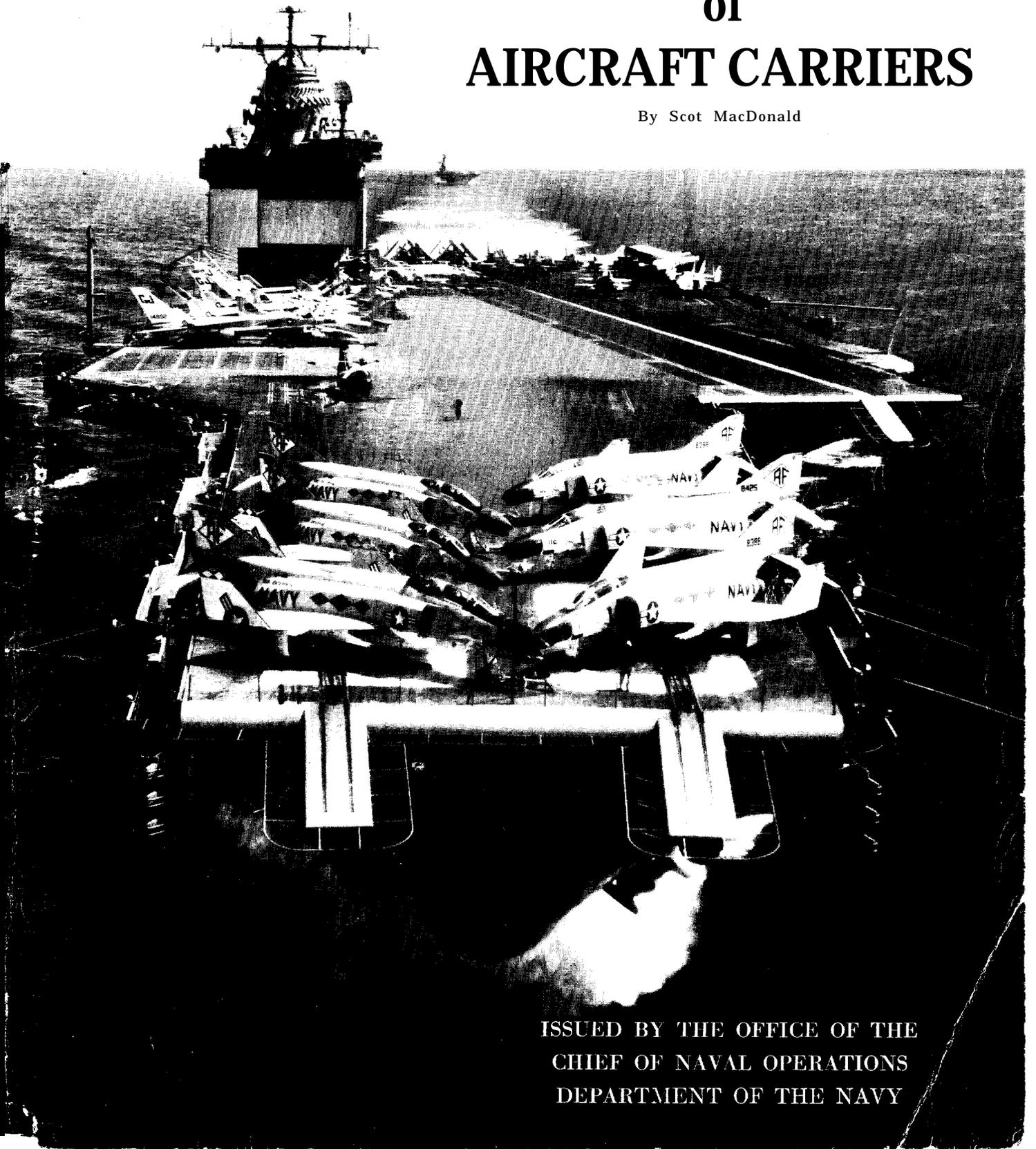


EVOLUTION of AIRCRAFT CARRIERS

By Scot MacDonald



ISSUED BY THE OFFICE OF THE
CHIEF OF NAVAL OPERATIONS
DEPARTMENT OF THE NAVY



FOREWORD

Since February, 1962, a series of articles has appeared in Naval Aviation News under the title "Evolution of Aircraft Carriers." They measure up as an authentic, earnest attempt to chronicle a history of carriers since the mobile airfield idea was initially conceived.

Here, under these covers, are the entire contents of those articles. This does not comprise a complete history of carriers--that history is still being written in seas around the world.

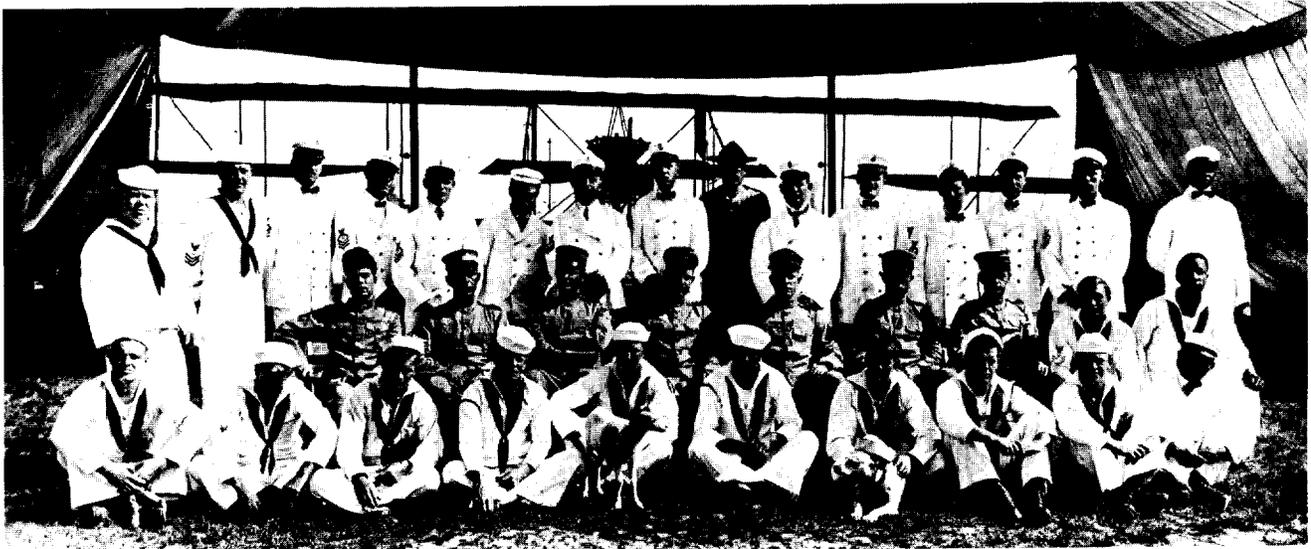
This collection, based on information gathered from many official sources, provides an interesting account of how and why the carrier developed as it did. It is the story behind the perhaps better known tale of carrier operations.

It is the story of change--change dictated by operational necessity and by technological progress. It is also the story of how naval constructors took full advantage of technological progress, and the lessons learned of operational experience to solve the Navy's unique problem of taking aviation to sea. As a result of their efforts and the constant improvement of tactics necessary to weld sea and air power together, the aircraft carrier stands today at the forefront of Naval power, ready and able to defend the nation and to project national interests to all parts of the world.



J. S. THACH
Vice Admiral, USN
Deputy Chief of Naval Operations (Air)

February 1, 1964



AT GUANTANAMO 1913 fleet games, early Naval Aviators, in dark uniforms, are (L) Victor D. Herbster (NO. 4), Bernard L. Smith, USMC (6), Alfred A. Cunningham, USMC (5), John H. Towers (3), P.N.L. Bellinger (8), W.D. Billingsley (9), and G. deC. Chevalier (7).

Evolution of Aircraft Carriers

THE AEROPLANE GOES TO SEA

By Scot MacDonald

First Article in a Series

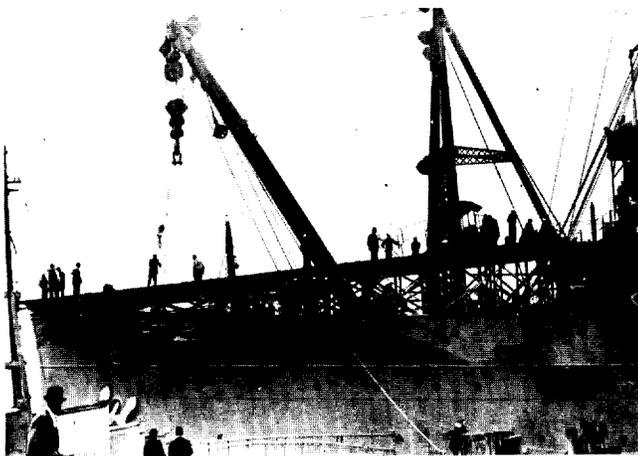
'The striking successes of carrier warfare in the Second World War are well known. Not so well known, but equally important in its own right, is the story of the evolution of sea-air power as a dominant segment in our military establishment. The formative years began almost with the birth of the aircraft itself, for the Navy was prompt to assess the value of the newest weapon in its arsenal.'—James V. Forrestal, SecNav, 1944-1947; SecDef, 1947-1949.

JULES VERNE, author of startling science-fiction during the last half of the 19th century, would have relished some of the sketches, plans, and ideas for "aeroplanes" that crossed the

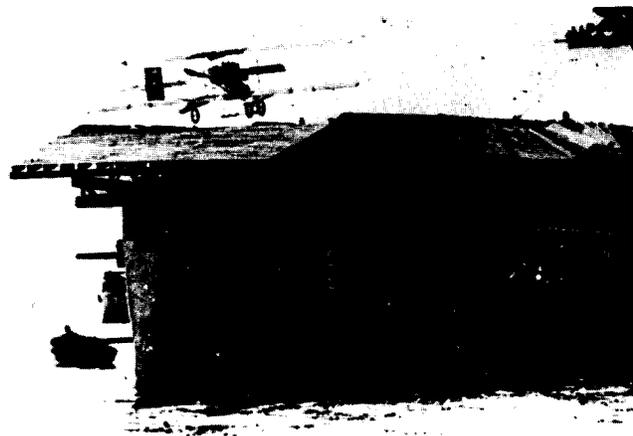
desk of Capt. W. Irving Chambers in 1910. Capt. Chambers had recently been assigned as Assistant to the Secretary's Aid for Material, and was given the collateral duty of liaison

between the Navy and the swelling number of letter-writers who were eager to advance their own schemes or designs involving aviation.

Less than seven years earlier, the



ELY'S AIRCRAFT is loaded aboard a special platform in USS Birmingham at Norfolk for first take-off from ships, in 1910.



FIRST LANDING at sea aboard a Fleet ship is made by Eugene Ely in 1911 aboard USS Pennsylvania at San Francisco. Vessel was anchored.

Wright brothers had launched their pusher biplane into a brief but impressive flight. In the intervening years, advocates of aviation fought for recognition—and money.

At first, the Navy's interest in aviation was skeptical, if not openly discouraging. Twelve years before Chambers entered the picture, "The Joint Army Navy Board to Examine Langley's Flying Machine" was formed at the urging of Assistant Secretary of the Navy Theodore Roosevelt. A Navy member reported favorably on it to the General Board. But the Secretary, upon the advice of another Bureau in the Department, decided "the apparatus as [it] is referred to pertains

decide the destiny of nations." And he added, "Encumbered as [our big war vessels] are within their turrets and military masts, they cannot launch air fighters, and without these to defend them, they would be blown apart in case of war."

The "battleship controversy" was on, puffed by publicity in a competitive press. Curtiss added weight to his argument by a series of tests in which he lobbed 15 out of 22 "bombs" into targets as large as and shaped like battleships near Hammondsport, N.Y.

There was a rumor that France was building an aircraft carrier. More to the point, a growing group of enthusiasts, the U.S. Aeronautic Reserve,

hers and two other officers were sent; for the Navy, Chambers, and Naval Aviation, it was a fortunate decision. There he met Curtiss and the Curtiss-trained pilot, Eugene Ely. At that time, the Navy had neither an aircraft nor a designated pilot. In a series of startling tests, Chambers, Curtiss and Ely demonstrated that this situation must change, and soon.

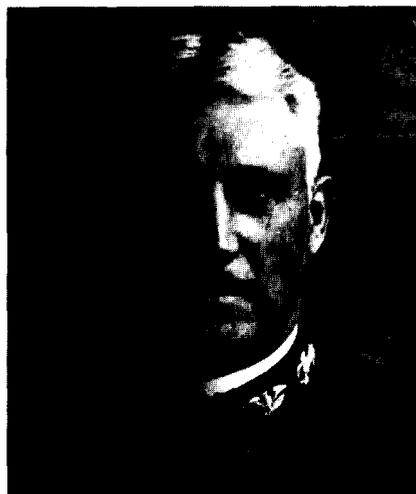
Several problems nagged Chambers. There was not conclusive proof, for instance, that it was feasible to launch and land aircraft at sea. And if there was to be any future for aviation in the Navy, it had to be demonstrated aircraft could be operated in, and were important to, the Fleet. Navy officials,



CAPT. W. I. CHAMBERS was *O-in-C* of Naval Aviation from 26 Sept. 1910 until 17 Dec. 1913.



CAPT. M.L. BRISTOL relieved Chambers, served until March 1916, led aviation in *Gitmo* games.



CAPT. NOBLE E. IRWIN was next leader, held title, Director U.S. Naval Aviation in WW I.

strictly to the land service and not to the Navy."

On at least two important occasions between then and 1910, the Navy participated in or observed the fledgling "apparatus" in flight—in the 1907 Jamestown Exposition and the 1908 tests by the Wright brothers at Fort Myer, Va. But the Navy Board held to the attitude that "aeronautics" had "not yet achieved sufficient importance in its relation to naval warfare" to warrant Navy support.

It was not until 1910 that specific action was taken to alert the Navy to the potentials of aviation. In one incident, pioneer Glenn H. Curtiss successfully flew a prize-winning flight between Albany and New York. At its conclusion, he prophesied publicly:

"The battles of the future will be fought in the air. The aeroplane will

asked the Navy to appoint a representative who would handle aviation matters. Since this civilian organization enjoyed semi-official status, Capt. Chambers was assigned to handle all correspondence on the subject.

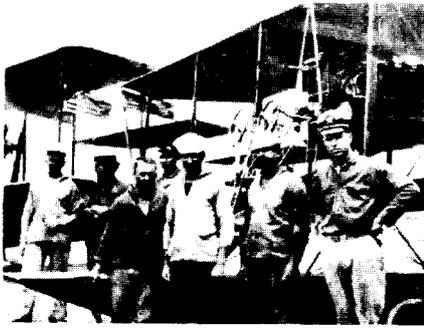
Chambers' job proved far from easy. He was given no space to work in, no clerical help, no operating money, no authority, and precious little encouragement. Despite this, he later wrote to Lt. T. G. Ellyson, "I am endeavoring to start an office of aeronautics here in such a way that things will run smoothly without having them all get into one Bureau and made a mess of as was the submarine question."

In October 1910, the Navy was invited to send the corps of midshipmen to Haleshorpe, Md., where an aviation meet was to be held. Instead, Cham-

military and civilian, were still apathetic about the program and gave it token and grudging cognizance—when they treated it with any degree of seriousness at all.

The first test was prompted by plans of a German merchant line to launch a plane from one of its ships in order to speed up its mail service. Chambers was appalled that such an advance might be made by a foreign power when the aircraft had been, in fact, developed by this country. He obtained permission to make a similar attempt at launching from the deck of the cruiser *Birmingham*. The Wright brothers were contacted, but they demurred; Ely was eager.

A temporary wooden platform was erected on *Birmingham* at the Norfolk Navy Yard. The German line, mindful of the Navy's experiment, moved



AT VERA CRUZ aviation camp, Mexico, pilot Bellinger, right, poses with ground crew.

up its target date in an effort to be the first to launch, and thereafter bask in the honors of claiming a significant aeronautical first. Luck was not with them, however. An accident aboard, caused by a careless workman, forced a delay of the experiment.

Chambers' plan went ahead without a hitch. On Monday, 14 November 1910, *Birmingham* pulled into the waters off Hampton Roads, in company with three torpedo destroyers. Aboard was pilot Ely and his biplane. Weather was unsatisfactory; visibility was dropped by a low cloud cover and there were light showers mixed with hail.

Ely was not discouraged. He slipped into the seat of his aircraft near three in the afternoon and signalled his handlers to let loose. The plane roared off the platform, took a dangerous dip when it left the platform, then swung into the air. In the take-off, the skid framing and wing pontoons of his plane struck the water, nearly aborting the flight. The prop tips were splintered and water splashed over his goggles. This brief baptism, and a steady rain, blanketed his vision and for a moment he swung dizzily in the air. Finally, he spotted the sandy beaches of Willoughby Spit and touchdown, ending a 2 1/2-mile flight.

The flight was an extraordinary success, but Chambers tempered his jubilation with native conservatism. Said he: "After [Ely] had demonstrated his ability to leave the ship so readily, without assistance from the ship's speed, or from any special starting device, such as that formerly used by the Wright brothers, my satisfaction with the results of the experiment was increased."

He admitted to pre-experiment perturbation: "The point of greatest concern in my mind, carrying out the

original program, was the uncertainty of stopping the ship or changing the course in time to prevent running over the aviator in case he should land in the water.

"His demonstration, that an aeroplane of comparatively old design and moderate power can leave a ship in flight while the ship is not under way, points clearly to the conclusion that the proper place for the platform is aft. An after platform can be made longer, will not require a lessening of the stays of any mast and its essential supports can be so rigged as a permanent structure of a scout cruiser as to cause no inconvenience in arranging the other military essentials of the ship's design."

News of the feat inspired a New York Navy Yard worker to design a light movable platform for installation above the turrets in battleships for the purpose of launching aircraft at sea. Some Navy officials were enthusiastic, but Chambers was not quite so ready for this innovation. "Recognizing the practicability of Quartermaster Joiner [E. C.] Keithley's idea," he wrote, he could "not contemplate the use of aeroplanes from turret ships in the immediate future."

Chambers' reasoning was cautious. As a result of the *Birmingham* flight, he did not think it necessary to launch aircraft into the wind. He had already gone on record as supporting the place-

ment of the platform in the aft section of the ship and saw no reason to take a different stand. The safety of pilots was another determining factor: he feared they would be run over by the ship if the plane, forced to ditch, landed forward of the carrier.

Though Ely's flight opened a few Navy eyes, it did not loosen the Navy's purse strings. Glenn Curtiss, at this time, offered to teach a Naval officer the mechanics of flying, absorbing the expense himself. Chambers recommended the immediate approval of the plan and Lt. T. G. Ellyson was ordered to Curtiss' San Diego camp. A series of experiments followed, in conjunction with the pilot's training.

Chambers, immensely pleased with the *Birmingham* launching, was now interested in proving it practical to land a plane aboard a Naval warship. Another platform was constructed at Mare Island and permission was obtained to install it on the armored cruiser USS *Pennsylvania*. While the vessel was anchored at San Francisco on 18 January 1911, Ely launched from a shore airdrome.

"There was never a doubt in my mind that I would effect a successful landing," Ely is quoted in a March 1911 Naval Institute *Proceedings* article. "I knew what a Curtiss biplane could do, and I felt certain that if the weather conditions were good there would be no slip."



PLANE LAUNCHES from catapult on cruiser *Huntington*. After U.S. intervention in WW I, catapult was removed from all U.S. ships. *Huntington* spent war years in convoy escort duty.

A simple arresting gear had been installed on the ship's platform. It consisted of 22 weighted lines stretched across the deck. On Ely's plane, a number of special hooks were fitted, designed to catch the lines as the plane made its rollout. In event the jury-rigged experimental arresting gear failed, a canvas screen was fitted to the end of the platform as an emergency stop.

The landing was, of course, a complete success, and Chambers was now armed with more ammunition in his battle to prove the feasibility of employing aircraft at sea. He vowed to take every opportunity to emphasize this fact to officers in the Fleet.

Just 31 days after the *Pennsylvania* landing, Curtiss taxied a seaplane from

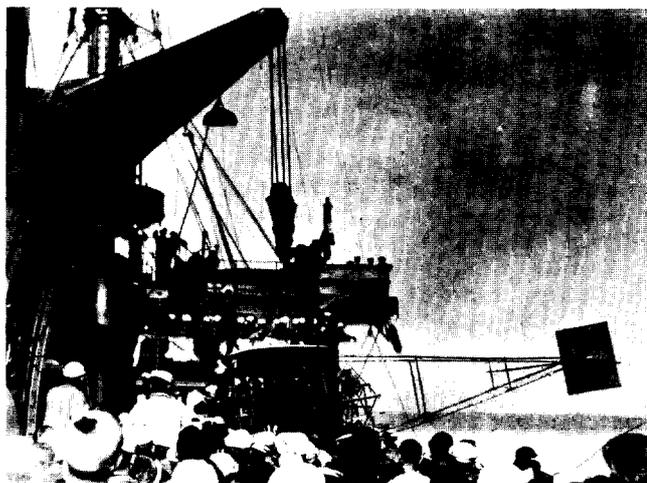
as "auxiliary ships." He stated, "I do not believe that we need such a vessel, even if we could get it," considering it "superfluous and inefficient."

With the hydro-aeroplane, Chambers hoped to find a method of getting a plane in the air from a fast-moving vessel without being forced to slow down the ship or stop. His solution was to devise a catapult system. Langley, the Wright brothers, and Chanute had pioneered in this field, but none of the systems developed quite met the needs of Naval Aviation.

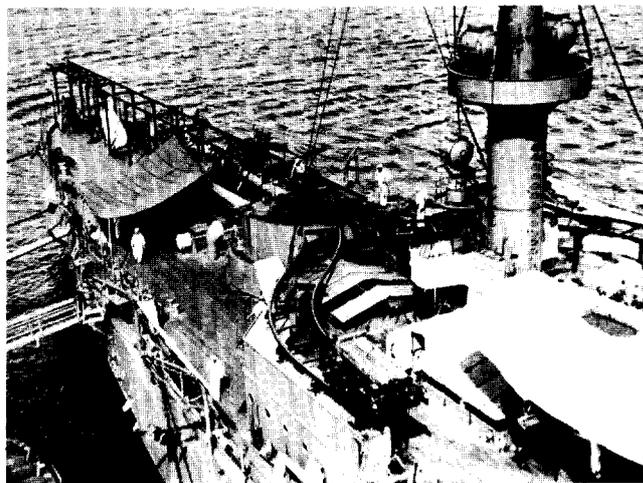
The catapult was a challenge. Chambers proposed a device using compressed air for thrust. The first test of it was made at Annapolis, with Ellyson at the plane's controls. The experiment was a failure operationally,

missions and exercises in spotting mines and submerged submarines. Under specific instructions from SecNav and Chambers, the unit, led by Lt. J. H. Towers, demonstrated the operational capabilities of the aircraft to stimulate interest in aviation among fleet personnel. More than a hundred "training" flights were made, carrying interested line officers on local hops to demonstrate the safety and maneuverability of aircraft, as well as to point out the superiority of aircraft in scouting and reconnaissance tactics.

Other nations, especially in Europe, were moving faster in the development of aviation for their navies, allocating more money than the U.S. for experiments. In the same month that Chambers was officially retired, in



TO PROVE IT POSSIBLE, Glenn H. Curtiss taxis his Seaplane to USS *Pennsylvania*, is hosted aboard, then returns to water and his base.



