroyed

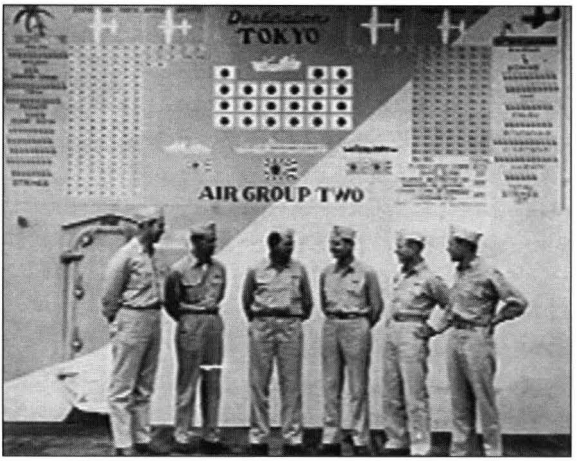
Tallies the total number of enemy targets destroyed as well as the number personally destroyed. Targets are grouped into four categories:

Aircraft — Number of planes shot down.

Ships Hit — Number of bomb, rocket, or torpedo hits.

Ships Sunk— Number of ships damaged beyond repair.

Ground Strikes — Number of ground targets destroyed.



Courtesy National Air & Space Museum, Smithsonian Institution

★ Air Group Two's enormous score card. Air Group Two saw extensive combat during the war, including at the Battles of the Coral Sea and the Philippine Sea.

Score

Scoring in *Aces of the Pacific* is based upon a number of different factors:

— Successful completion of your mission.
— Shooting down enemy aircraft, destroying ships and ground targets.
— Deducted points for aircraft in your flight that were shot down.
— Bonus points for landing at your own base or carrier upon completion of your mission.
— Your score is multiplied by the score factor, specified in the Realism panel.

In any of the missions available under Fly Single Mission, your score will determine your standing in the Best Missions listing. In Career mode, your score will affect your promotion through the ranks.

Board of Inquiry

If you shoot down a friendly aircraft during your mission, you'll come before the board of inquiry. During Fly Single Mission mode of play, going before the Board of Inquiry will lower your score. In Career mode, the penalties are much more severe. While playing a career, if you come before the Board of Inquiry a third time, you'll be stripped of your wings and grounded permanently.

MISSION RECORDER

One of the most exciting features of *Aces of the Pacific* is the Mission Recorder. With the Mission Recorder, you can record an entire mission, save it to disk and then replay it. The Mission Recorder allows you to *change* the saved mission. You can alter the views, watch the action from nearly any angle (including from behind other planes) and *enter* the simulation again from any point in playback. The changes you make can then be saved, played back and modified even further. You essentially become actor, producer and director of your own WWII dogfights. To help spread the news of your talent, you can use a modem or floppy disk to transfer your recorded missions to your friends who have *Aces of the Pacific*. They can then load the files and admire your handiwork.

Lights, Camera, Action!

The first step in using the Mission Recorder is to save your mission to tape when it ends.

— Naming the file and pressing *Save* will automatically save the mission in a sub-directory called TAPES.

— Pressing *Cancel* will abort the mission save, erasing the recorded mission and exiting the simulation.