EARLY CATAPULT in USS *North Carolina* viewed from crane. Nov. 1915, LCDr. H. C. Mustin was first to launch from curlier model.

his North Island base to the same ship, then in San Diego Harbor. The plane was hoisted aboard, returned to the water, and taxied back to its base. This experiment indicated the eventual liberation of aircraft from being anchored to shore bases, a necessary advancement if the aeroplane was ever to join the Fleet.

The Navy ordered its first aircraft the following May. SecNav George vonL. Meyer had earlier supported appropriations for Naval Aviation. In a meeting of the House Naval Affairs Committee he requested and received \$25,000 for aeronautics.

Chambers was against the development of the true aircraft carrier by the U.S. Navy at this time. He vehemently opposed the seaplane carrier or hangar ship concept, classifying them

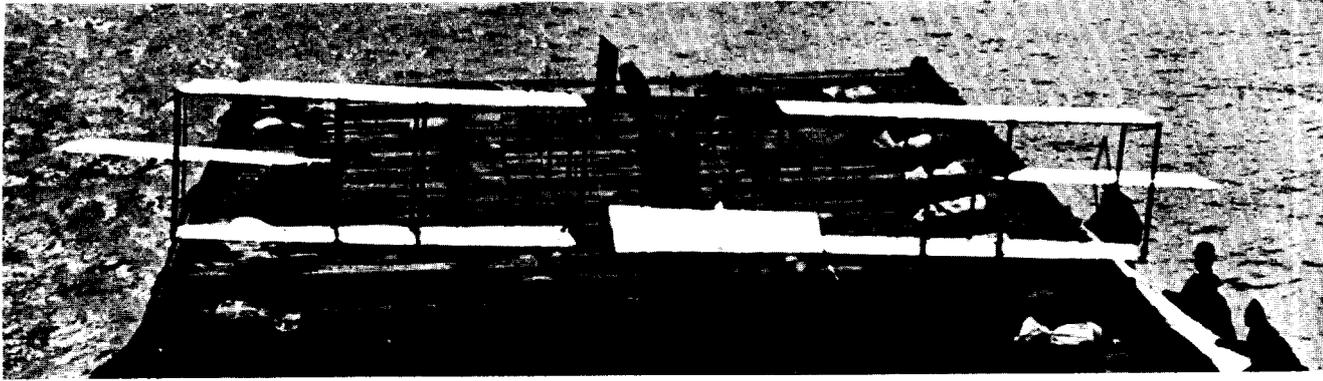
but Chambers learned much from it. He turned the project over to Naval Constructor H. C. Richardson who, with suggestions from Ellyson and Chambers, developed it further.

Three months later, they were ready to try again. On 12 November 1912, Ellyson launched in a hydroplane, the A-3, from a catapult installed in a barge off Washington Navy Yard. This time, they met with success. Curtiss, who witnessed the demonstration, considered it a significant achievement.

The following January, aviation joined the Fleet. Chambers sent the entire aviation unit to Guantanamo Bay, Cuba, to participate in Fleet operations for the first time. During the eight-week period beginning 6 January 1913, the unit conducted scouting

June 1913, the British reconfigured the cruiser *Hermes* by placing a launching platform on it and using this ship actively in maneuvers that followed. The nations vied with each other in building up their air arms; in the offing were the faint rumblings that soon would swell to a roar, eventually erupting into the outrage of war.

In April 1914, Naval Aviation went into action for the first time. A crisis developed in Mexico when a U.S. naval party was placed under arrest by Mexican police. Pilots and planes were embarked in *Birmingham* and *Mississippi*. Those in the former were dispatched to Tampico and saw no action. But Lt. Patrick N. L. Bellinger, leading the *Mississippi* detachment, continued down the coast to Vera Cruz and conducted daily reconnaissance flights.



PRIMITIVE ARRESTING GEAR comprised of 22 taut ropes weighted by 50-pound sandbags were strung four inches off the deck of USS Pennsylvania for Eugene Ely's historic landing. Plane had three hooks beneath it to catch ropes. DFC was awarded Ely posthumously in 1933.

On 5 November 1915, RAdm. W.S. Benson, the Navy's first Chief of Naval Operations, visited the *North Carolina* and a decision was made to launch the AB-2 aircraft from a new and temporary catapult installed aboard. LCDr. H. C. Mustin, who headed the Naval Aeronautic Station at Pensacola, was also aboard. He climbed into the aircraft and a successful launch was made. Though Mustin's launching was satisfactory, obvious improvements in the system were necessary. Other pilots tested the catapult, changes were made in the unit's mechanism, and finally, the catapult was removed altogether. Later a permanent catapult was installed.

Great Britain was the undisputed leader in number and operation of aircraft from ships at this time. As the U.S. was experimenting with *North Carolina*, the Royal Navy already had five vessels from which aircraft operated. First of these were *Hermes*, a cruiser converted to carry three seaplanes. Three others, formerly used as cross-channel turbine steamers, were outfitted with hangars and partial flight decks. These were *Engadine*, *Empress*, and *Riviera*, pre-*Langley* "carriers." The fifth was a converted tanker, *Ark Royal*.

Capt. Mark L. Bristol relieved Chambers in the winter of 1913. Mindful of Great Britain's progress in carrier experiments, he shot off a memorandum to SecNav:

"I desire to suggest the taking up of this question at once," he wrote, "along the line of purchasing a merchant ship and converting her into an aircraft ship, and at the same time considering the plans for a special ship of this type, developing these plans as more information is received from

abroad. It is strongly recommended that the bureaus consider the question of including in the estimates for the coming year money for the purchase and fitting up of such a ship with an idea of recommending to Congress the appropriations with the provision that it become immediately available without waiting until [1 July 1916]."

The memo went through the Chief of Naval Operations who sensibly felt such a venture premature. In his endorsement, he wrote: "It appears to the Department that the more immediate need of the Aeronautic Service is to determine by experience with the USS *North Carolina*, now fitted to carry aeroplanes, the details of such service upon which the characteristics of special aircraft ships, if needed, could be used." RAdm. Benson concurred with Chambers: it was not wise to spend large sums of money on carriers when the aircraft itself had not reached an acceptable state of development. There was still much to learn.

Undeterred, Bristol asked for funds for two three-million dollar carriers in his estimates for fiscal year 1917. It was a futile try. Next, he requested permission to take the command of naval air to sea and, upon receiving it, moved aboard *North Carolina*. He retained command over the Navy's aircraft, their development, the shore establishments connected with aviation, and the shaping of the air service.

Shortly after he assumed command of *North Carolina*, Bristol sailed for Guantanamo Bay to participate in war games with the Fleet. This 1916 exercise proved the most important participation of naval aircraft in any Fleet problems to date. By end of the exercise, the four planes aboard had

logged more than 3890 miles in a series of tests that proved instructive and, at the same time, emphasized the lack of equipment available and that coordination and planning left much to be desired.

In the summer of 1916, the organization, morale, equipment and prospects of Naval Aviation reached the ebb tide mark. The status of naval air so exasperated the normally reticent Bellinger that he wrote to SecNav a detailed, realistic summation of equipment available and experiments conducted. "Aeroplanes now owned by the Navy," he noted, "are very poor excuses for whatever work may be assigned them." Viewing current catapults, he continued, they are "by no means the finished mechanism desired in some of [their] essential features." The letter was frequently quoted by officers in the Aviation department.

With war imminent, the Appropriations Act of 29 August 1916 helped pull Naval Aviation out of the doldrums. Granted a million dollars the year before, this Act now allotted an additional \$3½ million to the development of naval air.

In October, Towers completed a tour in London as assistant naval attaché and reported to the Executive Committee of the General Board to inform it of European progress in aviation. He spoke glowingly of zeppelins, advocated the assignment of land planes on capital ships, and discouraged the direction of attention toward aircraft carriers.

"Aeroplane ships cannot keep up with the Fleet," he reported, echoing a widely held conviction. "If [the British] build a ship big enough and powerful enough to keep up with the Fleet, its cost is so high that they do not

consider it worthwhile. They are rather giving up the idea.”

Towers' recommendations weighed heavily with the Board. In its subsequent recommendations, it requested over 500 planes, in addition to kite balloons, non-rigid dirigibles, and an experimental zeppelin. No recommendation was made for the fitting out of a major ship of the line for the operation of aircraft on the scope of an aircraft carrier.

The U.S. entered WW I in April 1917. In the years prior to this, Naval Aviation concerned itself with the development of aeronautical design and a continuing series of studies was implemented to determine the adaptability of planes on ships. The war interrupted these studies. Instead, emphasis was on expansion in aircraft inventory, increase in the number of trained pilots and ground crew men, and anti-submarine warfare.

In April 1917, RAdm. W. S. Sims, heading the European naval forces, recommended to SecNav that, since German U-boats were sinking tremendous tonnages, attention be directed toward acquiring large numbers of seaplanes for anti-submarine reconnaissance. He also asked for the development of seaplane carriers for small seaplanes. Going a step further, he advocated the development of vessels from which seaplanes could be launched directly from their decks.

This emphasis on ASW was a reflection of the experiences of the Allied nations. Expectations of the British were high. Sims, in answering SecNav's request for information on what Allied nations' requirements for naval air support were, revealed the British preoccupation with ASW problems. Through Sims, they requested four seaplane carriers, with a capacity of six two-seater planes, six single-seaters, and a speed of at least 18 knots. They also requested four or more seaplane tenders, 100 kite balloons with necessary manpower to operate and maintain them, “any number of trained pilots,” and a good 300-hp engine.

But Sims appended a note of caution to these requests. He did not advise the U.S. Navy to develop this line of aeronautics if it would interfere with the completion of anti-sub programs already in progress.

Though the British pioneered in aircraft carriers, their emphasis in WW I—and that of U.S. Naval Aviation—

was on the development of seaplanes. Throughout this war, seaplanes and their tenders achieved far greater attention than any other weapon in the naval air arm arsenal.

The U.S. looked for the super seaplane, one that would be large enough to carry enough fuel aboard to make a trans-ocean hop feasible. This was an attempt to circumvent the worrisome number of sinkings of cargo ships by German U-boats; with the stricken ships went a large number of aircraft built for flight against the enemy in Europe. This plane was given the designation NC and was later to prove such a flight possible.

In the summer of 1918, the General Board showed considerable interest in the future of aircraft carriers. It called before it most of the leading Naval Aviators of the day in an effort to determine how much importance to attach to this development. Testimonies presented offered a wide range of thought on the subject. Several wanted carriers for ASW work. Towers suggested the conversion of a merchant ship—for experimental purposes. Others pointed out that aircraft aboard *Huntington* were smashed by concussion when that ship fired a practice salvo. Only a ship with the major mission of launching and landing aircraft at sea would do.

The Board deliberated and in September recommended a six-year program of expansion in all branches of the fleet. For Naval Aviation, it recommended that six carriers be built within that time span, each having a 700-foot flight deck, with an 80-foot beam “absolutely clear of obstructions.” Designed top speed was to be

35 knots, with a cruising range of 10,000 miles.

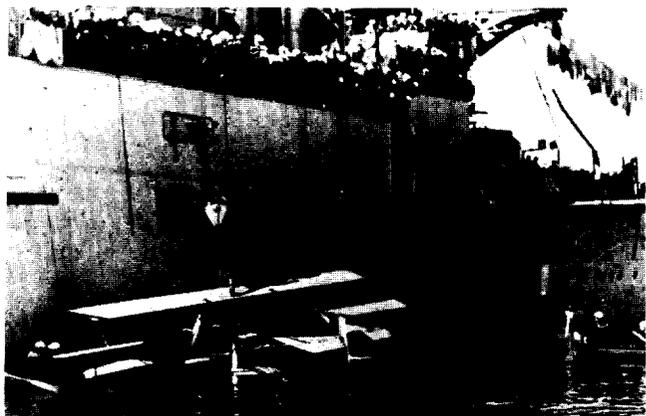
The bright future darkened swiftly on 2 October when SecNav Josephus Daniels temporarily put an end to the project. “The question of building aircraft carriers of special construction is held in abeyance,” he wrote, “and no action will be taken until the military characteristics considered advisable by the General Board are submitted, and no action will then be taken of a positive character unless it appears probable that these vessels can be completed and made serviceable during the present war.” This did not put a period to the program, simply a series of suspension dots . . . until the Armistice.

The British had been mulling over the problem of ASW and in October 1918 proposed a possible solution to it. The proposal, at the same time, gave a keen revelation of the effectiveness of its carrier operations. Since most submarine sightings and sinkings (there were few of the latter) made by aircraft were from shore-based seaplanes, the Royal Navy suggested planes be given a much wider range than they enjoyed. They proposed a plan to tow the planes on lighters or barges to within striking distance of the targets selected. A rear compartment in the barge would be flooded sufficiently to float the plane. The aircraft would then take off, bomb its target and return to home base.

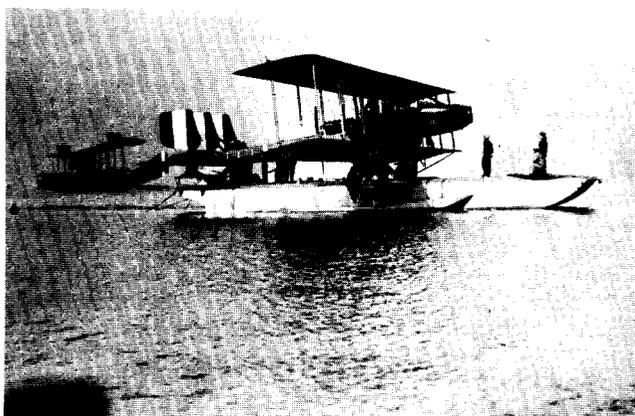
Surprisingly, the plan met with favor. The British volunteered to contribute 50 of the lighter units and asked the U.S. to provide 30, along with 40 planes. By the end of July 1918, the towed-lighter project saw the commissioning of a base at Kill-



DURING WW I, British developed a towed lighter from which planes were launched. Rear compartment was flooded for seaplanes. Here landplane is towed, later launched.



NAVYMEN ABOARD USS *Pennsylvania* stare incredulously as a Curtiss seaplane is brought alongside and hauled aboard by ship's crane.



A MUSTIN SEA SLED holds a Caproni bomber in post-WW I tests at Hampton Roads. Sled was designed to add launching power to planes.

ingholme, Ireland, with an American detachment in command. In a dress rehearsal for the scheduled bombardment of the submarine base at Helgoland, a German zeppelin appeared on the scene and photographed the entire operation. The secret type of attack no longer secret, the British called off the campaign in August.

The first draft for Naval Aviation's request for appropriations after the war contained no provision for the construction of aircraft carriers nor the conversion of a current ship of the line to carrier characteristics. But on return from Europe of Capt. Noble E. Irwin, who then had the aviation desk in the Office of the Chief of Naval Operations, the entire budget was revamped, new estimates were made, and the Navy was subsequently authorized to convert the collier USS *Jupiter* into the first experimental carrier.

The British, at that time, had three operating carriers, two training carriers and two under construction.

In 1919, the General Board met again, this time centering its attention on Naval Aviation. It was an exhaustive inquiry from which was produced a report on "Future Policy Governing Development of Air Service for the United States Navy." In it the Board stated, "The development of Fleet Aviation is of paramount importance and must be undertaken immediately if the United States is to take its proper place as a naval power."

At the close of the war, the evolution of thought on carrier designs centered on the development of two types, one a fast vessel with large radius for scouting operations with scout cruisers, and the other a larger, slower vessel to operate with battleship units as a base

for launching torpedo plane attacks.

The experiments and experiences of the British Navy in operating aircraft carriers influenced American thinking when design and performance were considered. Their carrier *Argus* weighed 18,000 tons and flew 20 Sopwith planes carrying 1000-lb. torpedoes. Its speed was 21 knots. Two other British carriers, *Furious* and *Cavendish*, were designed for scouting missions, travelled at 32 knots, and carried reconnaissance planes.

Arguments continued during the Board meetings. One faction wanted to convert battleships instead of colliers, but were out-argued by Irwin who pointed out the lack of stowage space below decks, the smoke menace amidships, the small headroom between decks, and the additional personnel needed for the fire room. One admiral protested the conversion. "I believe the development is going to be so rapid that by the time you get your carriers you will find you have to make all your ships carriers." But another voice

was heard, that of LCdr. E. O. McDonnell: "A plane carrier would carry 15 torpedo planes and, in my opinion, would be a menace to a whole division of battleships and in the same way a fleet of carriers could attack a place like Hawaii."

Congress considered converting cruisers. Merchant ship possibilities were renewed, but the Board prevailed; the collier *Jupiter* was selected.

Even at this late date, a new threat developed. After Congress authorized the carrier, RAdm. Benson shelved the project. Capt. Thomas T. Craven, who had by then relieved Irwin, found himself in the awkward position of facing a Congressional hearing and admitting that the appropriated money would not be used. He consulted Daniels who at once reversed the CNO's decision and ordered work to proceed immediately. In January 1920, Daniels allocated \$500,000 for the conversion and the future of *Jupiter-Langley* was assured.

Several years later, LCdr. B. G. Leighton commented on the controversy surrounding the selection of *Jupiter* for the first conversion to a carrier design. "There is no good reason," he said, "why a battleship might not become an aircraft carrier, or an aircraft carrier a cruiser.

"The *Langley*, 14 knots, no guns, 400 officers and men—a converted collier—is an aircraft carrier. The *Saratoga*, 33 knots, eight-inch guns, three times the size of the *Langley* with three times as many men—a converted battle cruiser—is an aircraft carrier. The British *Argus*—a converted passenger ship—is an aircraft carrier. 'Aircraft carrier' may 'mean almost anything!'"



FIRST SUCCESSFUL launch of a flying boat was made at Washington Navy Yard in Dec. 1912.

DECISIONS OUT OF JUTLAND

By Scot MacDonald

'It is impossible to resist the admiral's claim that he must have complete control of, and confidence in, the aircraft of the battle fleet, whether used in reconnaissance, gun-fire or air attack on a hostile fleet. These are his very eyes. Therefore the Admiralty view must prevail in all that is required to secure this result.'—Winston S. Churchill.

THOUGH THESE WORDS were written in 1936 as a private citizen, Winston Churchill earlier, as First Lord of the Admiralty, advocated the development of aviation in the navy while the aeroplane was still young. He was partially responsible for placing the new machines aboard British ships shortly after the first decade of this century. As a result, during World War I Great Britain developed the aircraft carrier and built a small number of them before any other country had a single ship designed for the operation of planes at sea.

Heavier-than-air craft had its start in Great Britain four-and-a-half years after Orville Wright launched the world's first successful aircraft at Kitty Hawk. Mr. Alliott Verdon-Roe completed constructing his plane at Broadside, England. Modeled after a Wright brothers' aeroplane, it was successfully flown on 8 June 1908.

On 2 March 1911, three Royal Navy officers and one Marine officer began taking flying instruction given by a civilian enthusiast. The first of the four to solo was Lt. Charles R. Samson who, in the next ten years, built a distinguished reputation for being a flamboyant man of action.

In 1912, Horace Short produced Britain's first seaplane (Churchill has been credited with coining this one-word description of the aircraft) and it was successfully flown by Samson. Only months earlier, Samson demonstrated the potentials of naval aviation when in December 1911, he test-launched a Short S.27 biplane from rail platforms on the foredeck of HMS *Africa* while the warship was at anchor at Chatham. He made a safe landing alongside, using flotation bags strapped to the wheels of his plane.

Four months later, in May 1912, the first British flight from a moving ship was effected when Lt. R. Gregory, one of the "original four," took off from a temporary flight deck of the battleship *Hibernia*. The ship was steaming in Weymouth Bay at a speed of 10 to 12 knots.

By this time, France already had an Air Corps, consisting mostly of landplanes. Between 1912 and 1914, she experimented with seaplanes aboard the converted cruiser *Foudre*, previously used as a mine ship, but apparently lost interest before any notable advancement could be made. The ship could not house an effective number of aircraft aboard; the rest were

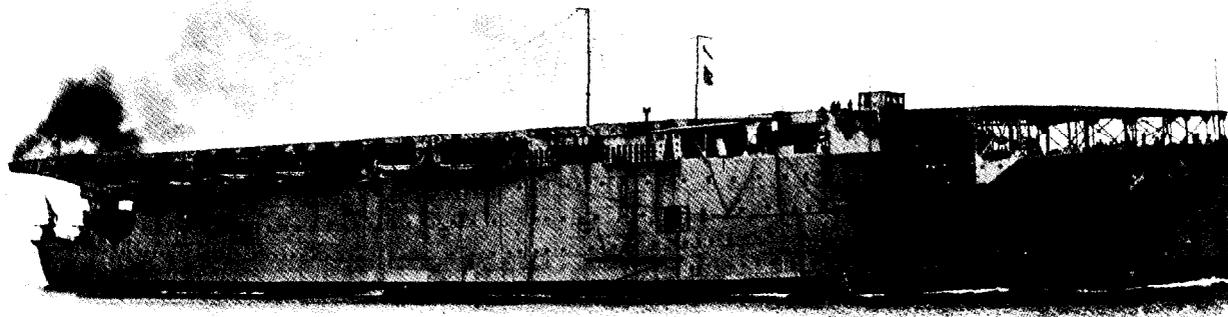
hanged on the beach at Frejus. But in number of landbased craft in the military inventory, and in pilots trained, France was the undisputed leader in pre-WW I years.

Germany believed her future lay in the development of lighter-than-air craft, eschewing experiments in sending heavier-than-air craft to sea. Her answer to war at sea was the U-boat, supplementing the High Seas Fleet, and she used it effectively in the turbulent years ahead. She did develop landplanes, some with extraordinary achievement, but it was with Count Ferdinand von Zeppelin and his airship designs that Germany placed her national trust.

Italy, at that time (and for many years after), did not believe carriers were necessary for her defense. The prevailing opinion was that the country was so centrally located it was virtually a land base from which the Mediterranean could be controlled.

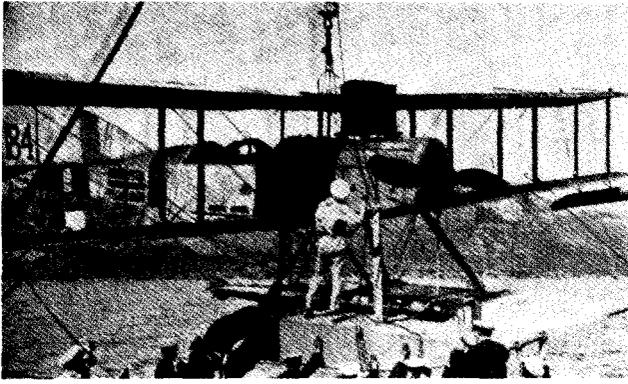
Japan developed aircraft carrier designs, but details of construction were not revealed to the rest of the world for decades.

The United States, after originally inventing the aeroplane, did not during WW I aggressively push their op-

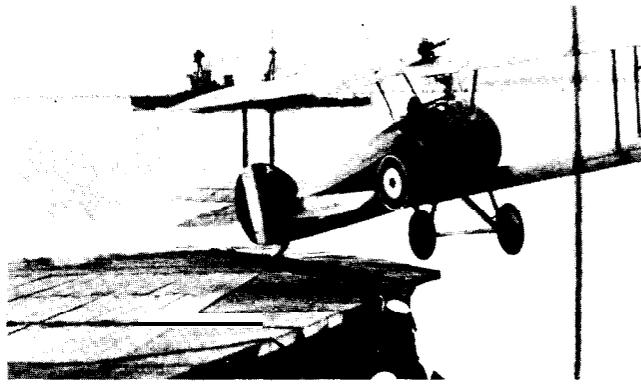


CONSIDERED BY MOST HISTORIANS to be the world's first true aircraft carrier, HMS Argus had flush deck installed. Completed toward

the end of the war, she never saw action. Tests conducted during construction and post-war operations influenced design of later carriers.



ON HMS BEN-MY-CHREE during the Dardanelles campaign, a Short seaplane is lifted over the side. Double-acting ailerons on both wings.



A SOPWITH CAMEL launches from converted HMS Pegasus in 1918. Note machine gun mounted on wing. Camels were used extensively.

eration at sea. True, the Navy had equipped at least three ships to operate aircraft by installing catapults on them, but the catapults were removed during the war. On the whole, the military was not encouraged and seldom financed; civilians had little motivation for building carriers.

With France the undisputed master of the landplane, Germany the acknowledged expert in lighter-than-aircraft, and the whole of Europe feeling the faint stirrings of unrest as early as 1912, Great Britain was intent on catching up with and overtaking, if possible, France and Germany in their respective aeronautic specialties.

As war years approached and the German submarine force grew in potential, Britain, as the major sea power, instinctively sought ways of adapting aeroplanes for operations with the fleet while out of flying range from home bases. Her success eventually gave her a weapon more powerful than those developed by competing powers.

The genesis of the British aircraft carrier can be plotted with simplicity. At first, attention was directed to the launching of aircraft from water. Both hydroplanes and flying boats were studied, tested, and developed.

Later, experiments were made in launching planes from ships, followed almost immediately with efforts to successfully retrieve them at sea.

Eventually, the performing advantages of the light landplanes over the awkward hydroplanes led to efforts to develop vessels which could take the landplane to sea. When these achieved success, the forerunner of modern aircraft carriers was born. The gestation period was surprisingly

short for such a complicated ship, but its parturition was forced by the pressures of wartime and an instinctive fight for survival.

Britain's first step toward carrying aeroplanes to sea was to establish an official air arm. On 13 April 1912, the Royal Flying Corps was constituted by Royal Warrant and, on 19 June, a Central Flying School was opened at Upavon Downs. Both the Corps and the School were planned for the centralization of aviation activities in the Royal Navy and the "Military."

Between 1912 and the outbreak of hostilities in August 1914, Europe became increasingly restless. In October 1912, following the establishment of the Corps, Britain commissioned a number of naval air stations for coast guard duty. One was placed at Cromarty, Scotland, and the remaining three in England, by the Channel coast at Calshot, Yarmouth, and Felixstowe. Two others were already in operation, one at Eastchurch and the other on the Isle of Grain. The sites were selected to form a chain so that planes could fly from one station to the next without requiring an interstop for refueling.

British naval aviation moved more closely toward the carrier concept when a wheeled launching platform was installed in the cruiser *Hermes* in June 1913. At first, two seaplanes operated from the ship. Later, she was capable of carrying a third. By October 1914, *Hermes* had been fitted to handle ten.

In the summer months of 1914, Prime Minister Lloyd George appointed Winston Churchill First Lord of the Admiralty, comparable to the

Secretary of the Navy in the U.S.

In a series of sudden decisions, Churchill immediately called out of retirement brilliant Lord Fisher, a cantankerous admiral who advocated great changes in the Royal Navy. He was made First Sea Lord (i.e., CNO). Almost at the same time, Churchill elevated the bellicose Sir John Jellicoe to command the Home Fleet, bypassing several senior officers en route.

Aviation fascinated Churchill. He flew at every opportunity and encouraged the development of aircraft for the Navy's use. In this respect, he was militant. In the words of Sir Sefton Brancker, then Deputy of Military Aeronautics, "The first sign of Churchill's policy was his sudden announcement that the Naval Wing of the Royal Flying Corps had become the Royal Naval Air Service—this without any reason or warning to the War Office."

His most startling decision was made shortly before war was declared. On his own initiative, Churchill called up full mobilization of the Navy, risking a veto by the Cabinet and not waiting for a signature from King George V. The entire reserve strength went on active duty; the ranks of naval aviation broadened with other units of the fleet. It was one of the few times in history that a defending nation's navy was adequately prepared upon the declaration of war.

Events moved swiftly. On 28 June 1914, the Austrian Archduke, Franz Ferdinand, was assassinated by Serbian students at Sarajevo. On 17 July Churchill concentrated the fleet at Spithead for review and maneuvers. All available naval aircraft took to the air: 17 seaplanes and two flights

of aeroplanes. On 28 July Austria-Hungary declared war on Serbia. Russia sided with the Serbs and Germany mobilized. On 1 August, the British planes at Eastchurch were tuned up. August 4th, England declared war on Germany, and Germany declared war on Belgium.

At that time, Great Britain had only one vessel that could even remotely be referred to as an aircraft carrier, the *Hermes*. Her wartime activity was cut short, however. On the evening of 30 October 1914, she was torpedoed and sunk. Fortunately, most of her crew survived.

In short order, an old merchantman was placed in a shipyard and her superstructure converted to carry and launch seaplanes from wheeled trolleys. It was the same type installation used in the *Hermes*. The merchantman displaced 7450 tons, was slightly longer than 350 feet, and had a speed of about 11 knots. This ship, HMS *Ark Royal*, was to prove valuable to the Royal Navy in future years.

In quick succession, other vessels were converted. The former fast cross-Channel packers, *Empress*, *Engadine*, and *Riviera*, were fitted with hangars for seaplanes and equipped with cranes for hoisting aircraft into and out of water. Later, an Isle of Man packet, *Ben-my-Chree*, was refitted for seaplane operations.

Except for submarine activities—which proved deadly in the early years of the war—the German Navy seemed tenaciously timid. The Kaiser adamantly refused to permit the High Seas Fleet to engage the British, so it hung reluctantly to safe ports. There were, therefore, few demonstrations of German belligerence by surface ships at sea. But in the early months, two engagements are notable, for they eventually affected some future designs of Royal Navy ships.

IN SEPTEMBER 1914, the German cruiser *Konigsberg*, skulking in the Indian Ocean, attacked and sank the British cruiser *Pegasus* in port at Zanzibar. She then hid in a maze of channels in the Rufiji Delta on the east coast of Africa. The Admiralty knew her whereabouts, but not exact location. Charts indicated five possible exits for *Konigsberg*, but there was only one ship in the area able to offer chase, *Kinfauns Castle*.

Not far away, on the island of Niororo, a civilian stunt pilot, H. D. Cutler, suddenly found himself commissioned in the Royal Naval Air Service and his two weathered Curtiss flying boats in the Air Service's inventory. He was immediately assigned to locate the cruiser. Only those familiar with the vagaries of war can appreciate the actions that followed.

On his first flight, Cutler had no compass, got lost, was forced to beach on a deserted island and awaited rescue. *Kinfauns Castle* found him. Two days later, his leaky boat repaired, he found the German cruiser deep up a tideway. He returned to the ship and reported. Charts at the home office indicated the water too shallow to support a ship of the *Konigsberg* draft; another recon was ordered by the Admiralty, this time with an observer aboard.

Ten days were lost while Cutler awaited shipment of his second Curtiss; the first now leaked so badly it was unusable. The ship's commanding officer observed during the next flight and confirmed the *Konigsberg's* location.

Sinking of the German cruiser now became an *idee fixe* with the Admiralty. The nearest ship of sufficient size and firepower to do the job was too far away. Days passed, while *Kinfauns Castle* awaited help. Cutler launched again to ascertain *Konigsberg's* continued presence, but shortly

after reaching the tideway, his engine failed. Forced down, he was captured by the Germans. Aerial reconnaissance no longer a threat, *Konigsberg* saw no reason for leaving her safe anchorage.

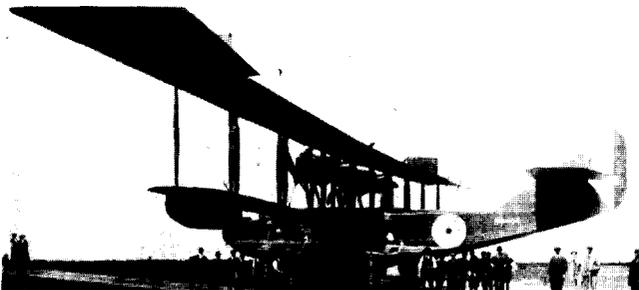
It was not until April that Short seaplanes arrived on the scene to take up Cutler's recon missions. One of the planes was shot down on its initial flight before completing a photo run. Use of the others was limited: they could not reach sufficient altitude for bombing.

Two more months went by before help finally came—in the monitors *Severn* and *Mersey*. They were equipped with Henri Farmans for spotting, but even then their job was not easy. A spirited fight ensued between the ships, interrupted by a five-day interim for necessary repairs to the Farmans. The battle then resumed and eventually, under persistent British gunfire directed effectively by the aircraft, the German cruiser fell.

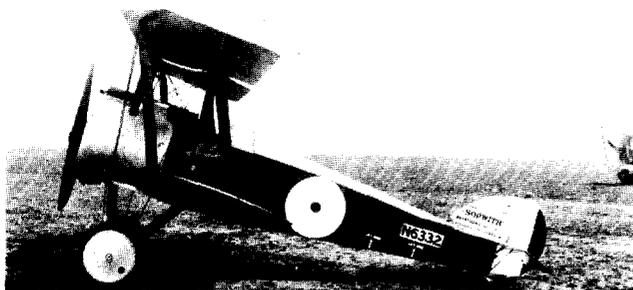
The third German-British naval engagement of WW I has been entered in history books as the Battle of the Falkland Islands.

Over on the China Station, Germany had eight cruisers operating in these and nearby waters. When Japan declared war against the Central Powers, the German squadron, commanded by Adm. Count von Spee, sailed for South America, bombarding Papeete and Fanning Island en route. He was joined by two more cruisers at Easter Island and, in company, they proceeded to the coast of Chile. The Admiralty, intent on destroying this enemy force, assembled as many ships as possible off the southeast coast of South America, and even dispatched three from the Grand Fleet to join in the hunt.

Von Spee, still eager for battle, decided to attack the Falkland Islands. It was a fatal decision: the British



THE FELIXSTOWE F-3, called "Large America," was a British improvement of Curtiss' flying boat built before U.S. entered World War I.



SILHOUETTE of Sopwith Camel shows machine gun installed on engine cowling. Synchronizer developed by Germans permitted this system.

squadron came upon him unexpectedly and sank all the German ships, save one, which managed to escape.

These two incidents—the spotting and sinking of the *Konigsberg* and the Battle of the Falkland Islands—led to the later development of gun-turret launching experiments in HMS *Repulse*, and the construction of Lord Fisher's "Hush! Hush!" ships, *Courageous*, *Glorious*, and *Furious*.

The British turret-launching system was designed and developed in 1917. By early 1918, nine battle cruisers and two light cruisers were equipped to launch seaplanes from systems installed over ships' gun turrets.

Though developed by the British under the pressures of wartime urgency, the idea was first recorded as early as November 1910 when New York Navy Yard quartermaster joiner E.C. Keithley proposed a design shortly after Ely's successful take-off from the *Birmingham*. Keithley's idea was rejected—too advanced for its time—into Navy files and forgotten.

But Fisher's "Hush! Hush!" ships have fascinated naval architects and historians since they were uncovered. Originally, they were built as cruisers of a sort under the war emergency program.

Ships of the Royal Navy describes them as white elephants. "In design," it states, "they suffer from being too strong and too weak. For light cruiser work, they are ludicrously overgunned, while the absence of armour precludes their being employed as battle-cruisers."

Apparently, the First Sea Lord wanted powerfully armed ships of high speed, capable of navigating very shallow waters. Officially described as light cruisers, they were ordered shortly after the sinking of *Konigsberg*. Subsequently, all three were converted into carriers, *Courageous* and *Glorious* after the war. Before *Furious* was commissioned in July 1917, she underwent the first of several conversions and emerged from the shipyard initially as an awkward-looking aircraft carrier.

Britain, in the first months of the war, realized the danger of zeppelin raids on home shores when the Germans became entrenched in Belgium. A series of air patrols in the Channel was immediately established, costing the Royal Naval Air Service in casual-



WW I AVRO 504 series biplanes were used extensively by the Royal Naval Air Service.

ties a number of seaplanes and pilots.

In December 1914, the British planned a raid on zeppelin bases at Cuxhaven. This time, they tried a new tactic, launching the attack with seaplanes based aboard ships. The converted *Engadine*, *Riviera*, and *Empress* were pressed into service, accompanied by a screen of destroyers and submarines. The mission was not restricted to the bombing of the airship sheds, but broadened to obtain as much information as possible on the strength of the German Navy in the area.

On Christmas morning, the ships converged at a point some 12 miles north of Heligoland. An hour later, seven planes took off. En route, they were attacked ineffectively by two zeppelins, and, as they neared the enemy's main naval base, by seaplanes.

Three hours after launching, three of the seaplanes returned to their ships, the mission only partly accomplished. The remaining four were forced to ditch. The crews of three were rescued by a friendly submarine; the fourth was captured by a Dutch trawler.

The seaplanes did not succeed in finding the zeppelin sheds, thus failing that aspect of the mission. But they did bring back valuable information on harbors and the number of German ships in them. The Admiralty was not disappointed.

If any single action gave birth to the concept of aircraft carrier operations, says one noted U.S. naval historian, this raid would qualify. Several similar raids were made in later years of the war, but attention was directed first at the development of seaplanes and then of flying boats. It was not until the last months of the war that Britain fully realized the limitations of seaplane characteristics and the superiority of landplanes. She then began various experiments with true aircraft carrier design.

MEANWHILE, Turkey refused to remain neutral. Influenced by Enver Pasha, the Minister of War, the country was pro-German. On 29 October 1914, Turkish warships, in company with two German cruisers, opened fire on Odessa, Theodosia and Sevastopol on the coast of the Russian Black Sea. Russia declared war on 2 November, and England and France followed three days later. The Ottoman Front was opened.

Churchill soon conceived a brilliant strategy. Had it been successfully carried out, the war could easily have been ended in 1915. Instead, the campaign ended disastrously, and the war dragged on bloodily until November 1918.

He proposed to concentrate British Forces in the Dardanelles, defeat Turkey, and force the Germans and Austrians to deploy troops and machines to that area. The Balkan states would probably join the Allies. And Russia would make a devastating victory in the east; the Central Powers would crumble. It nearly worked.

Though opposed at home and in France, Churchill ordered the Navy into action. As soon as a force of ships was gathered, including *Ark Royal*, the British armada headed toward the Dardanelles to force an entrance.

In *Ark Royal* were six two-seater seaplanes and two single-seater landplanes. Of these, only a Short seaplane, equipped with a good engine, was efficient. The rest could barely get high enough for effective spotting and could launch only when waters were calm.

On 5 March 1915, a Sopwith seaplane, manned by a pilot and observer, took to the air. The plane was to direct fire on a Turkish fort for the guns of the new superdreadnought, *Queen Elizabeth*. It climbed tortuously to 3000 feet and, as the observer readied to call the shots, the propeller fell off. The Sopwith plunged to the sea, under furious fire from the fort. Miraculously, both men were saved.

More catastrophes followed. The assault force, entering the straits, ran into a mine field and lost three battleships. Action was broken off abruptly by the admiral—although other ships had managed to toss the Turkish and German troops into confusion.

Churchill composed a telegram insisting the battle be resumed immedi-

ately, but was dissuaded by the Admiralty on the ground that the officer commanding the situation should be allowed to make his own decisions. For the prospect of a shortened war, later events proved this decision was unfortunate.

At war's end, German General Liman von Sanders, in charge of the Dardanelles during the battle, wrote, "If the orders given at that moment had been carried out, the course of the war would have been changed after the spring of 1915, and Germany and Austria would have been constrained to continue the fight alone."

The attack on the Ottoman Front next centered on Gallipoli, but this proved a worse disaster. The enemy learned of the next tactic and buttressed their defenses. The campaign—doomed to drag on till the following January—was lost.

Samson arrived on the scene, via brisk battles at Dunkirk and Belgium, commanding No. 3 Aeroplane Squadron. *Ark Royal* moved to the Gulfs of Enos, Smyrna and Xeros, providing effective spotting, and returned to her base at Mudros. Fighting was sporadic, both a success and a failure—in about equal measure. The Turks were worthy adversaries.

By late June the threat of German submarines in these waters was real, and *Ark Royal* was retired to the safety of Imbros where she functioned as a depot ship. Barely a week earlier, *Ben-my-Chree* was added to the force. Reconnaissance and spotting flights

were frequent, but the Dardanelles campaign was now a stalemate.

In early August, a major landing was effected by the British at night without opposition. With the enemy forces nearly all routed and running, the general in charge failed to press the attack. In the meantime, reinforcements came up and the battle raged anew, continuing until the British realized the hopelessness of the situation and evacuated, ending the campaign.

Great Britain recognized the deadliness of the German U-boats early in the war. *Lusitania* was torpedoed 7 May 1915 with 1200 lives lost; 139 Americans were among them. Britain searched for a long-range seaplane that was capable of carrying heavy bombloads. In 1914, Sopwith developed a flying boat he called a *Bat*, but it was inadequate.

A year later, Cdr. J.C. Porte was given command of the Felixstowe naval air station. He took up the problem, started with Curtiss flying boat designs, added improvements, and finally produced an operational craft that weighed between four-and-one-half and six-and-one-half tons. As Porte described them, they "carried sufficient petrol for work far out from land and big enough bombs to damage or destroy a submarine otherwise than by a direct hit." Called *Large Americas*, they were operational by the spring of 1917.

Until 1915, vessels converted for aviation at sea were designed as seaplane tenders. This year, a new ex-

periment was tried and proved successful. The Isle of Man packet, *Vindex*, was refitted to launch landplanes as well as seaplanes. A 64-foot-long deck was mounted on the ship, and a successful flight from it was made on 3 November by a Bristol *Scout*. The *Scout* seaplane was equipped with wheels which dropped off as the aircraft took to the air. It made a water landing, taxied alongside the ship, and was hoisted aboard again. Refitted with wheels and refueled, the plane was once more ready to fly.

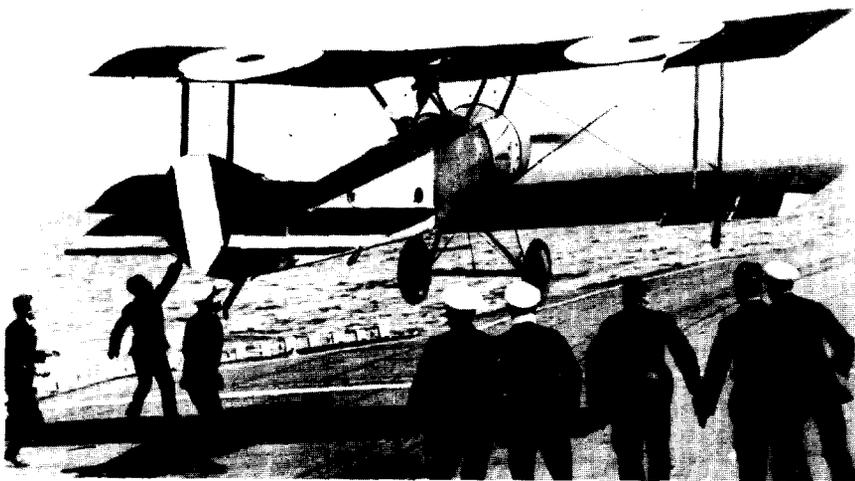
Two other experiments were made in attempts to launch aircraft at sea to provide wider range. In the first, British Navymen designed a floating barge upon which seaplanes were towed. Nearing target, the aft compartments of the lighter were flooded, permitting the plane to slide easily into the water and take off. A variation of this was a larger platform from which small landplanes were launched. They enjoyed a brief popularity and operated in the North Sea early in the war. In the closing months of hostilities, a Sopwith *Camel* was launched in the same area, engaged and downed a zeppelin. The towed lighter was not refined further and saw comparatively little action.

The second experiment made by the British in 1916 tried a new approach toward launching aircraft at sea. On their own initiative, two naval officers made a design that was a departure from the standard envelope-gondola airship. The envelope they used was comparatively small, but they hoped, capable of lifting an F.E.2C airplane. Once aloft and sufficient power given the plane, the envelope was to be detached.

Bizarre? Perhaps. At any rate, a trial launching was made of the contraption on 21 February. The plane lifted off successfully and was gaining altitude when the envelope detached prematurely. One of the officers was spilled from the plane and the other crashed with it.

IN MID-1916, the war's major sea battle was fought, the Battle of Jutland. Earlier in the year, the 20,000-ton Cunarder *Campania* was converted by the British to carry seaplanes and was assigned to Adm. Jellicoe's Grand Fleet.

May approached and nearly ended before the German High Seas Fleet,



FIRST LANDING of a British plane aboard a British ship is made in a Sopwith Pup. Deck handlers help bring the plane to a stop. A few days later, pilot was killed in a second landing attempt.

now under Adm. Reinhard Scheer, made a definite move to encounter the Royal Navy. Jellicoe was ready. Advised in advance that a squadron of German battle-cruisers had been ordered to Norwegian shores for a show of force, he ordered Adm. Sir David Beatty, leading a similar but larger British squadron, to intercept.

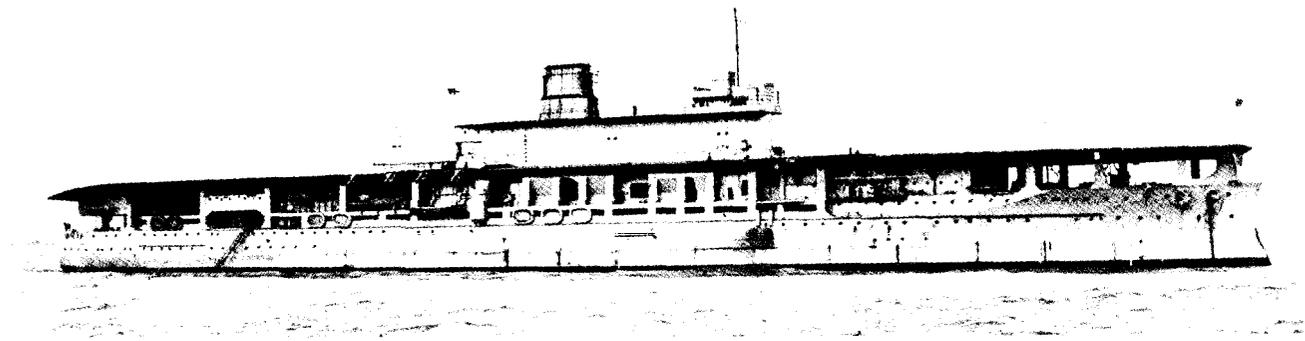
HMS *Engadine*, operating with Beatty's squadron, launched a seaplane

even though outnumbered, the German ships under Adm. Franz von Hipper, sank two of Beatty's vessels. Scheer's High Seas Fleet crested the horizon, and Beatty led his remaining ships on a strategic retreat, north toward Jellicoe.