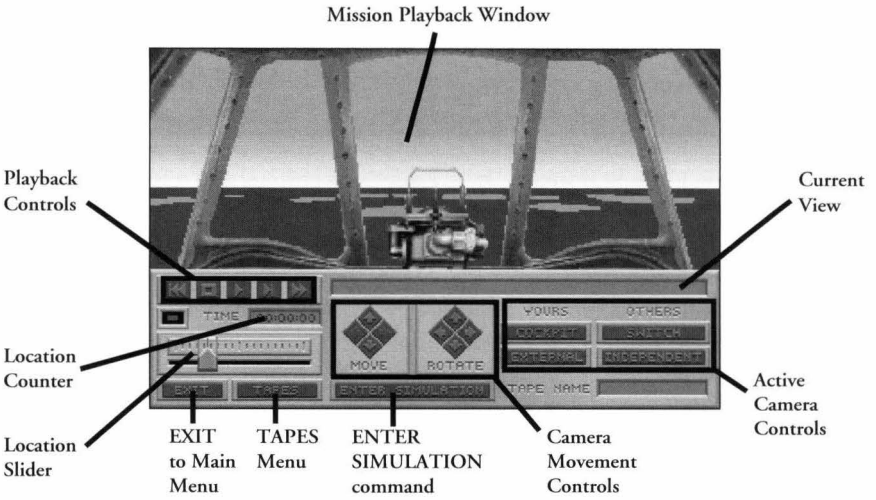
IMPORTANT! The mission name that you choose can be no longer than eight characters long. The computer will cut off the additional characters, saving only the first eight. If disk space is too low to save the mission, you will receive an alert.

Into the Editing Room

Once you have recorded and saved a mission, select Mission Recorder from the Main Menu. This will activate the playback mode of *Aces of the Pacific*. You will be shown a menu of all saved missions. Select the mission tape you wish to playback and press *Load*. The tape will load and the Mission Recorder's control panel will be displayed.

Courtesy National Air & Space Museum, Smithsonian Institution

★ Help from the homefront. A fortunate Marine Corsair pilot poses for a propaganda picture with a leggy brunette.



Mission Playback Window

The Mission Playback Window is where playback of your loaded missions is displayed. It will playback the loaded mission exactly as you originally played it. The playback window has two modes of display, **Edit** and **Full Screen**.

— **Edit** displays the Mission Playback Window with the Mission Recorder's controls covering the bottom part of the screen. Use this mode to view and edit.

— **Full Screen** displays the Mission Playback Window without the Mission Record controls. You will see a full screen image of your mission as it plays. You can use your joystick to edit the view.

To switch between Edit and Full Screen modes, press the **ESC** key.

Playback Controls

The Playback Controls operate like your everyday VCR controls. You can Fast-Forward, Rewind, Stop, Play, and Single Frame Advance. It should be noted that while you can Fast-Forward incrementally, Rewind will always rewind the tape to the beginning.

Location Counter

Operating just like a VCR counter, the Location Counter keeps a running mark of your playback position.

Location Slider

The location Slider operates in two ways. First, it will act as a visual marker to display movement through the playing tape. Second, it will act as a visual fast-forward slider, allowing you to pick the location you wish to fast-forward to. To use the Location Slider to fast-forward, move the slider bar to the desired distance into the tape. When you release the slider bar, the Mission Recorder will display an on-screen countdown as it fast-forwards to the specified point.

Note: the slider cannot be moved backward. You must use the Rewind command.

Active Camera Controls

The Active Camera Controls allow you to change the location of the playback camera.

Under the YOURS section, you can move the camera between your cockpit and your plane's external view. Under the OTHERS section, you can move the camera between other plane's external views and an independent world camera.

The options of *SWITCH* and *INDEPENDENT* become active when you have switched your camera viewpoint to *EXTERNAL*. Continually pressing SWITCH will cycle you through all the external views of all enemy actors in the recorded mission. Pressing INDEPENDENT will place the camera free from all aircraft movement to be completely controlled by the Movement Controls.

Camera Movement Controls

Once the Active Camera has been chosen, the viewpoint can be fine tuned by using the Camera Movement Controls. The two arrow pads operate slightly differently depending upon where your Active Camera is positioned.

Active Camera Inside Your Cockpit

COCKPIT allows you to look out the forward, left, right and back cockpit views.

EXTERNAL allows you to switch to forward, left, right and back outside views of your plane.

Active Camera Outside Your Cockpit

MOVE allows you to zoom the camera in/out. In INDEPENDENT mode, it also shifts the camera left and right.

ROTATE allows you to rotate the camera over, under and around.

Tapes

Pressing the Tapes button will bring up the Tapes control panel.

LOAD NEW TAPE: Brings up the tape menu for loading tapes.