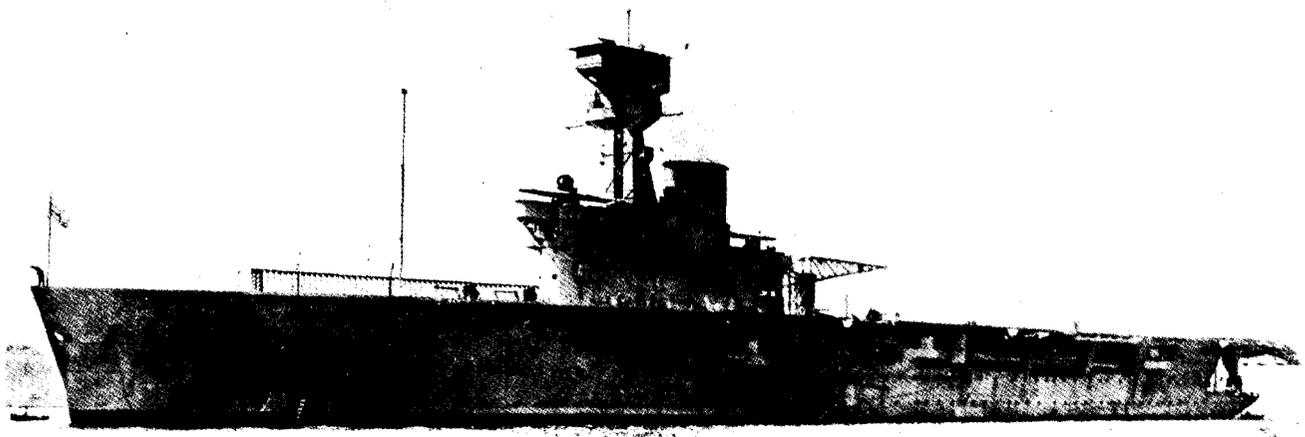
On the day before, *Campania* had conducted a series of successful gun-spotting training flights, returned to her Scapa Flow anchorage about five

Jellicoe assumed his aircraft "carrier," *Campania*, was in company. Thus Jellicoe at Jutland fought without benefit of aerial observation.

Briefly, about 1800 on the 31st, the High Seas Fleet met with the Grand Fleet. Jellicoe made a thrust to cut off Scheer's retreat, but the German admiral ordered his ships first south and then east. By this maneuver, he came up in pursuit along the flank



HMS EAGLE became Britain's second aircraft carrier. Originally planned as a Chilean dreadnought battleship, the ship was converted at end of WW I. Lessons learned from construction and operation of HMS Argus were applied to this ship, and further tests were made.



HMS HERMES, the second vessel with this name involved in the operation of aircraft at sea, is the first aircraft carrier built as such from the keel up. As HMS Eagle learned from tests in HMS Argus, so HMS Hermes profited from tests conducted in the HMS Eagle.

for reconnaissance at 1530 on the 31st. The pilot reported three enemy cruisers and ten destroyers taking a north-westerly course. Fifteen minutes later, the German ships changed course to the south. The pilot tried to flash this signal by searchlight, but his message was not received. One of the ships of the squadron noted the alteration, however, and the ships shifted in time. Thereafter, poor visibility and rough water kept Beatty's plane on deck.

The two squadrons clashed and,

miles from the main fleet, and awaited orders.

At 1735, a signal was flashed to all ships of Jellicoe's fleet to stand by to get under way. At 1900 the order to raise full steam was given and two-and-a-half hours later, *Campania* was ready. At 2254, the "proceed" signal was flashed—but the *Campania* did not receive it. Several hours passed before her C.O. realized that the rest of the fleet had gone.

Until 0200 the following morning,

of the British ships, turned again and launched torpedoes, forcing Jellicoe to retreat.

Scheer then ordered Hipper to engage Jellicoe's attention while the High Seas Fleet maneuvered for an escape route. Scheer found it by 2100, cutting east across the southerly-moving British ships, and dashed to safety.

At battle's end, each fleet had lost several ships, but the British suffered more heavily in tonnage—by almost double. In post-battle retrospect, the

Battle of Jutland could easily have ended in a triumphant victory for the Allies, had Jellicoe had the advantage of *Capania's* plane to report movements of Scheer's ships. The German fleet had no seagoing aircraft. This, combined with lessons already learned in previous sea encounters with the enemy—especially in countering U-boats—strengthened more than ever the British Navy's dedication to the perfecting of the aircraft carrier.

In February 1917, the pacifism of a patient president broke when, on the last day of January, Kaiser Wilhelm notified Woodrow Wilson and the American people that unrestricted submarine warfare would be commenced on the following day. Diplomatic relations were severed on 3 February, but the President decided to wait until the next overt act before asking Congress to declare war.

He did not have long to wait. In February and March, several U.S. ships were sunk and in March, the British Secret Service obtained the famous Zimmerman note, detailing German plans against the U.S. The note was deciphered and passed on to the Americans. Wilson sent his war message to the Senate on 2 April and war was declared four days later.

Advances in British naval aviation were rapid in the closing years of the war. *Furious* joined the fleet, and experiments on landing aircraft aboard were conducted. The first attempt was successful, though unorthodox; no mechanical arresting gear was used.

On 2 August 1917, a Sopwith *Pup* landed aboard. On deck, handlers grasped hold of lines from the plane's wingtips as soon as the motor was cut and the plane was skidding to a stop.

In the next attempt two days later, a tire burst upon touchdown, the plane folded over the side, and the



BATBOAT, developed by Sopwith in 1914, was inadequate. Initial power was 90-hp engine.

pilot was killed. Further studies were conducted and a primitive arresting arrangement was installed, along with netting to protect the ship's bridge.

Other conversions followed promptly. A cruiser of the *Hawkins* class was fitted with a flight deck and commissioned the HMS *Vindictive*. This deck was removed after the war.

In 1917, three ships were planned for conversion to carriers, but work was delayed intentionally on two of them. All three figured prominently in Britain's post-war development.

The first of these was the *Argus*, originally designed as the Italian liner *Conte Rosso*, and is generally considered the first true aircraft carrier. *Argus* had a flight deck 558 feet long by 60 wide and displaced 14,450 tons. She was the first "island" carrier, her superstructure moved to a tight location on the starboard side of the ship.

The second was commissioned HMS *Eagle*, but was originally laid down as the dreadnought battleship *Almirante Cochrane* under a contract with Chile. War interrupted completion of the ship, contracts were renegotiated, and she was converted to an "island" carrier. She was the only aircraft carrier to have two funnels.

HMS *Hermes*, the second carrier to bear that name, was designed from the keel up to operate as a carrier, the first such vessel constructed.

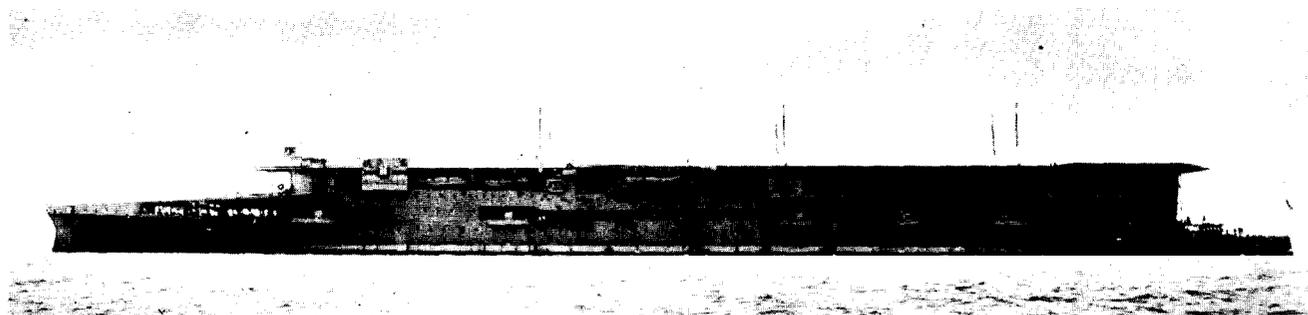
Argus was the first completed, but

saw no action in the war. Convinced now that the progress of seapower lay in the future of aircraft carriers. Great Britain suspended construction on the *Eagle* and *Hermes* until tests were made on the first carrier. The lessons learned were incorporated in the *Eagle*—and this carrier was further tested. Results from experiments on both her predecessors contributed heavily to the eventual construction of the *Hermes*.

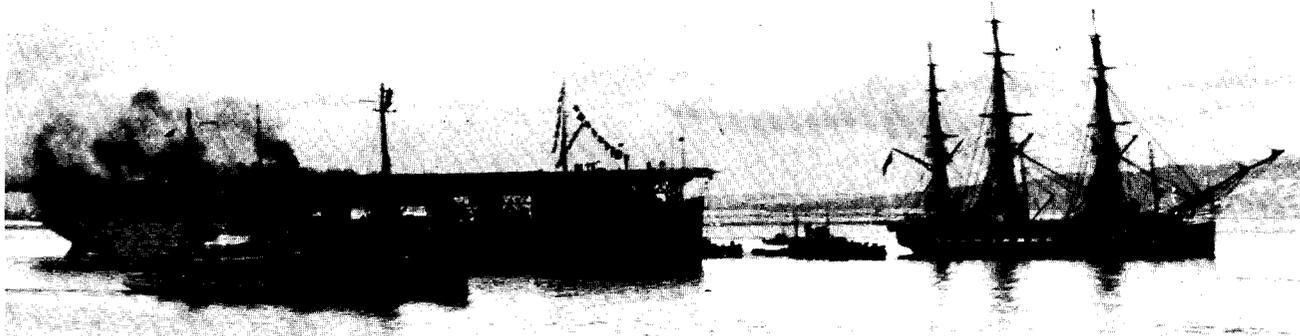
The formative, experimental years of carrier warfare drew to a close when, on 11 November 1918, hostilities ceased and the Armistice was signed. Out of the costly, bitter fight for survival a potent new ship-of-the-line developed. Great Britain pioneered in the creation of the modern aircraft carrier.

But at war's end, the U.S. had no vessel specifically built to carry aircraft to sea. Primarily, U.S. Naval Aviation launched patrol flights from shore bases. During the expansion of military forces, the Navy's General Board made concrete recommendations in favor of carrier developments. After the Armistice, it listened to exhaustive testimony concerning the role of aviation in the Navy. Acting on the Board's findings, Congress authorized a small amount of money for conversion of the collier USS *Jupiter*.

When the refitting was completed, the ex-collier was renamed USS *Langley* and commissioned on 20 March 1922 at Norfolk, Va. Surrounded by modern vessels of her day, she appeared to be the strangest-looking ship to join the fleet since the Federal ironclad *Monitor* squatted heavily in the water during the Civil War. Small and gangling as she was, USS *Langley* was the first-born of a large fighting family of powerful Navy ships.



HMS *FURIOUS* was originally a light cruiser, refitted to operate aircraft, and recommissioned in July 1917. Flying deck was 228 feet long, 50 wide. Hangars beneath held seaplanes and landplanes. Later, she was provided a landing deck aft, fitted with arresting gear.



ANCHORED IN SAN DIEGO harbor January 1933, U.S. Navy's first aircraft carrier, USS Langley, provides a startling contrast against the recent past. At right is USS Constitution. "Old Ironsides" was then on her last major voyage, a tour of important U.S. seaports.

Evolution of Aircraft Carriers

LANGLEY, LEX AND SARA

By Scot MacDonald

'It is the Navy's mission to protect our coasts, our seaborne commerce, and far-flung possessions. Once war is forced upon us we must take the offensive to win it. The Navy is the first line of offense, and Naval Aviation as an advance guard of this line must deliver the brunt of the attack. Naval Aviation cannot take the offensive from shore; it must go to sea on the back of the fleet. I do not believe aircraft on shore can ward off a bombing attack launched, perhaps, from carriers by night from an unknown point for an unknown objective. On the other hand, a fleet with adequate aviation of its own can drive the carriers back out of effective range. Both for offense and defense the fleet and Naval Aviation are one and inseparable.'

—R. Adm. William A. Moffett, USN, October 1925, in the *U.S. Naval Institute Proceedings*

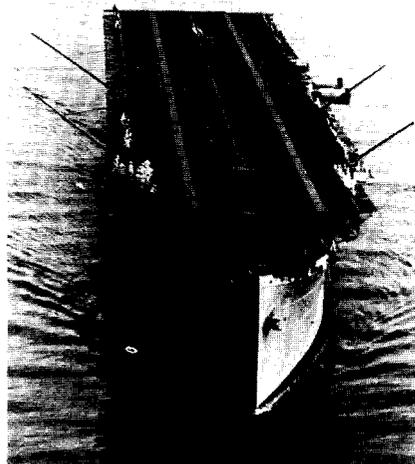
ONE DAY," said Capt. Thomas T. Craven, who had relieved Capt. Noble E. Irwin as Director of Naval Aviation in May 1919, "one day, when someone suggested that shoveling coal was becoming unpopular, we proceeded to angle for the colliers *Jupiter* and

Jason. Although some conservative seniors frowned on the plan, in time and with the Secretary of the Navy's approval, we persuaded Congressional committees of the wisdom of converting one ship, the *Jupiter*, into an aircraft carrier. Having an entirely inadequate speed, the vessel could not possibly fulfill all Service requirements, but she could serve as a laboratory for determining naval needs. Naval Aviation took heart."

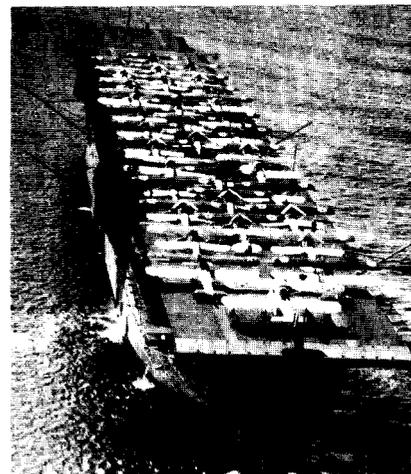
At war's end, Great Britain had the *Hermes*, *Eagle* and *Argus* in operation, while Germany successfully converted the merchantman *Stuttgart* into a carrier. Capt. Craven was in France at the time, assigned as Aide for Aviation to Commander U.S. Naval Forces, and Commander Naval Aviation Forces ("I was deeply involved in the complicated business of closing out the Navy's aeronautical account"). He was approached by the Chief of Naval Operations—and later, by Secretary of the Navy, Josephus Daniels—and asked to assume the Office of Director of Naval Aviation.

Returning to America, he immediately studied the problems of strengthening the Navy's complement of pilots and support personnel, obtaining "apparatus suitable for their use," and developing tactics.

Cdr. Kenneth Whiting, in a mem-



EXPERIMENTAL autogiro takes off from Langley in September 1931 during tests underway.



A 1928 VIEW of Langley at Pearl Harbor shows Vought O2U Corsairs, UO's, Boeing F2B's.

orandum to the Committee on Naval Affairs, sized up the situation:

"When the sear ended those who had chosen the Navy as a life work, and especially those of the Navy who had taken up Naval Aviation, revived the question of 'carriers' and 'fleet aviation.' They found the sledding not quite so hard as formerly, but the going was still a bit rough.

"The naval officers who had not actually seen Naval Aviation working retained their ultra conservatism; some of those who had seen it working were still conservative, but not ultra; they were in the class 'from Missouri' and wished to be 'shown.' Others, among the ranking officers who had seen, had conquered their conservatism and were convinced.

"This latter group, headed by the General Board of the Navy, and including Adm. Henry T. Mayo, Adm. N.C. Twining, Capt. Ernest J. King and Capt. W.S. Pye, both on the staff of the commander in chief during the war, Capt. H.I. Cone and Capt. Thomas T. Craven, incontinently demanded that 'carriers' be added to our fleets.

"The net result of these demands was the recommendation that the collier Jupiter be converted into a 'carrier' in order that the claims of the naval aviators might be given a demonstration."

Jupiter did not possess all the characteristics that would have made her an ideal aircraft carrier, but she did have many advantages. Commissioned April 7, 1913 as fleet collier No. 3, she, with the *Neptune*, carried the first Naval Aviation detachments to France in World War I. At war's end, she was scheduled for retirement.

"At the time she was selected [for conversion to an aircraft carrier]," Cdr. Whiting pointed out, "her advan-



CAPT. THOMAS T. CRAVEN, Director of Naval Aviation, pressed hard in Congressional hearings for conversion of the collier *Jupiter*.



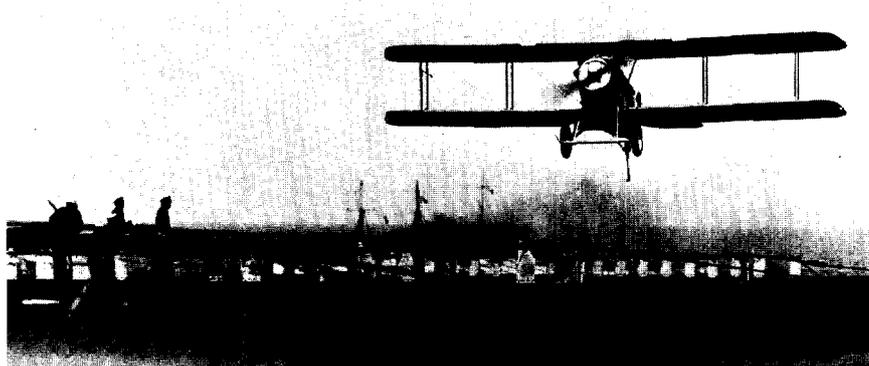
RADM. WILLIAM A. MOFFETT was first Chief of Bureau of Aeronautics and was an ardent advocate of the development of carriers.

tages outweighed her disadvantages."

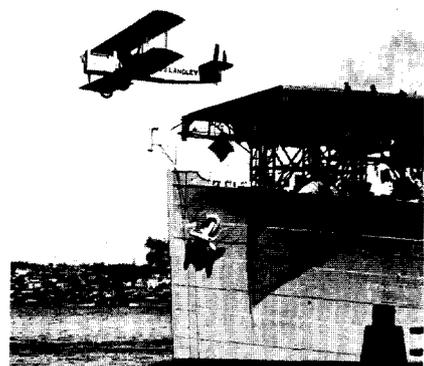
The ship was slow and might prove a drogue to a fast-moving fleet. But she did have the necessary length to permit planes to fly off from a specially prepared deck. Her hold spaces were very large, "with high head room in them, a difficult thing to find in any ship. She had larger hatches leading to these holds than most ships, a factor permitting the stowing of the largest number of planes."

Jupiter was electricly-driven, the first of a few ships in the current fleet to be so powered. Her top speed was a comparatively slow 14 knots. One of the clinching arguments for her conversion was her small crew requirement. With hostilities over, non-regular Navy men were eager to continue civilian activities and were leaving service in large numbers.

Jupiter sailed to Norfolk Navy Yard where the conversion work was accomplished. "We thought she could be converted cheaply," Cdr. Whiting said, "—that was a mistake, however. In any event, she will have cost less when completely converted than any other ship we might have selected. We thought she could be converted quickly—that was another mistake. The war is over and labor, contractors and material men are taking a breathing spell. The recommendation for her conversion was made by the General Board of the Navy early in 1919; Congress appropriated the money [on 11 July] 1919; she was promised for January 1921; she may be ready by July 1921." She was not. *Jupiter's* designation was changed to CV on July 11, 1919; she went into the yard for conversion March 1920, and was commissioned USS *Langley* (CV-1) on March 20, 1922, at Norfolk, Va.



A VE-7 AIRCRAFT lands on USS *Langley* in May 1927, using longitudinal wires on fiddle bridges for an arresting arrangement. Note tail hook on plane and masts of sailing ship under wings.



DOUGLAS TORPEDO bomber, DT-2, launches from *Langley's* deck while carrier is berthed.

In the yards, all the coal-handling gear was removed from the collier and a flight deck, 534 feet long and 64 feet wide, was installed. At first, it was planned that this deck would be completely free of obstruction, and so it was in the Langley. But in the *Sara* and *Lex*, this view was changed in favor of an island placed on the starboard side. This side was selected for the island's location because it provided a better view of buoy markers in narrow channels. It also facilitated left-hand turns which pilots preferred, owing to the torque of the turning propeller. The island design offered the only practical solution to problems predicated by smoke discharge, navigation, fire control, and communications.

An elevator was installed to lift planes from the assembly and storage deck to the flight deck. A palisade was built around this elevator to provide a windbreak, protecting the planes and men while the aircraft were being assembled.

For the hoisting of seaplanes, two cranes with large outreach were installed on the hangar deck, one on either side of the ship. Traveling cranes were installed beneath the flight deck for hoisting planes from the hold and for transferring them fore and aft to the ship spaces and elevator.

The collier's firerooms were located well aft. This permitted an easier handling of gasses to guarantee a minimum interference with planes when they touched down on her deck. "She had ample space for machine,

carpenter, metal and wing repair stowage; spare parts, spare engines, and shops; for gasoline and lubricating oil aircraft ammunition. Her living quarters appeared to be a bit crowded, but sufficient for the work to be undertaken."

Smoke pipe plans called for the provisions of a short smoke pipe on each side of the ship, clear of the flight deck. They were interconnected so that smoke could be discharged on the lee side. One of the smoke pipes was designed to hinge downward when considered necessary to discharge near the water; the second, to discharge smoke downward through water spray.

FROM MAY 1919 to March 1921, during his tour as Director of Naval Aviation, Capt. Craven directed much attention to the training of pilots. "Pending the completion of facilities that would enable the Navy to train pilots to fly landplanes from the deck of a carrier," he wrote, "arrangements were effected to have naval flyers instructed in the Army school at Arcadia, Fla. The entire naval contingent[s] quickly and easily completed the Army's course." They also received Army training at Mitchel Field on Long Island and at Langley Field, Va.

Earlier, LCdr. Godfrey de Courcelles Chevalier led a team of 15 pilots who were put into training with landplanes, practicing touch-and-go flight deck landings on a 100-foot long platform constructed on a coal barge at Washington Navy Yard. The barge

was moved to Anacostia where landing tests were conducted.

Experiments were conducted at Hampton Roads in which Lt. Alfred M. Pride participated. A turntable platform was used, similar to the type the British developed in WW I—in turn, an improvement of Ely's arrangement used on the *Pennsylvania*. A BUAEER letter dated November 19, 1923, described the Langley and *British* systems. The *Langley* gear, the letter states, "depends on an athwartship retarding force while the [British] gear depends on air resistance together with the resistance set up by fore and aft cables." The *Langley* wires were suspended about ten inches above the deck. They were not entirely satisfactory, but were used, with some modifications, in the *Lcxington* and *Saratoga* until 1929.

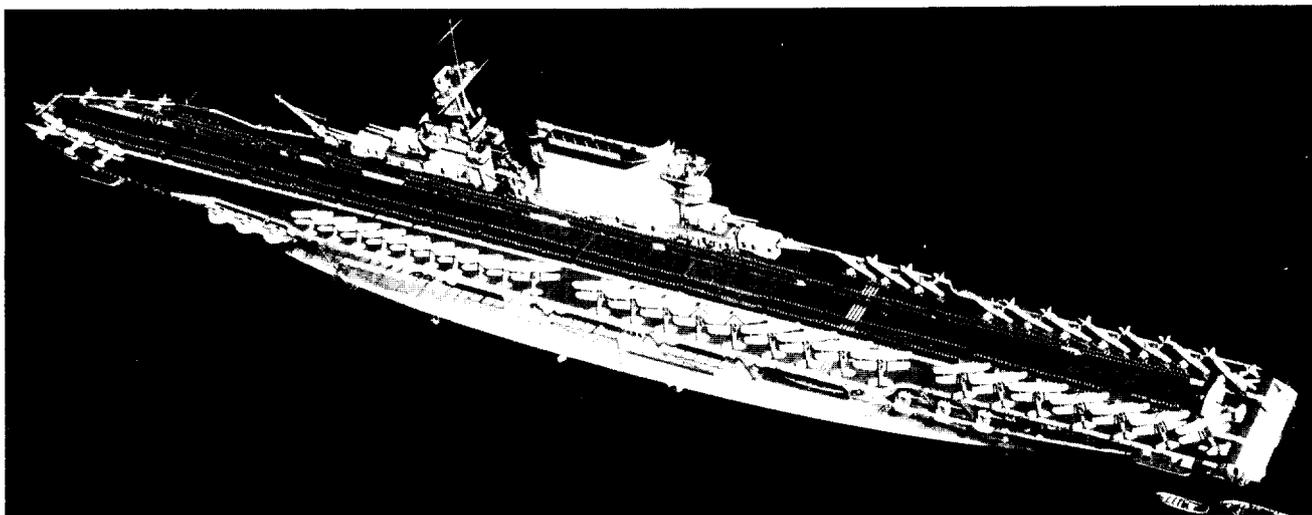
When *Langley* eventually went to sea in September 1922, she had an arresting gear installed.

A copy of an order dated February 1, 1923, signed by Executive Officer Kenneth Whiting, gives a clue to *Langley's* shipboard routine:

"The weather permitting, the ship will get underway at 9:00 A.M. tomorrow February 2, 1923, and will proceed out of the harbor for the purpose of flying planes off and on the ship.

"The tug Alleghany will accpnpany the ship and take station one hundred yards out and 200 yards astern of the starboard quarter, steaming at same ratio of speed as the Langley—about 6 knots.

"When [pilots are] flying off and



CREW OF USS LEXINGTON (CV-2) line up for admiral's inspection while the carrier is at anchor in Coronado Roads off the California

coast. Total accommdations on board berthed 195 officers and 1927 enlisted men. She was fourth U.S. Navy ship to be named Lexington.

on, both life boats will be lowered to rail and manned; the first or second motor sailing launch, depending upon which stack is in use will be lowered to the level of the poop deck, manned and equipped with grappels, crash kits and six men in addition to the crew. The Boatswain will be in charge of this boat and will go in the boat.

"The Flight Surgeon will fly over the ship in a flying boat piloted by O.M. Darling, ACR, USN. This plane will maintain station 200 yards behind and 200 feet above the plane which is flying off and on.

"This seaplane will start from the Naval Air Station upon a radio signal from the ship: Boatswain Fehrer will go in the tug accompanied by three men from the Fourth Division and a crash kit.

"In case of fog tomorrow the ship will not get underway, but will stand by until noon; in the event that the fog is cleared up by that time, will proceed.

"Steam will be kept on three boilers and engines in maneuvering condition. In case plane goes into the water, the first boat to get to it shall at once attempt to rescue the aviator, at the same time making a line fast to same strong part of the plane, in order to hold the cockpit above water. This line if possible should be passed around one of the 'A' frames or engine section, or a longeron in the vicinity of the cockpit."

THE FIRST take-off from the deck of the *Langley* was piloted October 17, 1922 by Lt. Virgil C. Griffin in a VE-7-SF. On October 26th, the first landing was made by LCdr. Chevalier in an Aeromarine aircraft while the ship was underway. He had contributed significantly to perfecting the arresting gear installed aboard—still in an experimental stage. His plane nosed over. Cdr. Whiting, on November 18, became the first to catapult from the deck of the *Langley*; he flew a PT torpedo bomber.

These aircraft—and other types used at the time—were of standard design. The Bureau of Aeronautics decided to delay introducing new types, although studies of planes built for carrier operations started with the conversion of the collier. Vought and Aeromarine service types were first to be modified for operations aboard; arresting hooks were installed and the landing gear strengthened.

For the first three years following her commissioning, USS *Langley* had no regularly assigned squadrons. She



VOUGHT CORSAIRS are parked on deck of USS *Lexington*. View emphasizes battle cruiser hull design. Weather bow, appearing in 1933-34, was standard in post-WW II modernization.

was used as an experimental ship, testing gear and aircraft, and training pilots and support personnel. For the first five years of her operations, she was the only aircraft carrier in the U.S. Navy. Because of the flight deck installed, she was quickly dubbed "the Covered Wagon," and this was reflected in her official insignia.

Principal purpose of the *Langley* was to teach Naval Aviators about carrier operations, but the early days were certainly tough on pilots, according to *Our Flying Navy*, a book published in 1944. "Instrument face" was the distinguishing mark of the *Langley's* pilots, who loosened teeth and flattened noses against their instrument panels while negotiating the hazards of landing on the *Langley's* small flight deck and crude arresting gear. Planes went overboard, piled up in the crash barrier, stood on their noses and came apart. [There were few fatalities.] But the science of carrier operations was developed as a monument to these pilots' perseverance." The "small flight deck" was as long as later-day "baby flattops."

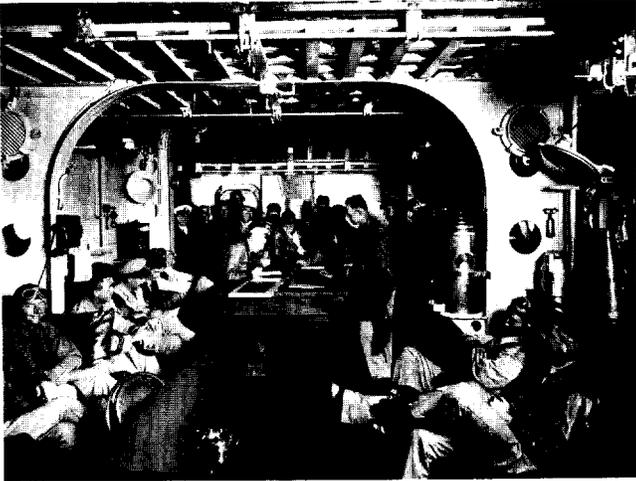
Arresting gear and catapult systems were tried, modified, improved upon; pilots qualified for carrier landings and take-offs. In March 1925, she entered her first fleet exercise, Fleet Problem No. Five, off the lower coast

of California. Scouting flights from the carrier now became standard procedure and so impressed official observers that they recommended the completion of USS *Saratoga* and USS *Lexington* be speeded up.

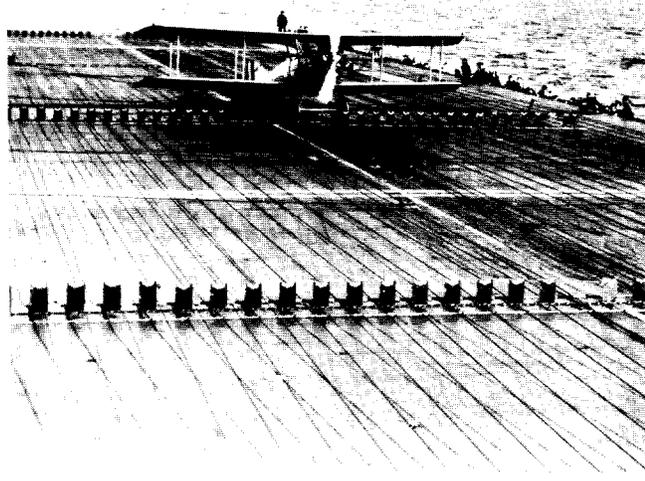
There was an urgency related to these tests. Already in the ways were the keels of two battle cruisers destined for the scrap heap as a result of the Washington Naval Treaty of 1922. A clause within this treaty permitted their conversion to aircraft carriers. Tests aboard the *Langley* were to influence greatly the final designs of the two ships under conversion. These converted battle cruisers were to become USS *Lexington* (CV-2) and USS *Saratoga* (CV-3).

At first, the U.S. Navy contemplated the construction of a 39,000-ton aircraft carrier and initial design of it was started February 24, 1921. These plans were laid aside the following November. Because of the 135,000-ton limitation in aircraft carriers, the General Board recommended the conversion of the two battle cruisers to carriers. Each was limited to 33,000 tons, with an additional 3000 tons permissible if protecting armor were added.

The Board considered building a 30-knot carrier to operate with the Scouting Force, and a smaller, 24-



AVIATOR'S READY ROOM in *Saratoga* is photographed in August 1929. Device on fore-table is Morse radio key for practice code transmission.



LONGITUDINAL Wires still use on Jan. 11, 1928 for first landing on *Sara*; UO-1 plane flown by Marc Mitscher, S.B. Spangler, passenger.

knot carrier for the Battle Force. It also weighed the possibility of constructing three separate carriers within the tonnage limitations: one at 10,000 tons and 15 knots, another at 20,000 tons and 29.5 knots, and a third at 35,000 tons at 33 or 34 knots. Instead, it returned to the battle cruisers and went ahead with plans to convert them. The *Langley* was not an influencing factor in carrier tonnage limitations since it was officially listed as an experimental ship.

Before *Langley* was commissioned, Craven became Commandant of the Ninth Naval District, relieved March 7, 1921 by Capt. William A. Moffett, who became the last Director of Naval Aviation. On July 26, 1921 that office was abolished, replaced by the newly authorized Chief of the Bureau of Aeronautics, which Moffett assumed.

MUCH OF THE WORK that went into the design of the abandoned 39,000-ton carrier was adapted in the design of the battle cruiser conversions. These plans were worked up by the New Design Section of the Bureau of Construction and Repair. Draftsman Ernest A. Perham gave a detailed report on the progress of construction:

"During February 1921, the first scheme for the stowage of planes in the hangar was begun and to date, October 1922, we have drawn up 18 schemes and not even the latest has progressed beyond the pencil stage.

"There had been a feeling, not definite enough to be called a requirement, that the ship should carry 100 planes, two-thirds in the hangar ready

for use, and one-third completely assembled in the reserve stowage.

"The first few schemes were as fragmentary as the data on which they were based. It was necessary to start as early as possible as there was absolutely neither data nor precedent to work on, and every scheme made, however poor, gave us so much more training.

"Scheme #7 was the first that was based on a hangar of the island type of ship, and even then we were considering a land plane of 70-foot wing spread for a large plane.

"When scheme #8 was worked up, the sizes of the elevators had been settled and we worked on the basis of a plane of maximum size, 60-foot wing spread.

"Scheme #11 was the first in which we used planes that Aeronautics considered would meet their requirements. The small plane, a flying boat of 30-foot wing spread, had appeared several schemes earlier and the large or bombing plane was the Davis Douglas type, of 50-foot wing spread. The wings of the small plane were arranged to take off bodily and those of the larger were designed so that the ends would fold back."

Armor considerations were the subject of brisk correspondence between various Bureaus. Preliminary studies offered a long, sloping, protective deck at the sides, beginning six feet below the water line and rising to about six feet above, to the flat third deck. The armor was five or six inches thick at the slopes and three inches on the flat.

Further studies by the New Design Section produced a change in these plans, shrinking the flat deck plating to 2¾ inches, with a side belt 1½

feet deep, seven inches thick at the top and four at the bottom. The Bureau of Ordnance raised "serious objection." The General Board reviewed the problem and recommended the inclined deck armor. A new contract plan narrowed the belt to 8½ feet, seven inches thick at the top, four inches at the bottom, a deck 4½ inches thick on the slopes and 2¼ inches on the flat.

The matter of battery was also problematical. Under the treaty, eight-inch guns were allowed for this type vessel. Also scheduled for installation were anti-aircraft guns and torpedo tubes.

The Bureau of Aeronautics believed in January 1922 that anti-aircraft guns were not necessary. In a letter written on the 16th of that month, BUAER stated: "The necessary defense of an airplane carrier against aircraft should be the aircraft carried on the carrier. It should therefore not be necessary to install anti-aircraft guns on board an airplane carrier." BUAER also advocated six-inch guns instead of eight.

But the General Board took exception to these objections the following April:

"The after eight-inch guns are an important part of the airplane carrier's armament; six-inch guns would complicate the battery and would not be as efficient

"The carrier may be able under many conditions to defend itself with some success with its own aircraft. The primary mission, however, of those aircraft is not the defense of their carrier, so it may well happen

that they will not be available for defense when most needed for that purpose. Aircraft will, of course, be useless as defensive weapons at night and under certain conditions of weather.

"Having these points in mind, the General Board considered it necessary to provide a strong anti-torpedo, anti-aircraft battery in spite of the encroachment of that battery on the clear deck space forward.

"Should experience in service and the development of tactics justify the removal of any or all of the guns, they can be removed with almost no expense or delay, while it would be a long and expensive job to install these guns after the ship is completed, should such installation then appear necessary."

The draftsman Perham discussed elevator machinery. In a report, he wrote as follows:

"The topic of elevator machinery was actively taken in hand February 1921. Some consideration was given to wire rope hoist, but the obvious difficulties caused its rejection.

"Screw actuated elevators appealed greatly because of the feature of absolute control As the investigation progressed, practical objections arose, such as the wear on the screw, methods of aligning and especially the impracticability of obtaining the necessary speed.

"The Otis Elevator Company then recommended hydraulic plunger elevators, and as the locations could be obtained for the plungers, the Bureau readily consented to the adoption of this type.

'As finally worked out, the speed of the large elevator, 20 x 60 feet in size, is to be 60 feet per minute and that of the smaller one, 30 x 36 feet, is to be 120 feet per minute. When both are run at the same time, they will be capable of making round trips every four minutes."

Fire protection came into consideration and a fire foam protective system was adopted, supplemented by a complete sprinkling system in the hangar and reserve plane stowage.

In original designs, a flight deck clear of obstructions was considered basic. Wind tunnel tests were conducted and on July 6, 1921, the island type was approved. On June 27, the General Board reported: "The adoption of the smoke pipe type (island type) [is recommended] as the experiments in the wind tunnel show that in the flush deck type the gasses are drawn in against the ship's side

and across the deck even with a slight cross wind. As no attempt has ever been made to dispose of such an enormous volume of gasses without the use of a smoke pipe, the success would be doubtful."

TURNTABLE catapults were considered necessary for a long period for the launching of small planes. But in January 1922, BuAER knocked them out of the design as being "not required." The Bureau did, however, recommend the installation of catapults in the flight deck. In a letter dated January 18, 1922, it stated by way of explanation.

"The preliminary mission of the carrier is to get planes in the air quickly, both torpedo planes and combat [fighter] planes. Due to lack of operating experience, it is impossible to tell at this time whether this can be accomplished without the use of catapults and, if not, how many catapults will be necessary; hence, it is deemed imperative that at least two catapults be provided—one forward and one aft—with structural provisions to increase this number to three forward and three aft, should operating experience prove this to be necessary."

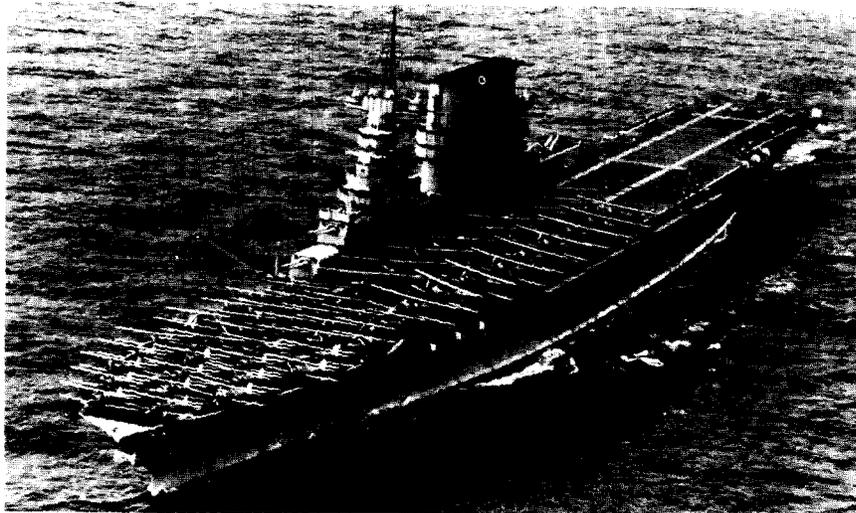
The compressed air catapult was installed in the *Langley*. Though seldom used, launchings from it contributed to future design. The *Saratoga* and *Lexington* were equipped with fly-wheel type catapults when the two carriers were commissioned.

On October 3, 1925, USS *Lexing-*

ton slid down the ways of the Fore River yards of the Bethlehem Shipbuilding Corp., at Quincy, Mass. There were 30,000 people cheering as aircraft swept low overhead. Three hours after the launching, she was towed to a pier in the shipyards for the installation of machinery and the completion of her inner structure. On December 14, 1927, she was formally commissioned. Nearly a month earlier, on November 16, USS *Saratoga* had been commissioned CV-3. It had been constructed by the New York Shipbuilding Corporation, Camden, New Jersey.

Standard displacement of both carriers was 33,000 tons. Each had a 901-foot overall length, a beam of 111 feet, 9 inches, a mean draft of 32 feet, and 16 boilers, as opposed to the eight aboard most current carriers. Their engines produced 180,000 hp, and their speed was 33¼ knots. Armament included eight eight-inch and 12 five-inch guns. The cost of building the *Saratoga*, according to an August 1952 article in *BuSHIPS Journal*, was \$43,856,492.59, while the *Lexington* was slightly more expensive, \$45,952,644.83.

Earlier, upon the occasion of the first take-off from the *Langley*, RAdm. Moffett declared: "The air fleet of an enemy will never get within striking distance of our coast as long as our aircraft carriers are able to carry the preponderance of air power to sea." In *Lexington* and *Saratoga*, the U.S. Navy had two of the strongest aircraft carriers in all the world.



A SOLID STRIPE painted down center of *Saratoga's* stack distinguished her from her sister ship, USS *Lexington*. *Saratoga* was commissioned November 16, 1927, *Lexington* on Dec. 14, 1927.

CARRIERS FROM THE KEEL

By Scot MacDonald

'Such remarks as I may have to make as to the nature and extent of the air force required by the Navy will be based upon the assumption that the airplane is now a major force, and is becoming daily more efficient and its weapons more deadly, . . . that therefore even a small, high-speed carrier alone can destroy or disable a battleship alone, that a fleet whose carriers give it command of the air over the enemy fleet can defeat the latter, that the fast carrier is the capital ship of the future. Based upon these assumptions, it is evident that our policy in regard to the Navy air force should be command of the air over the fleet of any possible enemy.'—Adm. William S. Sims, USN, October 14, 1925



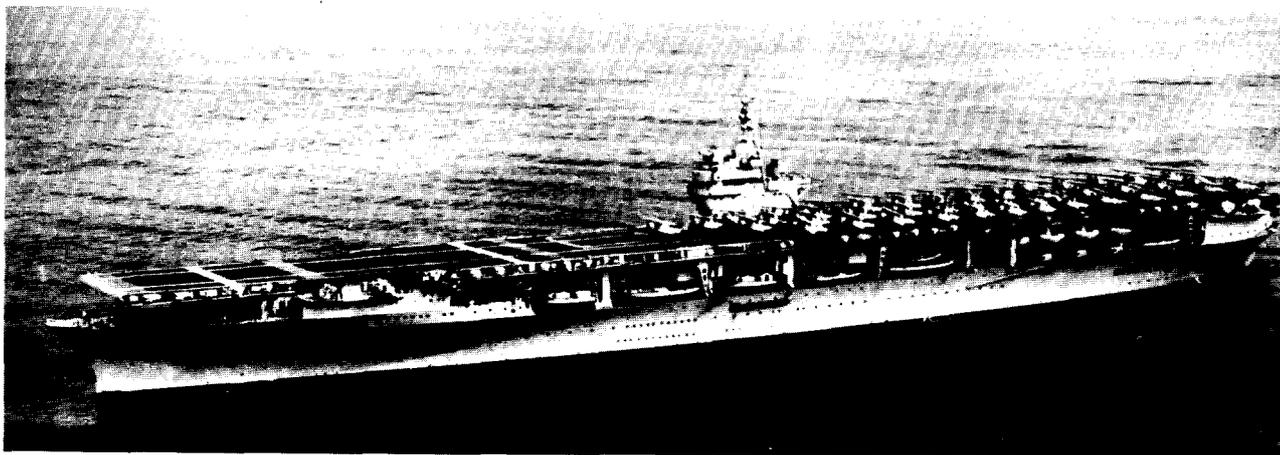
USS RANGER (CV-4) is viewed in March 1937. Commissioned in June 1934, she was the U.S. Navy's first aircraft carrier built from the keel up. Four more were built before World War II.

P LENIPO TENTIARIES of the United States, the British Empire, France, Italy and Japan met in Washington in the early Twenties to reach an agreement on the limitation of naval armament. The treaty they signed on February 6, 1922 had a profound effect on the evolution of aircraft carriers. From the time the U.S. Navy first embarked upon a carrier-building program, it was faced with tonnage limitations established by this treaty.

The total tonnage for aircraft carriers of each of the contracting powers permitted the U.S. and Great Britain 131,000 tons each, France and Italy 60,000 tons each, and Japan 81,000 tons. Of its allotted tonnage, the United States had already consumed 66,000 in the *Lexington* and *Saratoga*. Only 69,000 tons remained for future construction. The Navy gave much thought and study to the means of best utilizing this remainder, and, in 1927, when drawing up a five-year shipbuilding program, the General Board recommended construction of a 13,800-ton carrier each year.

The program involving this plan was promptly submitted to the President who approved it on December 31, 1927. It was subsequently submitted to Congress which, by act of February 13, 1929, authorized construction of one 13,800-ton carrier. The Navy attempted in the following years to obtain authorization for construction of the visualized sister ships, but without success. Indeed, before another carrier was to be authorized, the Navy had become more interested in larger ships of about 20,000 tons.

In addition to the legal reasons which led the Navy to seek a 13,800-ton carrier, there was a body of thinking on the part of some Naval Avia-



OPERATING WITH THE FLEET, *USS Ranger* had 14,500-ton displacement. Unusual features were bow arresting gear, small island, stacks at stern. On deck are parked Vought scout bombers, Grumman fighters, Martin dive bombers in 1937 view. Capt. A.L. Bristol was first C.O.

tors which recognized the utility of small carriers. This was evident as early as 1925 when the General Board briefly considered but rejected the conversion of 10,000-ton cruisers to light carriers.

Two years later, LCdr. Bruce G. Leighton, then aide to the Secretary of the Navy, prepared a study on possible uses of small carriers. In addition to protection of the battle line, he suggested their suitability for anti-submarine warfare, reconnaissance, and reduction of enemy shore bases.

At about the same time, RAdm. William A. Moffett argued that British and Japanese experience with small carriers had made it clear that such ships could keep more aircraft in operation than could an equal tonnage devoted to larger ships.

Fleet commanders, who might be expected to have had a more conservative view of the military utility of aircraft than did Moffett and Leighton, expounded concepts that provided further justification for smaller carriers.

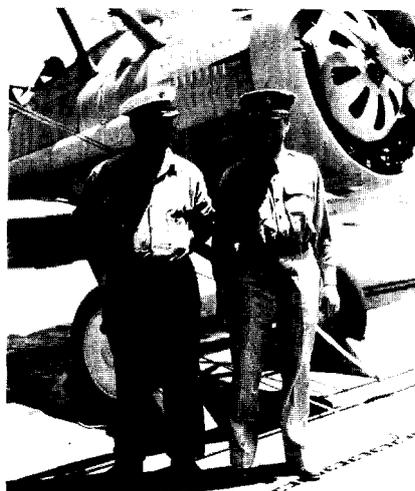
For example, the Commander in Chief, U.S. Fleet, noted in his 1927 annual report that the Fleet was seriously handicapped by the absence of a carrier with the battle line upon which spotting planes could land. Thus, both the aviation protagonists and the surface commanders recognized the need for carriers which would perform important roles, even if they were not of a size approaching that of the giants, *USS Lexington* and *USS Saratoga*.