SAVE CURRENT TAPE: Brings up the tape menu for saving tapes.

DELETE TAPE(S): Brings up the tape menu, allowing you to delete recorded missions. Selecting a mission and pressing *Delete* will delete the mission from the TAPES subdirectory.

DONE: Closes the Tapes control panel.

Enter Simulation

Pressing the *Enter Simulation* button at any point during playback will place you back into the simulation. You can replay the mission, making whatever changes you desire. When the mission is over, you will be presented with the options of seeing a Mission Review based upon the changes made or returning to the Mission Recorder.

Exit

Quits the Mission Recorder, returning you to the Main Menu. If you have made changes that haven't been saved, you will be asked to save or discard your modifications.

Editing Tips

When tape playback is stopped, you can fine tune the view.When you have the desired camera view, resume playback. View changes will instantaneous upon playback.

If you wish to include a tape in the *Aces of the Pacific* demo, name it in the form of **demo*.vcr**. From the Main menu's Options menu, select DEMO. All demo tapes named demo*.vcr are shown.

ENLISTING IN A CAREER

When you elect to fly a career, you not only fly a pilot's missions, you live a pilot's life. Your career will be composed of a series of campaigns, and you'll fly for one of the squadrons that actually took part in the struggle. Each campaign has unique challenges and strategies, and each campaign includes pivotal battles that shaped the war's outcome. Having seen a campaign through to its conclusion, you can choose to either retire from active duty, or sign up for another campaign.

You will fly a wide range of mission types, including escorts, intercepts, and patrols. You will also have new aircraft to fly (and to fly against) as they are introduced. While some of the missions will be what you expected from your briefing, you must remain ever vigilant; the great aces of the war are prowling the skies.

When flying in Career mode, you can earn the right to command through promotion. You may choose to begin your career as an untested wingman, following you wing leader's instructions. With success in combat, you will be promoted and gain the responsibility of commanding your own wingman. Ultimately, you can be designated a Flight or Shotai Leader, commanding several aircraft in combat.

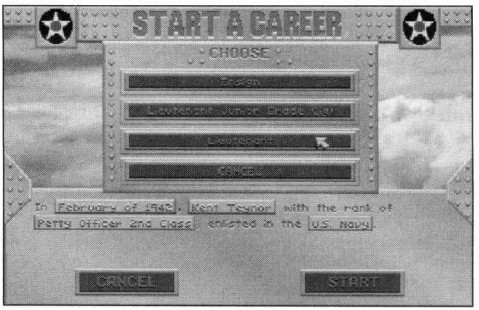
If you display exceptional gallantry, you will receive medals to recognize your greatest achievements. As a Japanese pilot, the First Class Order of the Rising Sun is the highest award you can receive. American pilots can hope to earn the Congressional Medal of Honor if they perform "... above and beyond the call of duty..." Whenever you receive a medal, it can be seen on your Pilot Record or in your photolog.

If your flying days last until the end of the war, your career will end in retirement. You will be shown your pilot record, as well as your pilot standing in comparison to your fellow aviators. If you are credited with more air victories than any friendly ace earned historically, you will be proclaimed "Aces of Aces."

Career Menu

Start a Career

You will be asked to select your alliance and to enter the name of your pilot. If the career roster is full, you will be asked to delete an existing pilot from the roster.



Once you've chosen your alliance and typed in your name, you'll be presented with a synopsis. You may choose the date when you will start flying. You may also change your service, rank, or name. Press ACCEPT to begin your career. Good luck!

Continue a Career

Select which pilot you wish to continue with. Pressing *View* will display the selected pilot's record.

View Best Careers

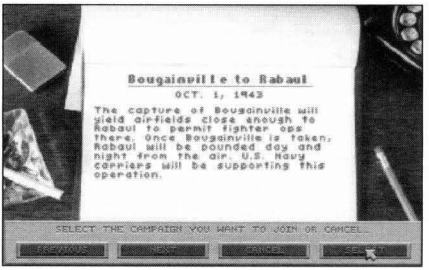
Displays the top ten career performances to date, ordered by number of victories. Pressing *View* will display the selected pilot's record.

Return to Main

Cancels the Career menu, returning to the Main Menu.

Campaigns

At the beginning of a career, you will be asked to select a historic campaign. Each campaign recreates a key conflict. The squadrons, warships, and maps are taken directly from each conflict.



Campaign Select

You will see a campaign briefing sheet. Use the NEXT and PREVIOUS keys to scan other campaigns. Press SELECT to begin the displayed mission.

Squadron Select

Information on a squadron is displayed, including plane type flown, pilot quality, and any aces of the squadron. If you have more than one squadron to choose from, pressing NEXT and PREVIOUS will let you review them. Press SELECT to join the squadron currently displayed. Once a squadron is selected, you can begin the campaign.

Map of the Pacific Theater

You are shown where your squadron is stationed. Use the < and > keys to scroll the map to the left and right. You can locate other places of interest by moving the cursor over the map. The name of each locale will appear (no button press needed). Press EXIT when you are done.

Flight Deck Menu

Squadron Info

This screen displays the same info you reviewed while selecting your squadron: plane type flown, pilot quality, where you are stationed, and aces of the squadron.

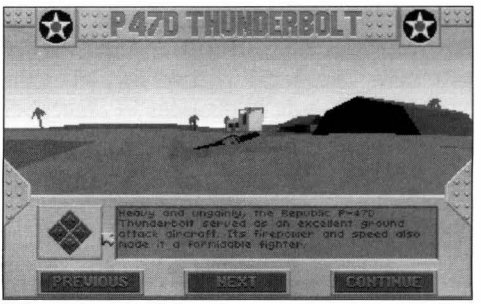
View War Map

View the Pacific Theater map.

View Pilot Record

Review your current record including total victories by target type, pilot rank, plane flown, decorations and career score. From within your pilot record, you can view your Victory Log. This log is a collection of photos and mementos recounting your career's highlights. You may flip the pages by placing the cursor on either the lower corner of the page or the page number..

View aircraft



Inspect your aircraft. Use the arrow buttons to change your viewpoint.

Backup Career

If you are doing very well, you may want to backup your status just in case you're shot down. After pressing *Backup Career*, enter the name under which you wish to backup the career. If the career roster is full, you will be prompted to delete another pilot or to cancel. This backup career may be restored from the Continue A Career option in the Career Menu.

Note: A pilot's most current career progress is automatically saved upon exiting the Flight Deck menu. Backup Career is used to save a separate version of the current career for later restoring. This is useful for undoing a mistake you've made in a mission. If you die or perform an act that damages your career, you will have the option of *restoring* the backup career and replaying the mission until you are satisfied with the outcome.

Return to Main

Pressing *Return to Main* will save your current pilot status and return you to the Main Menu. You may later restore this career by pressing *Continue A Career* from the Career Menu and selecting the pilot on the Career Roster.

Special Career Events

Throughout your career, you will be witness to and participate in major events that affect your career.

Squadron Movements

You will be notified if your squadron is relocated.

Forced Transfers

If your squadron is disbanded or rotated out, you will be notified of the reassignment.