Such considerations were in the genesis of CV-4. When it came to reducing them to detailed plans for

construction of a new ship, very little had been done. Studies made in 1923 and 1924 had been concerned with island-type vessels, such as the *Lexington* and *Saratoga*, and were not directly applicable to a new design—which was to be of the flush-deck variety. In addition, the basic concept for CV-4 was embodied in the General Board recommendations of 1927 and predated the commissioning of *Lex* and *Sara*. Hence, the concept could not incorporate any lessons learned



TWO-SEATER Vought O3U-3 Corsairs, such as the one above, operated from *USS Ranger*.



FIRST LANDING on CV-4 was made June '34 by LCdr. A.C. Davis; H.E. Wallace, ACMM.

during their early fleet operations.

This concept, as outlined by the General Board, included a speed of 29.4 knots, a clear flying deck, 12 five-inch anti-aircraft guns and as many machine guns as possible. On July 26, 1928, BUAEER elaborated on this proposed design in a letter to Commander Aircraft Squadrons, Battle Fleet. The flight deck was to be about 86 feet by 750 feet and fitted with arresting gear. The navigating and signal bridge were to be under the flight deck, well forward, with extensions beyond the ship's side, port and starboard.

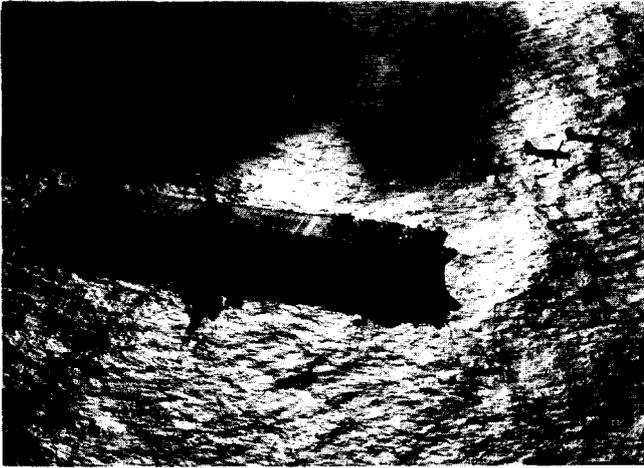
As for the anti-aircraft battery, it had been reduced to eight 5-inch 25-caliber guns located two on each quarter. Anti-aircraft battery directors were to be provided, but BUAEER thought that range finders should be omitted.

Secondary conning stations were to be located on the starboard side of the upper deck and combined with the aviation control station. A plotting station consisting of flag plot and aviation intelligence office was also to be provided.

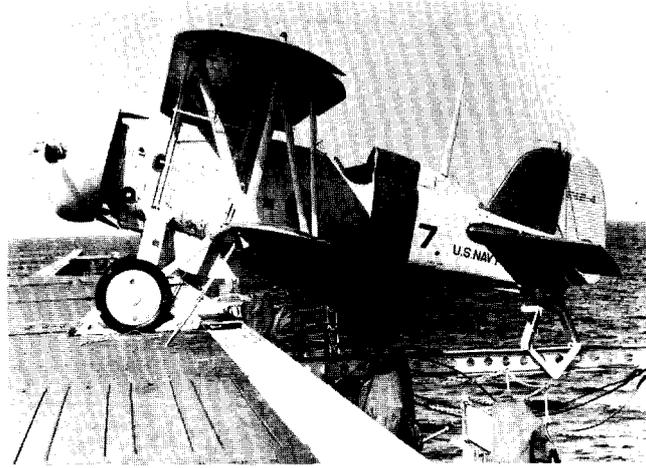
Despite the fact that the general concept could not benefit from experiences of the *Lexington* and *Saratoga*, the two ships did comment on plans for the *Ranger* on the basis of such experience as they had obtained during the first year's operation.

For example, they felt that both elevators and shop provisions should receive special consideration above and beyond that which had already been given.

"Experience during the present con-



CURTISS HELLDIVERS fly over the USS Ranger during WW II. Spotted on the deck forward are Vought Corsairs and Grumman Hellcats.



OUTRIGGER PARKING, here on the USS Ranger's starboard side, supported a Boeing F4B-4 in August 1934. This system saved deck space.

centration on both carriers has emphasized the importance of the after elevator in addition to the two now contemplated (for CV-4)," wrote *Saratoga's* commanding officer.

"There is required a great deal of re-spotting of planes in flight operations, and an after elevator will considerably expedite this process. After planes have landed on deck, it is sometimes necessary to send below a plane from the after part of the flight deck, which is now difficult with the flight deck filled with planes and the elevators forward."

OFFICERS ABOARD both *Lex* and *Sara* held informal conferences, the results of which were passed to BUAER. Speed was most desirable in aircraft carriers, but speed also had its drawbacks, as these officers were quick to point out to their superiors.

"The location of the A&R and general work shops aft is decidedly undesirable," BUAER informed the Bureau of Construction and Repair, "and it is strongly recommended that they be relocated further forward, if there is any possible way of doing so. Experience on CV-2 and CV-3 has shown that it is impossible to do any work requiring precision or accuracy, such as cutting a thread, when the ship is steaming at about 22 knots or more."

Early in the planning stage, BUAER encountered head-on the problem of lighting and night landings. A memorandum written for BUAER files pointed out: "The primary difficulty involved in night operations for airplane carriers is the provision of ade-

quate illumination to enable the pilots to make safe landings and at the same time to enable the ship to maintain darkened ship conditions that will prevent disclosure of the carrier's provision to surface craft and enemy aircraft. . . . The technical difficulties in this project are so great that complete success can scarcely be hoped for for several years and then not without the expenditure of much more time and effort than appears desirable at present.

"Night flying experiments were conducted on the *Langley* to determine the type of illuminating equipment for the *Saratoga* and *Lexington*. Although the number of landings made were not very great, enough information was obtained to determine upon equipment that would at least provide for a point of departure for future experiments in an effort to further solve the basic problem. No carrier night flying has been conducted since 1925." The memorandum was dated June 14, 1929.

This sparked an intensive series of experiments which caused the introduction of several lighting systems aboard various carriers. At best, most of these provided safe illumination for night landing but were less successful in maintaining darkened ship. Incandescent lights of low wattage were tested in various arrangements and intensities. Neon tubes were tried, some colored green, red, blue or amber. Of these, plain white was considered the best—but was not a solution. Even luminous paint was investigated. The problem of night deck illumination

was to plague Navy for years to come.

How the problem was handled in USS *Ranger* is indicated by a November 1934 report her commanding officer made to BUAER:

"In anything but bright moonlight when the ship's outline can be made out at a reasonable approach distance, it is very difficult, definitely too difficult, to get in the groove when only landing deck lights are used. Although Ranger's landing deck lights extend the length of the ship and are well lined up on each side, which it was hoped would improve the difficulty described by Saratoga and Lexington pilots, the pilot is frequently too near the ship before he can find out which way to swerve. If he happens to hit the groove early, he is well fixed. If he doesn't, he sees a jumble of landing deck lights and can only guess whether to change course to right or to left.

"With ramp lights turned on in addition to the landing deck lights, there is unanimous agreement that getting in the groove is very easy. Exactly why this is true is not clear, but the string of lights across the ramp appears not only definitely to locate the end of the deck, but also to give the pilot sufficient basis for setting his course normal to the lights and up to the centerline of the deck.

"Athwartship landing deck lights at bow and stern are no use and would be hazardous if opened when planes are landing. (Confusion in getting in the groove existed whether or not these lights were opened, worse when opened.)"

Other problems were of concern to BUAER during the design stage of CV-4. Relatively minor, but illustrative of the care devoted to carrier de-

sign, was the question of paint color for interior surfaces. A flurry of correspondence between BUAER and BUC&R concerned the color of paint to use on the deck, overhead, and bulkheads of the hangar.

This was not so much a problem of habitability as it was one of weight limitation and maximum reflective power. White paint, light gray and aluminum were considered. Misinformation supplied the Bureau of Engineering caused it to advocate light gray, but BUAER objected. Tests were conducted and aluminum proved lighter and more reflective of the three paints considered.

Finally, in early December 1929, plans for CV-4 received approval. Copies were sent to the Fleet, noting that major changes could not be made in them, but that the Bureau would "be glad to have comment or suggestion with regard to minor points, should such comment appear desirable."

By February 1930, active work on the design of the 13,800-ton carrier had stopped. Shortly after British Prime Minister Mr. MacDonald visited the United States, the President gave instructions to suspend all work on this ship, pending the outcome of the then projected London conference on naval armament. Months went by, the President was consulted again, and again the Navy was told to do nothing about the ship until the treaty had been ratified.

The treaty was signed in London on April 22, 1930. Ratification of the treaty was advised by the Senate on July 21, 1930, and by the President on the following day.

In the meantime, the Navy Depart-

ment, Office of the Judge Advocate General, drafted an advertisement which was published when the ratification restriction was lifted. The advertisement invited bids for the construction of CV-4. The bids were opened September 3—and proved to be "bombs."

All bids submitted far exceeded the appropriation given the Navy for construction of the ship, the lowest bid (by Newport News Shipbuilding and Dry Dock Co.) exceeding the limit by an estimated \$2,160,000.

The four Navy Department bureaus involved in the construction plans—BUC&R, BUAER, BUORD, BUENG—forwarded a joint memorandum to the Secretary of the Navy requesting a 60-day extension of the period before execution of the contract in order to consider necessary changes in characteristics which would permit construction of the carrier within the cost of the lowest bid.

Permission was obtained and the various departments reviewed their requirements. Panels of officer-experts in each were formed to submit recommendations. Out went consideration of an extra elevator. Out went the possibility—at this time—of moving the shops forward, as *Sara* and *Lex* had suggested. Submitting its list of recommended savings, BUAER listed the elimination of catapults, smokestacks on one side, sliding doors for the hangars, securing tracks, and airplane booms and nets, and requested that necessary eliminations be made in that order.

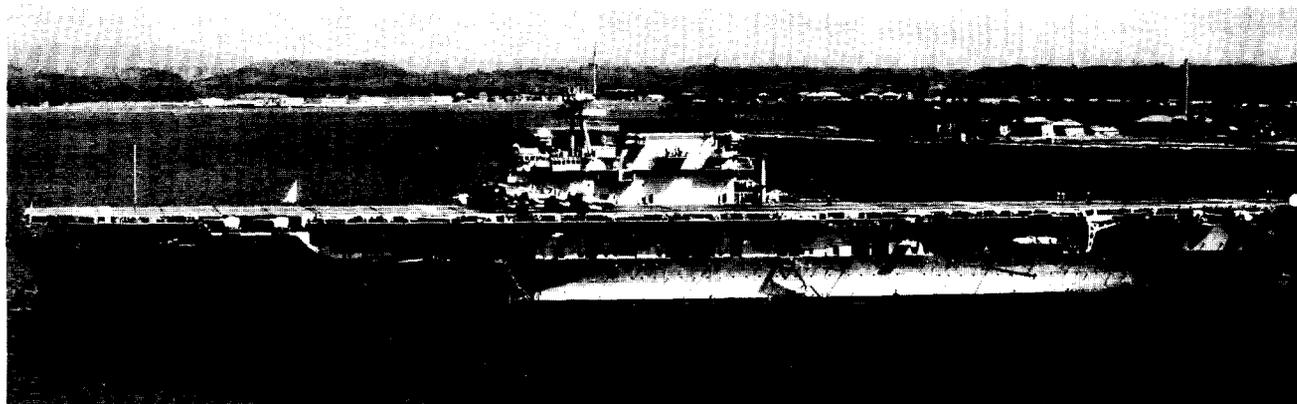
"This bureau feels," wrote Cdr. R. K. Turner for BUAER, "that elimination or reduction in the balance of items considered, namely, arresting

gear, elevators, or gasoline capacity would seriously affect the characteristics of the ship as an aircraft carrier, and, therefore, urgently recommends against any sacrifice in these items."

By October 2, the Bureaus had signed another joint letter, addressed to the General Board, listing their recommendations on how to cope with the problem of the elimination of design features. Among other things, *Ranger's* fire control was to be simplified, ammunition storage space was to be reduced, bombing planes were to be substituted for torpedo planes (this eliminated the purchase of torpedoes), deck catapults were to go by the boards, as were plane booms and nets. Twenty percent of the flight deck securing tracks were to be eliminated, as well as housing palisades, and the voice tube system. Finally, the arresting gear system was to be reduced. On November 1, 1930, the contract was signed by Newport News.

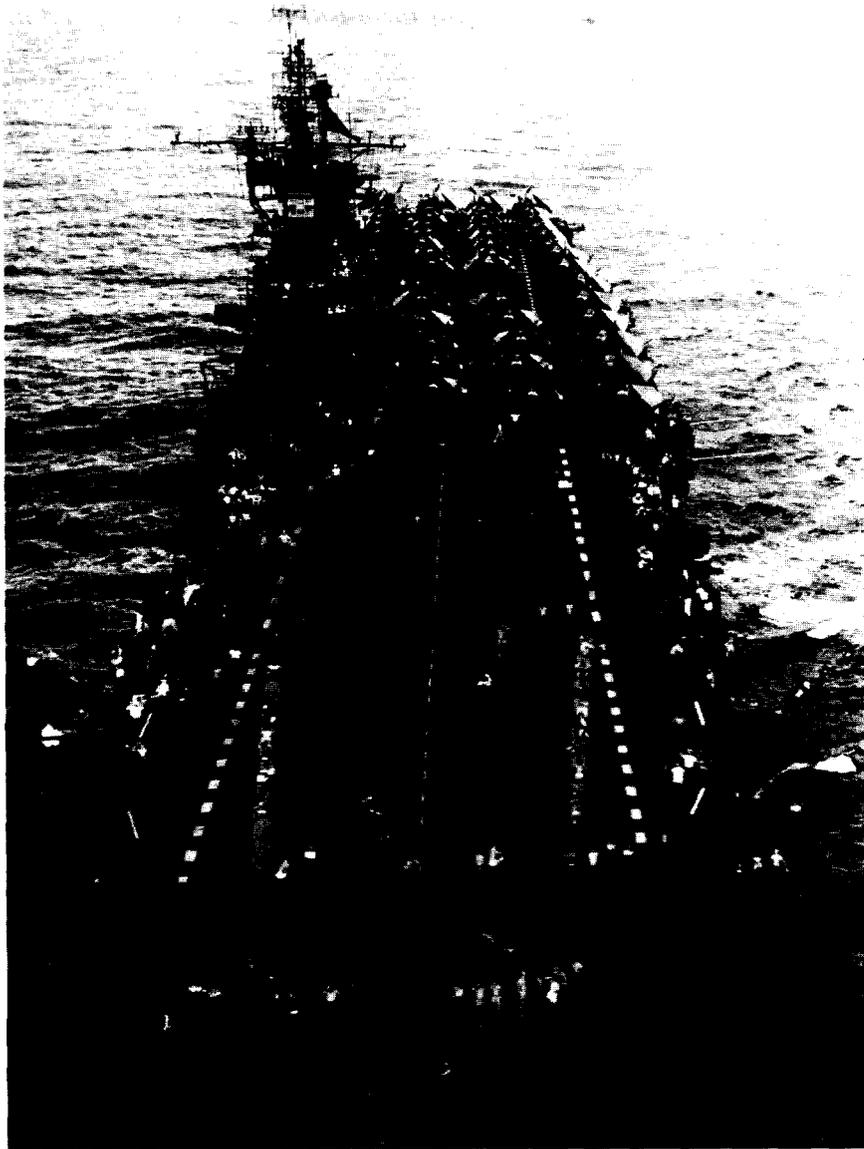
Throughout official correspondence, the 13,800-ton carrier was referred to simply as CV-4. On December 10, 1930, the Bureau of Navigation informed a long list of addressees that "The Secretary of the Navy has assigned the name *Ranger* to Aircraft Carrier No. 4, authorized by Act of Congress dated February 13, 1929. The assignment of the name *Ranger* is in accordance with the Department's policy of giving names formerly assigned to those battle cruisers scrapped by terms of the Washington Treaty."

On September 26, 1931, *Ranger's* keel was laid. Seventeen months later, the ship was launched, and on June 4, 1934, she was commissioned. Though planned originally as a 13,800-



USS YORKTOWN (CV-5) was launched in April 1936 and commissioned in September 1937. The 19,800-ton aircraft carrier operated in

both the Atlantic and Pacific before WW II, participating in Fleet problems and training activities. First C.O. was Capt. E.D. McWhorter.



USS ENTERPRISE (CV-6) was commissioned in May 1938, a sister ship to the *Yorktown*. "The Big E" was to become a popular ship. Capt. N.H. White, Jr., was her first commander.

ton aircraft carrier, she exceeded this tonnage by 700 tons. Original plans also called for a severe flush deck, but, upon commissioning, she had a small island.

USS *Ranger* had eight 5-inch 25-caliber AA guns, other AA guns in gallery. She could operate 75 aircraft and had a complement of 1788, of whom 162 were commissioned officers. Her aircraft consisted of four squadrons of bombers and fighters and a few amphibians. CV-4 also was equipped with a box arresting gear—a feature included in other fast carriers until early 1943.

The General Board had become con-

vinced—even before the *Ranger* was launched—that the minimum effective size of aircraft carriers was 20,000 tons. A request for two of these heavier ships was made in the Building Program for 1934, which was issued in September 1932. In May the following year, the Board again submitted this recommendation. As a result, the Secretary of the Navy asked the President for Public Works Administration funds to build two carriers of this tonnage, in addition to other ships. USS *Yorktown* (CV-5) and USS *Enterprise* (CV-6) were authorized.

Files of the Bureau of Aeronautics

housed in the National Archives reveal a memorandum dated May 15, 1931, which was to affect the two new carriers:

"The Department has approved a new building program with two aircraft carriers similar to the Ranger, but before embarking on this new construction, it is suggested that a careful examination may show many design changes are desirable.

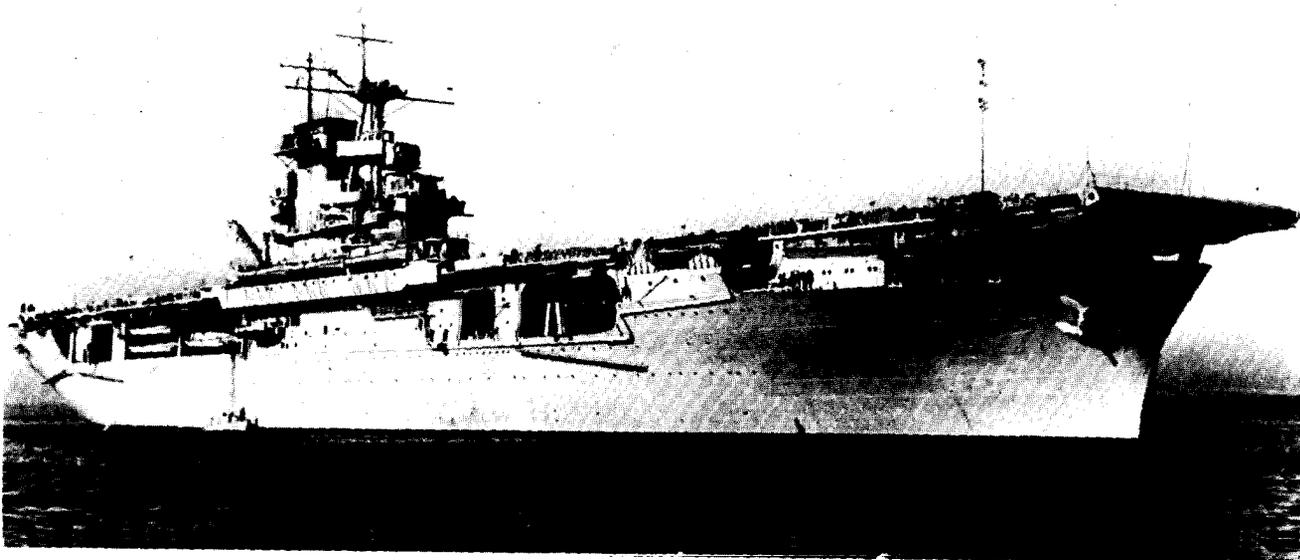
"The particular improvements in the Ranger design that should be considered are: speed increase to 32.5 knots; addition of underwater subdivision to resist torpedo and bomb explosions; horizontal protective deck over machinery magazines, and aircraft fuel tanks; improvement in operational facility (this includes hangar deck devoted exclusively to plane stowage, four fast elevators, complete bomb handling facilities, possible use of two flying-off decks, and improved machine gun anti-aircraft defense)."

The *Yorktown* was launched April 4, 1936, sponsored by Mrs. Franklin D. Roosevelt. When the carrier was commissioned September 30, 1937, her over-all length was 827 feet, four inches; extreme beam was 95 feet, four inches; and standard displacement, 19,800 tons. Her trial speed was 33.6 knots.

USS *Enterprise* (CV-6) was the seventh Navy ship to bear this name. Her keel was laid July 16, 1934 and she was launched October 3, 1936, sponsored by Mrs. Claude A. Swanson, wife of the Secretary of the Navy. She was placed in commission at Norfolk on May 12, 1938. Her specifications were similar to *Yorktown's*. She had accommodations for 82 ship's company officers and 1447 enlisted men.

As soon as CV-5 and CV-6 were authorized, the General Board did not request additional carriers of such tonnage. It did, however, vainly plead for a 15,200-ton replacement for the obsolete *Langley*. The *Langley* had been classed as an experimental ship and did not figure in the U.S. Navy's aircraft carrier tonnage limitations. To replace her with another carrier would have been to violate the treaty. The Navy did plan, however, to request new aircraft carriers when the *Lexington* and *Saratoga* reached retirement age.

Tightening of world tensions in 1938 caused the Navy Department to reconsider its carrier-building program,



USS WASP (CV-7) was launched in April 1939 and commissioned in April the following year. She displaced 14,700 tons, this weight restricted by the tonnage remaining from the limitation of the 1922 naval armament treaty. First skipper was Capt. J.W. Reeves, Jr.

and USS *Hornet* (CV-8) was authorized on May 17 that year. She was launched December 14, 1940 and commissioned October 21, 1941, with Capt. Marc A. Mitscher, her first commanding officer.

USS *Wasp* (CV-7) had been ordered earlier, on March 27, 1934. Her keel was laid April 1, 1936, she was launched April 4, 1939, and commissioned April 25, 1940. This carrier had to be built within what was left of the 135,000-ton limit set by the treaty. She was commissioned at 14,700 tons. Thus there were left only a few hundred tons remaining of the treaty-authorized carrier strength.

Already in the mill, during construction of *Yorktown* and *Enterprise*, were plans for a new class of aircraft carrier, the first of which would be known as USS *Essex* (CV-9).

War clouds were gathering over Europe and the Pacific. Fleet exercises and war games were stepped up as international tensions mounted. The treaties of 1922 and 1930 terminated December 31, 1936 when Japan abrogated.