The Bar

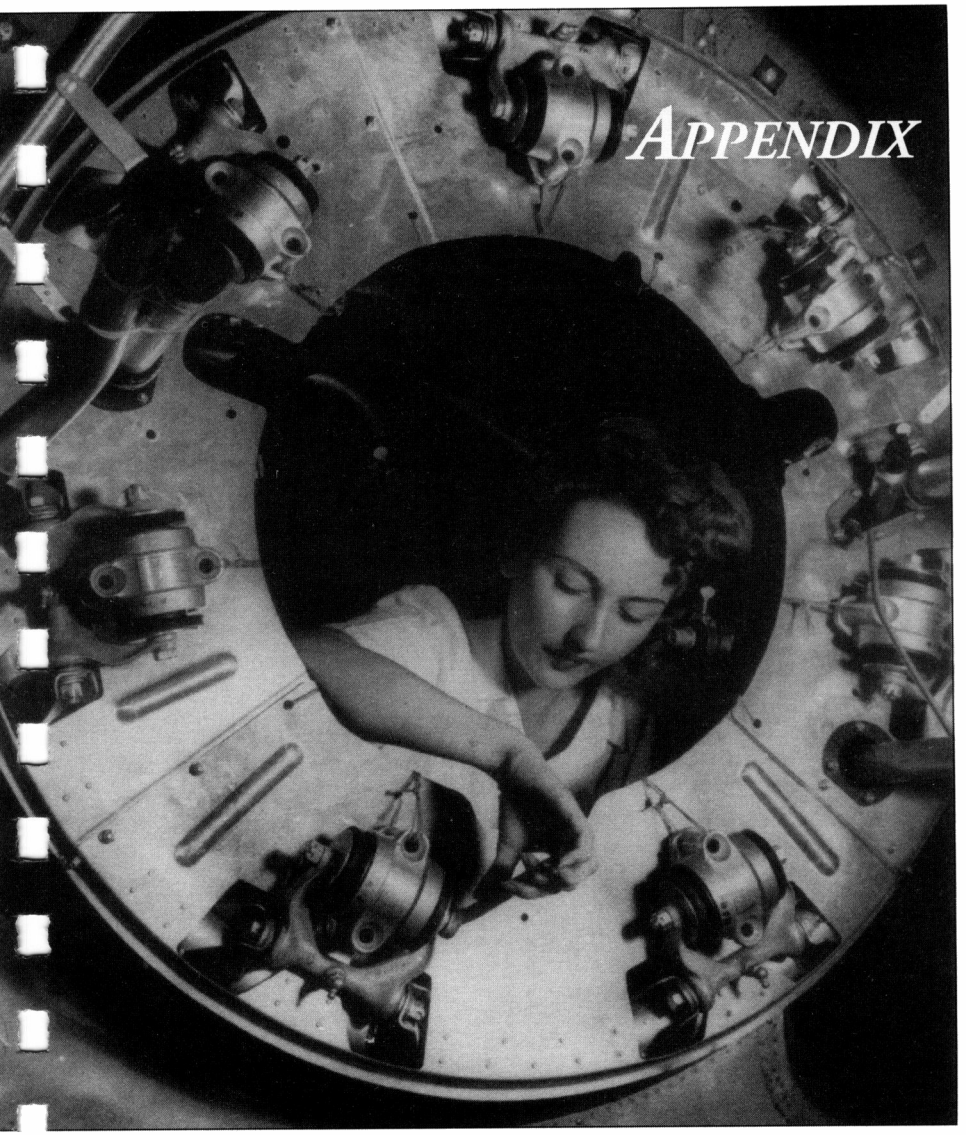
You'll hear the latest talk about the war from your fellow pilots. You can receive useful combat tips, and hear of new planes rumored to be released soon.

Promotions and Medals

If you perform your duty with distinction, you may receive a decoration to acknowledge your valor. The medals available depend on the service you're flying for. See the section Medals and Awards. Promotions are often given to the pilot who consistently completes mission objectives.