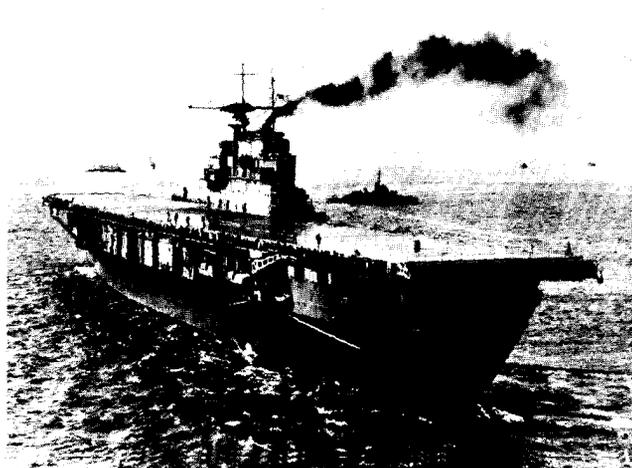
In its provisions for Naval Aviation, the Naval Expansion Act of May 17, 1938 authorized an increase in total tonnage of under-age naval vessels amounting to 40,000 tons for aircraft

carriers, and also Authorized the President to increase the number of naval aircraft to "not less than" 3000. Carriers built as a result of this authorization were the *Hornet* and *Essex*.

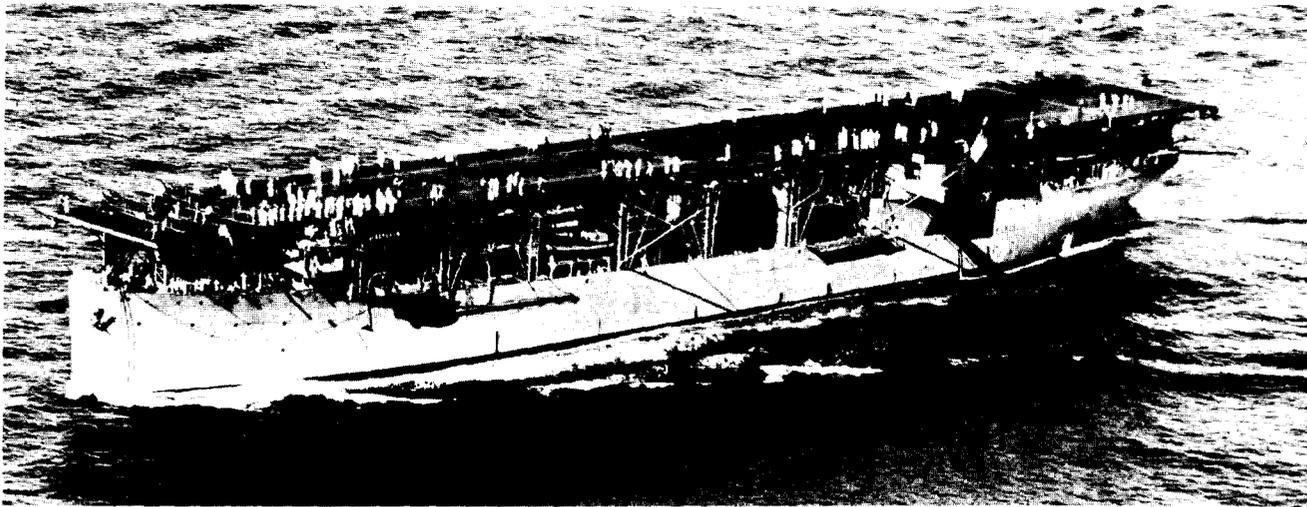
On September 8, 1939, President Roosevelt proclaimed the existence of a limited national emergency and directed measures for strengthening national defenses within the limits of peacetime authorization. In May 1941, an unlimited national emergency was declared. Seven months later Japanese aircraft, launched from carriers, attacked Pearl Harbor, and within 24 hours, the President went before Congress and the nation was at war.



USS HORNET (CV-8) was authorized in 1938 when world tensions mounted, launched in December 1940, commissioned in October 1941.



SISTER SHIP to *Yorktown* and *Enterprise*, *Hornet* had a standard displacement of 19,800 tons. First C.O. was Capt. Marc A. Mitscher.



AS SHE APPEARED in March 1925 when the first aircraft carrier appeared in the annual war games, USS Langley (CV-1) provided actual carrier capability that the first four games lacked. Fleet Problem V was conducted off California. It provided "valuable experience."

Evolution of Aircraft Carriers

FLATTOPS IN THE WAR GAMES

By Scot MacDonald

'If the mind's eye is always directed upon the series of engagements, so far as it can be perceived beforehand, then it is fixed upon the direct road to its goal, and thereby the movement of our strength acquires that rapidity, that is to say, our volition and action acquire that energy which the occasion demands and which is not disturbed by extraneous influences.'

—Karl von Clausewitz, *On War*

ONE OF THOSE whose untiring efforts helped shape the evolution of the "all big gun battleship," Adm. William S. Sims, did not immediately endorse Naval Aviation—especially ships carrying naval aircraft—upon its introduction as a weapon in the country's arsenal. In 1909, for instance, he wrote: "According to the papers, one of the Wright brothers has stated that it would be impracticable to hit anything by dropping a projectile from his flying [machine]. That Wright man is right, all right."

Sims had a deep appreciation and understanding of the merits of the battleship as a weapon system whose evolution he had fought to promote and he was not about to write it off, except on the basis of sound evidence. During WW I and the years immediately preceding it, aircraft design improved spectacularly. By the end of the war the U.S. Navy still did not have an aircraft carrier. His observation of the limited use of such ships permitted him to state with justification, "All the aeroplane-carrying ships

in the world could not make an attack upon a foreign country unless they were supported by a battleship force that was superior to that of the enemy."

Not until the end of the war, when Adm. Sims assumed leadership of the Naval War College at Newport, did his thinking undergo a profound change. At the game board there in 1921, he recognized not only the advantages and potentials of airpower but also the brevity of the future of battleships. "If I had my way," he said, "I would arrest the building of great battleships and put money into the development of the new devices and not wait to see what other countries are doing."

By March 1922, after witnessing bombing tests off the Virginia Capes (in 1921), he had written, "The battleship is dead."

During Sims' tenure at the War College, the Navy Department inaugurated a series of war games, fleet exercises, that were conducted during the next two decades. Through these prob-

lems, the Navy obtained practical experience in testing the "new devices" under simulated combat conditions.

Naval Aviation had entered fleet maneuvers as early as the winter of 1912-13 when the entire aviation element—pilots, student pilots, enlisted men and aircraft inventory (which then totalled five planes)—was transported to Guantanamo Bay to take part in planned exercises. From their camp at Fisherman's Point where the present air station is located, they worked to achieve three goals: first, to prove the utility of the airplane as a scout under simulated war conditions; second, to test its usefulness in detecting mines and submerged submarines; and third, to stimulate interest in aviation among officers in the Fleet.

Naval Aviation next joined the Fleet in 1914, in connection with actual hostilities in Mexico. At that time, an A-3 and a C-3, put aboard the *Mississippi*, saw action at Vera Cruz. Daily reconnaissance flights kept landing forces informed of the enemy dispositions inshore. (Three planes placed

aboard the *Birmingham* were taken to Tampico but did not see action.)

As a result of the experience at Vera Cruz, Naval Aviators judged the hydroaeroplane more efficient than the flying boat type then in use. Recommendations were also made on the design of aircraft.

The Navy's air arm was still very small when the United States entered WW I. In the next year, seven months and four days, while war raged, its growth was extraordinary. By the time the Armistice was signed, the Navy had 2107 planes, 570 of which were overseas, 15 dirigibles, 205 kite balloons, and 10 free balloons.

Thirteen bases were established in the U.S. and the Canal Zone, only one of which, at Galveston, was not yet in operation. In Ireland, the Navy had four seaplane stations, one kite balloon station, a receiving station and a supply station. Two stations, including a major assembly and repair base, were established at Eastleigh, England. Two more stations and a training school were built in Italy. There were 18 stations in France, including an assembly and repair base at Pauillac and a school at Moutchic. Additionally, the Navy had a base operating in the Azores, one in Canada, and a rest station in the British West Indies. There were less than 300 officers and men in Naval Aviation when the war started in April 1917. At war's end, in November 1918, there were 39,871, of whom 19,455 were abroad.

Naval air operations in this war were predominantly in support of allied shipping, launching aircraft from land bases for anti-submarine patrols. It was not until the years immediately following the war that the U.S. Navy returned to the theory of integrating aviation with the Fleet. Although aviation had proven itself, there was still resistance within the Fleet toward the imminent merger. A CNO newsletter of July 30, 1919 carried a report on Fleet Air Operations:

"Early in January 1919, it was decided to send a Detachment of six H-16 flying boats to Guantanamo Bay, Cuba, to operate with the U.S. Fleet for the purpose of proving to it the use of aircraft in actual naval operations and of demonstrating the practicability of maintaining an Air Detachment with the Fleet. It was accordingly decided to operate these flying boats from moorings and to quarter the aviation

personnel on a ship carrying necessary repair personnel, necessary spare material, etc., for the upkeep of the squadron.

"In addition to the six flying boats there was also an airplane division consisting of two Sopwith Camels and [a Sopwith] 1½ Strutter on board the USS Texas under the command of LCdr. E. O. McConnell, USN." The Air Detachment also had a Kite Balloon Division.

At conclusion of the exercise, the newsletter continues, "Not once when the Air Detachment was called upon to send machines for operations with the Fleet has it failed to send them, and not once when machines have been sent on a certain mission has he Air Detachment failed to accomplish that mission. This has required flying in all sorts and conditions of weather, high winds, rain, fog, and low visibility. It has required duty in spotting, bombing, scouting, passenger carrying, mail carrying, and all types of work which aircraft with the Navy can be called upon to do."

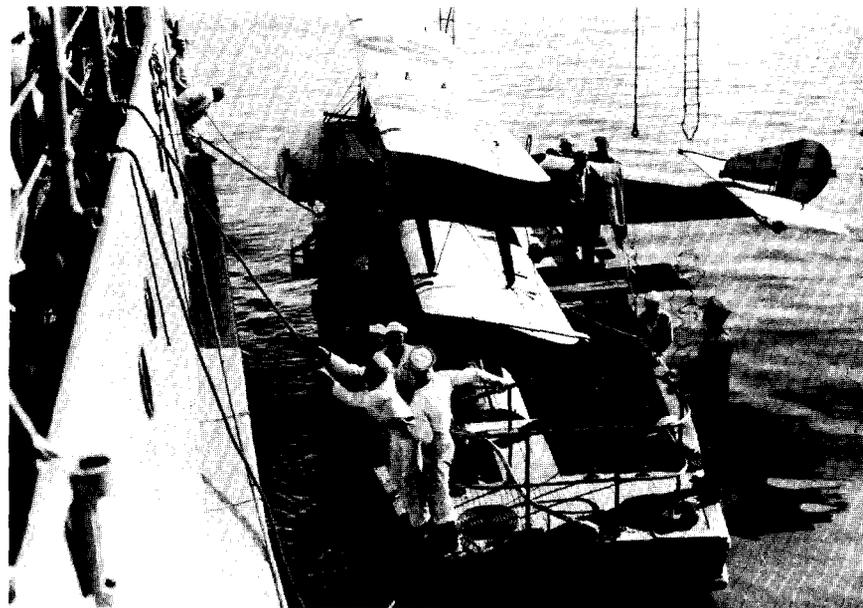
The report ends with an optimistic, though probably inaccurate, note: "The result has been that the officers of the seagoing Navy have been converted to the belief that aircraft are practicable and essential to a well rounded Fleet."

Numerous training periods and exercises were conducted subsequently, in which aviation participated with the Fleet, but it was with the annual Fleet Problem of the Twenties and Thirties that these maneuvers were conducted on the largest scale.

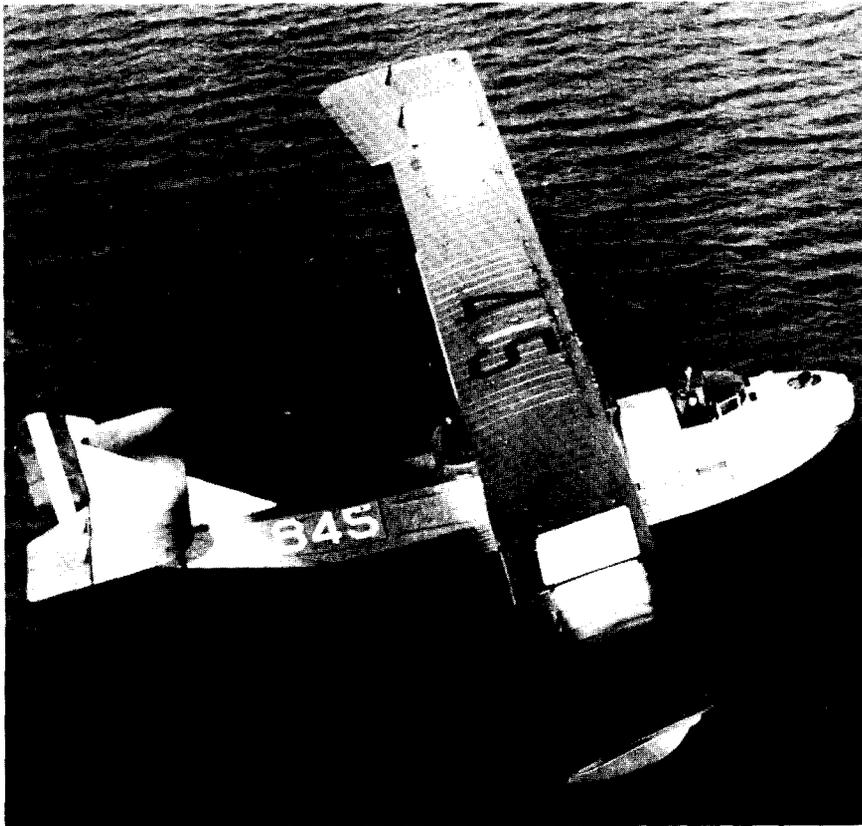
"Taking an ever increasing role in these problems," says historian LCdr. James M. Grimes, USNR, in a monograph on the subject, "Naval Aviation gradually developed and came of age. The Fleet Problem, therefore, serves as the measuring rod for this growth to maturity. It provides an annual check on what Naval Aviation was accomplishing and the reports and recommendations which grew out of each problem show how important the problems and their results were in development of aviation in the Navy."

A study of these problems can be made successfully by breaking them down into five groups, studying each to determine tactics employed and lessons learned. Basically, these groups are: (1) the days of the "constructive" carriers, when other ship types were designated aircraft carriers because of unavailability of the real thing; (2) the period when the USS *Langley*, a converted collier, joined the games as the only aircraft carrier in the U.S. Fleet; (3) the profound effects on tactical thought precipitated by entry of the USS *Saratoga* and USS *Lexington* into the games; (4) addition of the USS *Ranger*; and (5) the years immediately prior to WW II when the U.S. Navy operated five aircraft carriers.

The first of the Fleet Problems occurred in 1923, in the Panama-Pacific area. It was a resounding success for



SOPWITH 1½ STRUTTERS, equipped with hydrovanes in the event of a forced landing in the water, were used by the air detachments in exercises with the Fleet immediately after World War I



FLYING BOATS, such as this World War I Curtiss H-16, made up the principal portion of the aviation units operating with the Fleet in the early post World War II naval exercises.

the *Black Fleet*, given the mission of attacking the defenses of the Panama Canal, and a shattering failure for the

Blue, assigned the defense of the Canal. *Blue's* air forces consisted of the tenders *Wright*, *Sandpiper* and *Teal*,

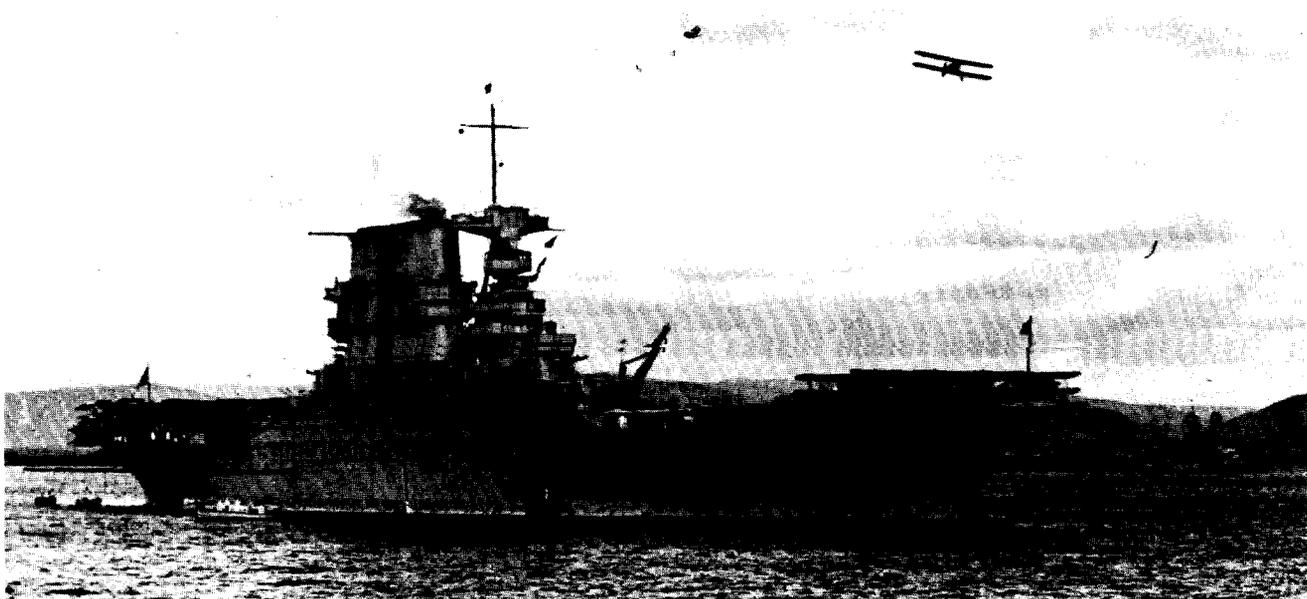
and the 18 patrol planes of Scouting Plane Squadron One (half the planes were based at Ballena Bay with the *Sandpiper* and *Teal*, the remaining at Bahia Honda with the *Wright*), the patrol planes based at Coco Solo, and all the available Army planes.

The *Back Fleet* was assigned the battleships *New York* and *Oklahoma* as "constructive" carriers.

Approaching the Canal, one of the battleship "carriers," the *Oklahoma*, launched a seaplane by catapult to scout ahead of the force. Early the next morning, a single plane representing an air group took off from Naranyas Cays, approached the Canal from seaward, flew over Gatun Spillway, and dropped ten miniature bombs. This plane completed its mission undetected and theoretically destroyed the Spillway.

An official report submitted after the problem pointed up the susceptibility of vital parts of the Canal to destruction by air. The report urged, among other things, that air defenses of the Canal be strengthened and that rapid completion of aircraft carriers be effected for offensive and scouting purposes.

Naval Aviation played little part in the next three exercises. It was not until Fleet Problem V in March 1925 that USS *Langley* entered exercises off the California coast. The second phase



USS SARATOGA (CV-3) and her sister ship USS *Lexington* entered the war games in Fleet Problem IX in 1929. The extraordinary tactic employing *Saratoga* in this exercise revolutionized naval strategy and spurred requests for more aircraft carriers for fleet operations.

of the problems began; a new element was introduced.

Basically, the supposition for this problem was that strained relations existed between *Blue* (the U.S.) and *Black*, an imaginary country in the area of the Hawaiian Islands. When *Black* declared war, its Commander-in-Chief was ordered to Guadalupe Island where he was to occupy an unfortified anchorage from which he was to operate against *Blue* in the Eastern Pacific.

Black was given the *Langley* and the tenders *Aroostook* and *Gannet*, as well as planes based aboard battleships and cruisers. The *Blue* force was considerably smaller, having only 15 cruiser-based planes and two other aircraft based on the *Wyoming*. Planes aboard the *Wyoming* were useless, however, for the battleship was not equipped with a catapult. Grimes records:

"The Black War Diary shows that the greatest part of the air activity during Fleet Problem V was centered around the Langley. Scouting flights were conducted each day as the Black Fleet proceeded towards Guadalupe. The largest number of planes used at any one time was ten. The duration of these flights ranged from 30 minutes to two hours.

"On the last day before the arrival at Guadalupe, the Langley received a 'well done' for the feat of launching ten planes in 13 minutes! None of these flights resulted in contacts.

"On March 10, the Langley was ordered to have her planes ready for an 0530 take-off the next morning. These planes were to make an aerial reconnaissance flight over the anchorage before the Black Fleet entered. This operation never took place, the problem being terminated at 0508 March 11 by the Chief Observer."

Introduction of the *Langley* to Fleet operations was considered a valuable experience. As a result of this problem, the Commander-in-Chief, U.S. Fleet, recommended that the *Saratoga* and *Lexington* be completed as quickly as possible. He also urged that steps be taken to insure the development of planes of greater durability, dependability and radius, and that catapult and recovery gear aboard cruisers and battleships be further improved.

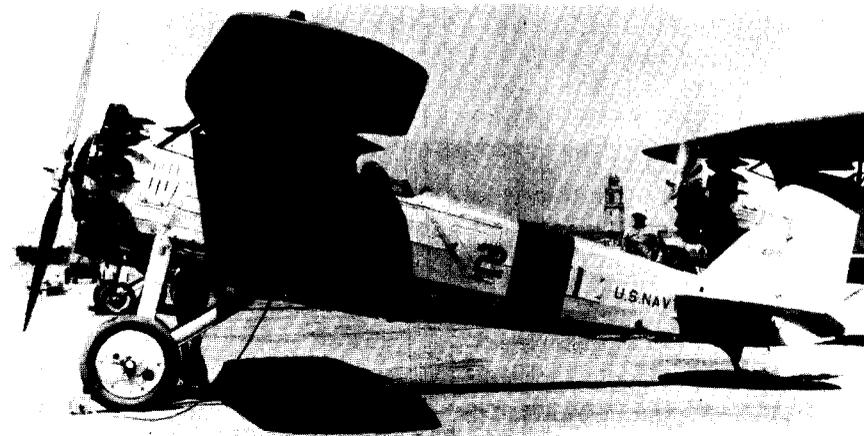
Details concerning Fleet Problem VI, conducted in 1926, are unavailable. Pertinent documents on orders, instructions and operation reports are lost. It is known, however, through

the Annual Report of the Secretary of the Navy, 1926, that a combined U.S. Fleet participated in a joint Army-Navy minor problem and conducted "strategical and tactical exercises in the vicinity of the Canal Zone until the middle of March 1926. Fleet Problem VI was conducted during this period."

Just before Fleet Problem VII got underway in 1927, a joint Army-Navy exercise was conducted, again testing defenses of the Panama Canal. USS *Langley* provided defense against attacks on ships by land-based Army planes and was also used for spotting submarines. This exercise marks the first time an aircraft carrier was used to protect ships of the line. Battleship-

enemy opposition. This Fleet was then to oppose the *Black* Naval Force from that base. *Black's* mission was to provide search and contact scouting, track submarines, and attack a large convoy accompanied by a strong escort. The *Langley* was assigned to the *Blue* force. Again, the converted collier-made-carrier was to provide protection for ships of the line.

On the last day of the game, *Black* conducted a surprise air attack—delivered by 25 land-based aircraft (Mole St. Nicholas)—against the *Blue* force. Shortly before this, *Langley* maintained a protective air patrol over the convoy, but discontinued it hours before the attack was pressed home. Caught unawares, *Langley's* planes were no help.



TYPICAL OF THE EARLY air-cooled engine carrier fighter, scout, and dive bomber types which flew from the *Lex* and *Sara* in Fleet Problem IX were the Boeing F2B-1's of Bomber Squadron 2.

based planes were used for spotting during bombardment of the Canal installations.