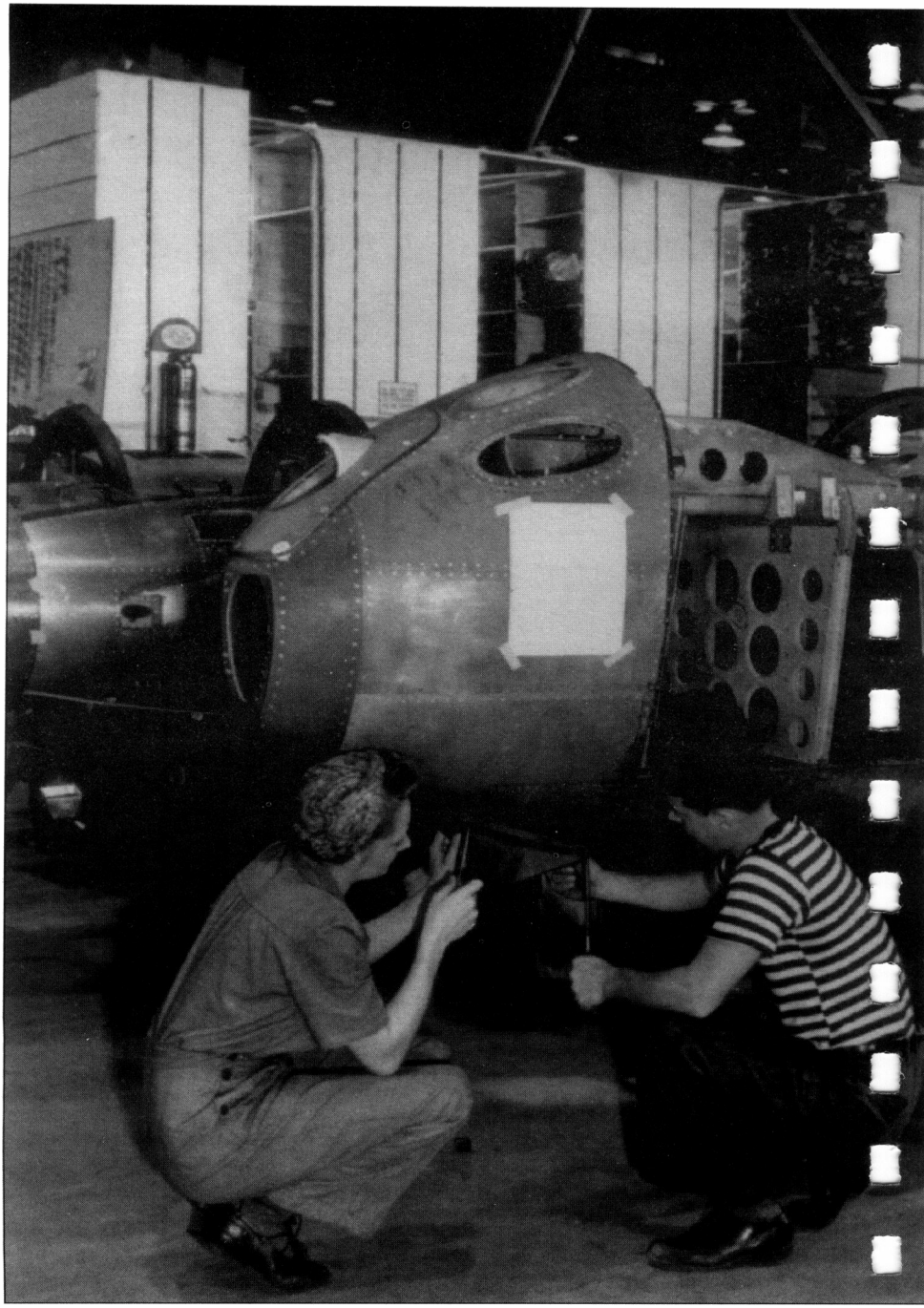
War Resolution

If you are fortunate and skilled enough to survive, you will see the war's end. At the close of your career, your final ace status will be ranked with all other pilots. If your performance places you among the ten best careers recorded, you will be placed onthe BEST CAREERS screen.



Courtesy National Air & Space Museum, Smithsonian Institution

★ Women played a vital role in the American aircraft industry during the war.



Courtesy National Air & Space Museum, Smithsonian Institution

★ Factory workers assemble the nose section of a P-38 Lightning.

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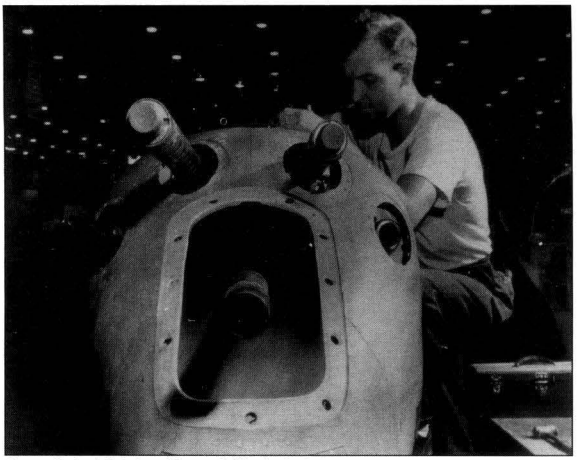
GLOSSARY

Ace: A pilot who has been credited with at least five aerial victories.
A.G.: Early Navy abbreviation for Air Group. An Air Group in 1941-42 consisted of one fighter squadron, one scout squadron, one dive bomber squadron and one torpedo squadron.
Ailerons: The movable surfaces on an aircraft's wings that control its bank.
Altitude: Another term for the pitch of an aircraft.
Angels: The altitude of a particular group of aircraft. Angels 12 means 12,000 feet.
Ant Freight: A Japanese term used to describe moving troops by barge traffic, a common mode of transport in the Solomons.
Bandit: An enemy fighter.
Bank: The rotation of an aircraft about its longitudinal axis (the axis running from the tail to the nose.)
Bogey: An unidentified aircraft.
Bounce: To surprise an enemy flight, usually from behind.
Break!: A term used to tell another fighter pilot that he is being attacked and should quickly take evasive action, as in: "Bandits on your six! Break left!" A break is also a fast, tight turn.
Buntai: A Japanese Two-plane tactical unit. Used from 1943 on.
Buntaicho: The Japanese term for flight leader.
C.A.G.: Carrier Air Group or commanding officer of a carrier air group. Late war C.A.G.s consisted of one fighter squadron, one fighter-bomber squadron, one dive bomber squadron and one torpedo bomber squadron.
Check Six: To look behind your plane. The rear of any aircraft is known as the "Six O'clock Position," which is the most favorable place to attack. "Check your six" advises you to look behind your plane to ensure that no enemy fighters have crept up from behind.
Chutai: Two to three Shotai—six to twelve planes.
Clobber College: When young pilots reported to their combat outfits, the old hands would tell them the best tactics to use in order to survive in combat. This period of indoctrination was known by some as Clobber College.
Deflection Angle: The angle a target is in relation to the aircraft shooting at it.
Dive-brakes: Air brakes equipped on dive bombers used to keep them from gathering too much speed in a steep dive during the attack run.
Division: Two sections—four planes. Also known as a Flight.
Dogfight: A twisting, turning engagement where moves are met by counter-moves as each pilot attempts to put his guns on the enemy. Indicative of the combat style used in WWI. Loosely used it means any air combat engagement.
Drag: The amount of air resistance a plane experiences. The less drag on a plane, the faster it can fly.
Elevators: The movable surfaces on an aircraft's tail assembly that control pitch.
Ensign Eliminator: One of the early nicknames given to the F4U Corsair. Its touchy flight characteristics proved to be more than many fresh ensigns could handle, resulting in numerous fatal crashes.
FDO: Fighter Direction Officer. A naval officer who usually serves aboard an aircraft carrier to direct fighter interception operations. He tells the fighter pilots where and at what altitude incoming hostile planes are located.
Fish: The U.S. Navy term for torpedo.
Flak: Antiaircraft fire.
Flamed: A downed plane.
Flaps: Control surfaces on the inner part of the wings. They are used during take-off and landing to increase lift.
Flat-Hatting: Tree-top level, high speed flying. To be caught flat-hatting in the U.S. guaranteed serious punishment.
Flightleader: The term for the leader of a division or Shotai.
G-Force: A measure of acceleration. One G is equal to the force of gravity. In steep turns, a plane and pilot will experience additional G's. The human body will lose consciousness between 8 and 10 G's.
Group: Several squadrons, usually 3-4.
Hawks: Enemy aircraft.
Hell Jelly: A concoction created by U.S. Marines in the Solomons that mixed gelatin and aviation gas into a belly tank. On the outside of the tank the Marines would strap a phosphorous grenade that was used as a detonator. In effect, the Marines had developed a form of napalm in the field. Later, refinements of this procedure would lead to the production of napalm in the United States.
Hey Rube!: Standard U.S. Navy fighter director jargon meaning "All fighters returned to carrier at once."

Jarhead: A common derogatory label given to Marines.
Joy: A term used to describe whether or not a flight saw combat. "No Joy" meant no air combat was encountered.
Kahili Knock: The peculiar sound a fighter makes when its pilot has cold feet. Named after one of the most dangerous targets in the Solomon Islands. Occasionally, pilots would announce they had engine trouble and could not continue the mission.
Kill: A downed aircraft credited to a pilot.
Lift: The amount of upward force generated by an aircraft's wings. It is lift that keeps the plane airborne.
L.S.O.: The landing signal officer, who assisted pilots when landing on the carrier.
Marsten Matting: The perforated steel planks laid down on nearly every American airbase constructed during the war in the Pacific.
Pickle: Another Navy term for torpedo.
Pitch: The up and down rotation of an aircraft about its lateral axis (wing tip to wing tip). It is controlled by the elevators.
Rat Express: Japanese term used to describe the transport of troops by fast destroyer from one place to another.
Roll: The rotation of an aircraft about the axis running from nose to tail. It is controlled by the ailerons.
Rudder: The control surface on the tail of an aircraft that controls its yaw.
Scuttle: To destroy a friendly vessel with torpedoes or gunfire after it has been severely damaged by enemy fire and is not salvageable.



Courtesy National Air & Space Museum, Smithsonian Institution

★ A worker assembles part of a P-38 nose section. Note the four .50 calibre guns along the top and the 20mm cannon in the center.

Scratch: To destroy, as in "Scratch one flattop!"
Section: Also known as an element or pair. A two-plane tactical unit, including a section leader and his wingman.
Shotai: A three-plane tactical unit. Altered in 1943 to include four planes divided into two Buntai. Also known as a Flight.
Splashed: An aerial victory, usually when the enemy was shot down over water.
Squadron: Several divisions.
Stick: The control column in an aircraft's cockpit used to operate the ailerons and elevators.
Trap: Landing on a carrier and catching the arresting wire with the tail hook.
Type One Lighter: A nickname for the Mitsubishi G4M Betty. Given by Japanese pilots to the Mitsubishi G4M Betty. It was so named due to its propensity to explode when hit by enemy fire.
V.B.: U.S. Navy abbreviation for dive-bomber.
V.F.: U.S. Navy abbreviation for fighter.
V.S.: U.S. Navy abbreviation for scout-bomber.
V.T.: U.S. Navy abbreviation for torpedo-bomber.
V.S.I.: An acronym for the vertical speed indicator in a plane's cockpit.
Victory: The shooting down of an enemy aircraft.
Wing: Several groups.
Yaw: The rotation of the aircraft in the horizontal plane. It is controlled by the rudder.

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Director of Programming	Bob Lindstrom
Lead Simulation Programmer	Lincoln Hutton
Lead Shell Programmer	Christopher Reese
Programming	Nathan Dwyer, Paul Bowman, Ryan Hinke, Caedmon Irias, Dayne Freitag, Nancy Hamilton
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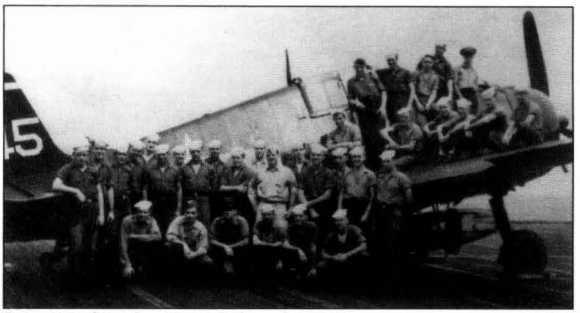

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★ Posing for a group photo on deck with an F6F Hellcat.

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