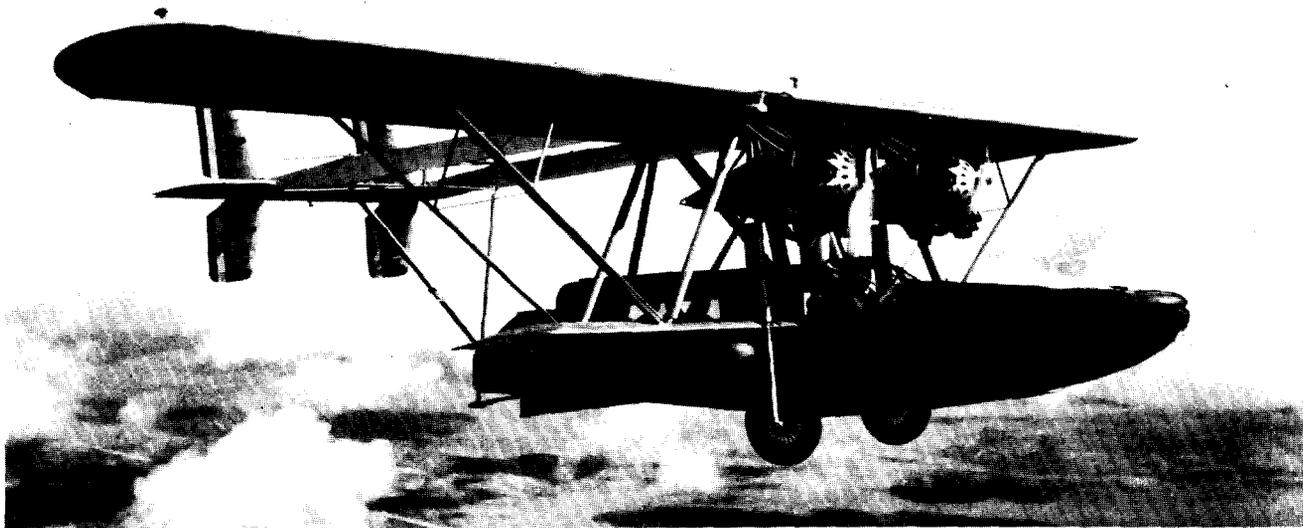
Canal defenses were again found weak, but again, "constructive" planes were used in the attacks. In each of the two attacks on Miraflores Locks, only one plane was launched; it represented the attacking forces. This was not considered an effective test. Grimes noted: "In later problems when carriers were available from which attacks in force could be launched and greater reality could be introduced into maneuvers, the vital necessity for air defense of the Canal was to become even more apparent."

The seventh Fleet Problem provided more experience in carrier operations. Conducted in the Caribbean in March, *Blue* Fleet was given the task of escorting a large, slow, overseas convoy and was then to establish a base under

Even though the problem had officially terminated by the time *Black's* aircraft reached *Blue's* ships, observers considered the attack successful, though the Commander-in-Chief scored the clumsy formation of the attacking planes.

One of the most revealing outcomes of this problem was the need to allow aircraft carriers greater latitude in maneuvering, as dictated by weather and the position of the enemy forces. Commander, Air Squadrons, also felt that he should have complete freedom of action in employing carrier-based aircraft in order to get maximum efficiency in air operations.

Fleet Problem VIII, conducted in the Hawaiian-Pacific area in April 1928, provided further experience in aircraft carrier operations and scouting patrols, *Langley*, *Aroostook* and *Gannet* again participated and again air



A SIKORSKY AMPHIBIAN, similar to this RS-3, based on the *Aroostook*, pilot "bombed" the Atlantic side of the Canal without opposition, represented all the Langley's squadrons in Fleet Problem IX. Its landed, and informed the "enemy" of what he had just accomplished.

operations were limited to scouting. Bad weather and heavy seas effectively limited air operations, but despite uncooperative weather, Commander-in-Chief, Battle Fleet, noted that a sufficient number of aircraft were launched from the *Langley* "to show that the use of planes from carriers for all contemplated operations is both practicable and feasible."

Of all the Fleet Problems conducted before 1940, the next, Fleet Problem IX, undoubtedly received the most publicity. Conducted in 1929, it saw the introduction of the world's largest aircraft carriers, the *Saratoga* and *Lexington*. The problems entered their third phase. "The experience gained and the conclusions drawn," says historian Grimes of this problem, "had a marked influence on the development of fleet tactics and strategy in general, and on Naval Aviation in particular."

The Panama Canal was again chosen for the critical area under hypothetical attack. Previous exercises indicated a major weakness in defense of the Canal, protection from air attack, but this problem was to test the conclusions reached in the past by providing actual aircraft carriers and full strengths of aircraft.

The problem assumed that a war had existed between *Blue* (the U.S.) and two enemy nations, *Black* (in the Pacific) and *Brown* (in the Atlantic). In airpower, *Blue* was assigned the *Lexington*, 145 naval aircraft, and the cooperation of the U.S. Army in the

Canal Zone and 37 planes based there. *Black* was given the *Saratoga* and the *Langley*. When it became evident that *Langley* would not complete overhaul in time for the games, the tender *Aroostook* was substituted, the single amphibian aboard representing *Langley's* 18 fighters and six scouts, though these aircraft were actually transferred to the *Sara*. The *Brown* force proved to be a paper power; neither ships, planes, nor personnel were assigned; other than in initial planning and estimates of the situation by *Blue* and *Black*, *Brown* ceased to be a factor in the game.

A detachment from the *Blue* force, including the *Lexington*, transited to the Pacific side before *Black* force could launch a surprise attack. On the same day, the remainder of the *Blue* force was to have left Hampton Roads for the Canal. It was *Black's* intent to destroy the Canal before this second detachment could complete the passage.

Blue's intelligence indicated that *Black* would attempt an attack on the Pacific side. Actually, *Black* planned a surprising two-pronged attack. The "squadron" aboard the *Aroostook* was to make a long-range flight, far beyond capability of return. Its attack was to be made on the Atlantic side, at the conclusion of which, the "planes" were to land and surrender. Simultaneously, *Saratoga*, accompanied by *Omaha*, was to attempt a daring tactic: take a wide, two-day swing to the south and then

launch carrier-based planes for the Pacific attack. This latter demonstration was to make a profound impression on naval tacticians.

On the morning of January 25, 1929, two days before the problem was to end, the main *Blue* force, including the *Lexington*, came upon *Black's* Striking force. *Black's* Battleship Division Five was steaming down wind while the carrier was steaming up, preparatory to launching her planes for an air attack. The battleships opened fire and, because of the close range, would surely have sunk the *Lexington* in actual battle. For this carrier, it was a disastrous ending to her first important activity in the problem.

Umpires ruled the carrier "damaged," however, for the loss of the carrier at this early stage of the game would have had a profound restriction on *Blue's* capability during the coming "interesting" part of the problem. *Lexington* was instead penalized in speed; she was permitted only 18 knots.

The carrier had already launched some planes. After the attack by the battleships, the carrier, running into rain and reduced visibility, was forced to recover these aircraft under very adverse conditions. Noted the Commander-in-Chief, U.S. Fleet: "Flight deck personnel and flying personnel alike are deserving of great credit for the manner in which squadrons came aboard on this occasion."

The *Saratoga*, in the meantime, was steaming south. She was detected by

an enemy destroyer upon which she opened her eight-inch guns. This had unfortunate results. The destroyer was "sunk," but in the process, one of *Sara's* planes, a T3M, was destroyed. Spotted in the hangar deck just aft of the forward elevator and 68 feet from the muzzle of the gun, the plane suffered 36 crushed ribs and some torn fabric, directly attributable to the blast from the heavy gun. The eight-inchers were destined to be removed from the *Saratoga*, but not before WW II.

Later that day, the carrier encountered another *Blue* ship, the *Detroit*, which continued to track her through the night, supplying the *Blue* commander with vital information. The *Lexington* was ordered to give chase, but because of her reduced speed could not close during the night. At 0525 the next day, the Chief Observer canceled this penalty.

The 26th was an active day for the *Saratoga*, and not an altogether lucky one. Near five that morning, while about 145 miles from Panama, she launched an initial attack of 70 planes against the Canal. Her aircraft in the air, the good times were over for the *Sara*. Because of navigational discrepancies, the carrier and the *Omaha* contacted *Blue's* Battleship Division Two instead of her own Battleship Division Five. The carrier was under heavy fire at short range from three of the enemy battleships and was scored a "sinking." Had she escaped this disaster, four torpedoes "fired" from an enemy submarine at 1200 yards would have hurt her heavily and possibly sunk her. At 0656, *Sara* launched two more

squadrons, at the completion of which, she had 83 aircraft in the air.

At 0600 the same day, the *Aroostook* stopped near Jicarón Island and 17 minutes later her single plane—a Sikorsky amphibian, theoretically representing *Langley's* squadrons—took off to bomb Gatun Locks, Gatun Spillway and Coco Solo. The commander of the *Blue* force, though, had committed a blunder by not advising either Coco Solo or the Army of the substitution. The Sikorsky went about its mission of bombing the Atlantic side of the Canal, encountering no opposition. When he completed the job, he landed at the Atlantic terminal of the Canal, surrendered to a stunned "enemy" and confessed his accomplishment.

Saratoga's problems were not yet over. Shortly after the Chief Observer lifted the speed limitation from the *Lexington*, *Lex* launched her aircraft against her sister ship. The *Sara*-based planes, returning from a successful raid on Miraflores and Pedro Miguel locks and the airfields at Fort Clayton and Albright, were in the process of landing when the *Lexington*-launched planes arrived on the scene. *Sara* "went down" for the third time.

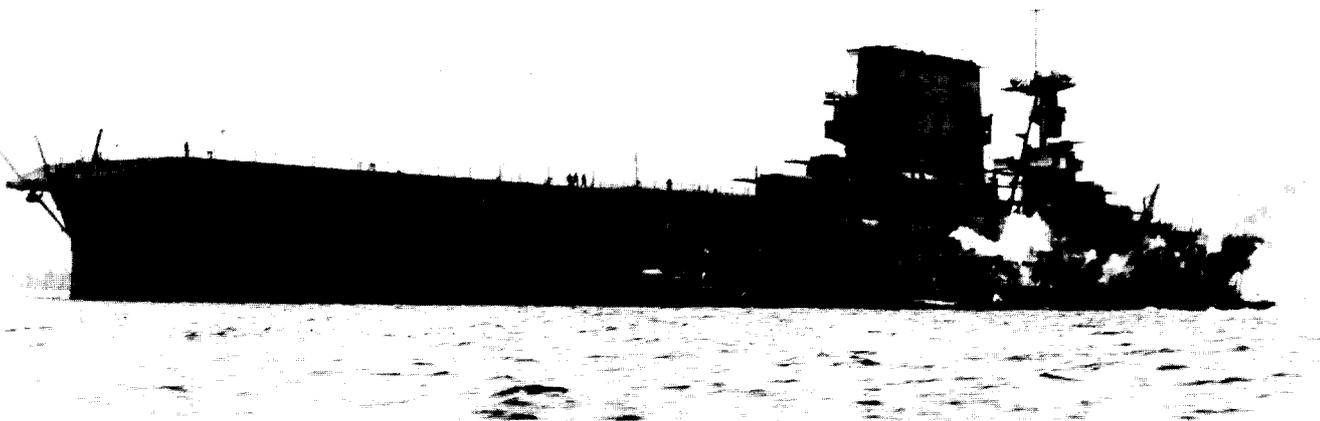
Men in the *Lexington* had little to cheer about, though, on the morning of January 27. Friendly planes of VT-9 took off from their moorings at Balboa and stood out to attack the *Black* carrier and bombarding forces. About 0700 they reached a carrier and started bombing. Later, they learned it was their own ship, the *Lexington*.

"This error was understandable," said Commander-in-Chief, U.S. Fleet,

"in view of the fact that *Saratoga* and *Lexington* were operating within 12 miles of each other at that time and it was not possible to distinguish markings, owing to the presence of a large number of men on turret tops. For purposes of identification, each turret top of the *Saratoga* bore two painted white stripes parallel to the axis of the guns. The turret tops of the *Lexington* were painted conventional war color." In later years, *Saratoga* was made more easily recognizable by the painting of a large stripe down the center of her stack.

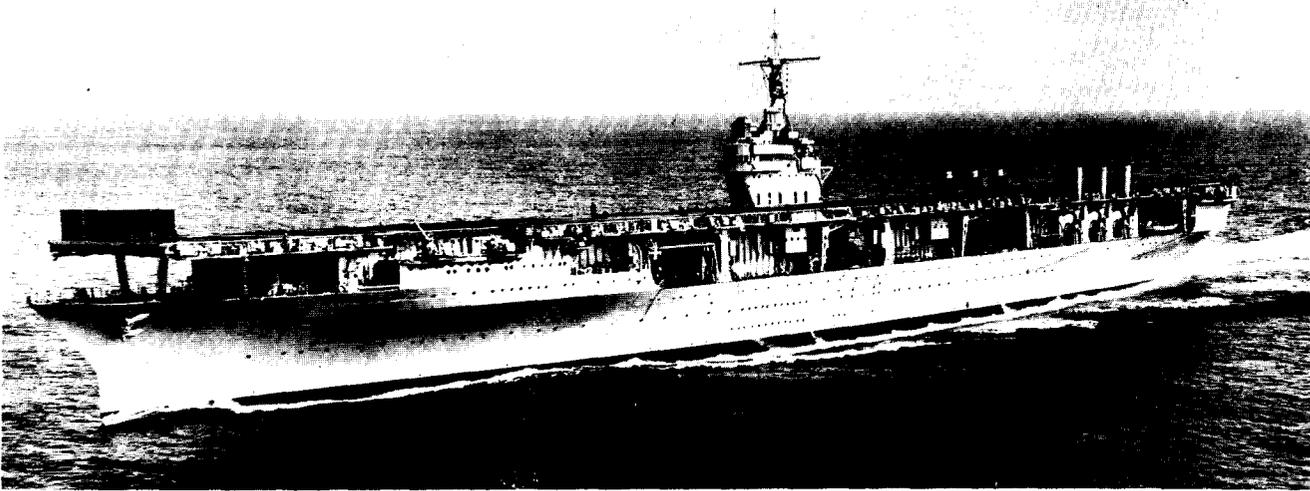
Fleet Problem IX marked an outstanding achievement in Naval Aviation. It marked the first appearance of modern large carriers with the Fleet in a fleet problem. But the most significant event of this problem, and possibly in any before WW II, was the employment of *Saratoga* as a separate striking force. Its effect on the future use of carriers was immediate. In the 1930 maneuvers, a tactical unit, built around the aircraft carrier, appeared in force organization for the first time.

For many historians of naval warfare, Fleet Problem IX marked the introduction of the fast carrier task force. Regardless of its genesis, this tactical weapon was tested and refined during the war games of the Thirties. Addition of the carriers *Ranger*, *Lexington*, and *Saratoga* was to provide more flexibility and realism in future games. A discussion of them, as well as the results of the fleet problems, will be presented in the following chapter describing in detail the evolution of aircraft carriers. * * *



USS LEXINGTON (CV-2) as she appeared in January 1928, a month after she was commissioned. Too late to participate in the war games of

that year, she entered the next enthusiastically. Pilots aboard learned much from the experiences of their colleagues in the *Langley*.



A FAMILIAR VIEW of USS Ranger (CV-4) shows forward palisade placed from wind, spray and water. She entered the Fleet Problems in 1935 aboard carriers with cross-deck tie-downs to protect planes and men and with comparatively light tonnage indicated role of small carriers.

Evolution of Aircraft Carriers

LAST OF THE FLEET PROBLEMS

'The culmination of the year's operations arrives when the carriers with their squadrons participate in the annual cruise of the Fleets. On these cruises, the year's efforts to perfect the detail of aircraft operations are given the test of simulated major campaigns against possible enemies. Our efforts in the past have been crowned with a certain amount of success, but every success has only indicated new possibilities of the employment of aircraft in fleet operations and has emphasized the vital importance of continuously operating with the Fleet the maximum number of aircraft that can be carried on our surface vessels.'—RAdm. J. M. Reeves, USN, Commander, Aircraft Squadrons, Battle Fleet, 1929

RADM. REEVES described the year-long training schedule of Naval Aviators as the Twenties came to an end:

"Concurrently with . . . gunnery exercises, the squadrons are embarked on the aircraft carriers and they participate in the monthly exercises with the Fleet. These fleet exercises are arranged to present new and increasingly difficult problems to all arms of the Fleet and to insure the effective coordination of these arms in major fleet operations and engagements.

"It is not sufficient for one officer, Commander, Aircraft Squadrons, to be proficient in effectively employing aircraft. This knowledge must be possessed by all flag officers. To this end, aircraft on the various carriers, and the carriers themselves, are assigned from time to time in fleet exercises to the various subdivisions of the Fleet. In part of a problem, the aircraft will cooperate with destroyers; in another pint, they operate offensively against

By Scot MacDonald

destroyers; in another part, they operate with and against submarines; they operate continually with battleships and these battleship planes must continue their activities during the attack of 'hostile' aircraft. This employment of aircraft on widely differing missions reacts not only to the vast improvement of the air arm, but also and equally important, it acquaints the officers of command rank with the possibilities and effective means of employing aircraft to further the main mission of the Fleet, the destruction of the enemy."

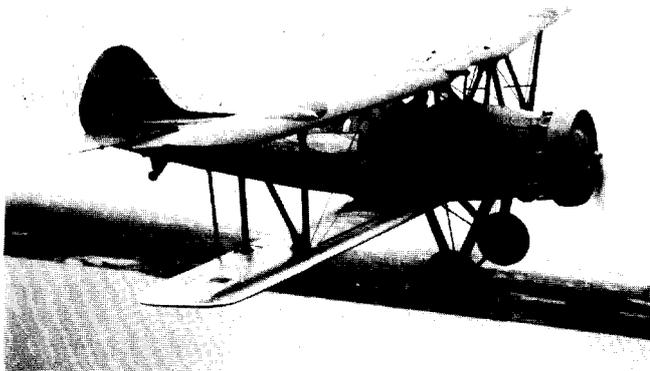
Fleet Problem Nine, conducted in 1929, created a profound impression on the tacticians of the day. In March and again in April of 1930 two more problems were presented the Fleet, both conducted in the Caribbean, and both concerned with the versatility of aircraft carriers as naval weapons. They were Fleet Problems X and XI.

Fleet Problem X investigated the maneuvers necessary to gain a tactical superiority over a force of approximately the same strength and in the use of light forces and aircraft in search operations. Carriers were here defined as a complete tactical unit, operating with cruisers and destroyers as a high-speed striking force.

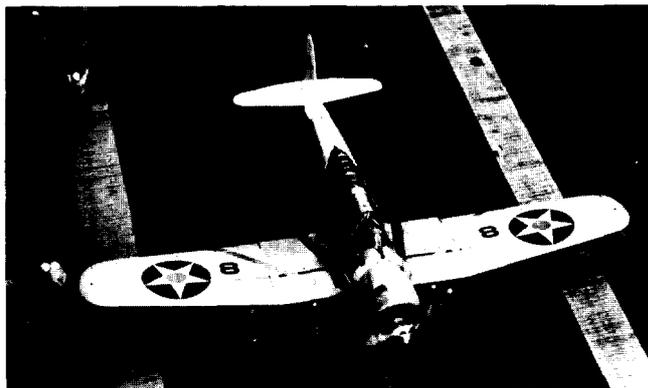
The *Blue* force, representing the U. S., was assigned both *Saratoga* and *Langley*, while the *Black* force, a coalition of enemy nations, operated the *Lexington*. Earliest control of the Caribbean was crucial to solving the problem.

At the outset, neither force knew exactly where his opponent was, though *Black*, through intelligence reports, had enough information available to assume the *Blue* ships would transit the Panama Canal to the Atlantic side. The ships already had.

Blue's commander considered the water too rough for the safe operation of seaplanes on the first day of the



VOUGHT CORSAIR attached to *Ranger's* utility unit was typical of Corsairs used for scouting observation duties during the later war games.



MONOPLANE TYPES, such as this Vought SB2U-1 of VB-3 on the *Saratoga*, were employed in the Fleet Problems conducted in the late Thirties.

problem and was reluctant to send his carrier-based planes, for he expected to contact the *Black* carrier force before dark. The *Black* ships were in a position just north of the island of Haiti. By dawn next morning, they had moved to the west side of the island.

On the second day of the problem, the *Blue* commander again called off air operations because of bad weather and rough seas. *Black*, on the other hand, conducted extensive scouting operations while advancing to the west. Haitian-based planes scouted from daylight to dark, while *Lexington*-based fighters and scouts launched every three hours for a 12-hour period.

Weather improved on the third day and the *Blue* commander ordered his carrier planes launched. Still neither side had any idea where the opponent was. This status continued through the fourth day, and it was not until the fifth that contact finally was made.

Saratoga was spotted by *Lexington* aircraft and as a result of the attack that followed, *Sara's* flight deck was damaged. Before her planes could be

respotted for launching off the usable end of her deck, *Sara* suffered another and finishing attack. *Lexington* next turned her attention to the *Langley* and in two flights of first 15 and then 12 planes successfully placed the converted collier's flight deck out of commission.

Next, USS *Litchfield*, one of *Saratoga's* plane guards, was dive-bombed and placed out of action. *Blue's* battleships then felt the effects of *Lexington's* planes with the result that the *West Virginia* suffered the destruction of two anti-aircraft guns, the *California* lost an observation plane on deck, injury or death to personnel, foretop material damaged, and a 15 per cent reduction in main battery fire; and the *New Mexico*, lost four AA guns as well as an observation plane still on one of the ship's turrets. Neither *Saratoga* nor *Langley* took part in the main action that followed the destruction of their flight decks.

At its conclusion, Fleet Problem X demonstrated the suddenness with which on engagement could be com-

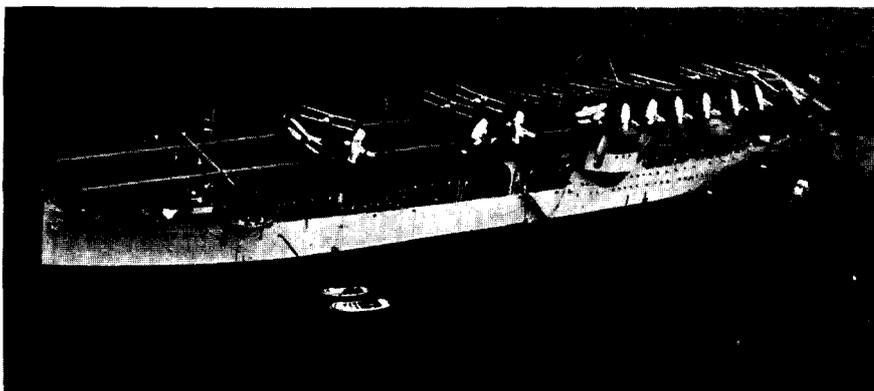
pletely reversed by the use of air power. Scouting planes and scouting operations were also scored, the planes found wanting in range and the scout pilots unable to bomb carrier decks when contact was made.

A month later, Fleet Problem XI investigated further the limitations of scouting planes as well as their most effective use. After the game, it was recommended that scouting squadrons be increased to 18 planes and that a more suitable scouting plane be developed. It was felt that better flotation was needed for amphibians and that a greatly increased range for carrier-based scouts, as well as the ability to take off with a short run were necessary. Among desirable secondary characteristics were small size, folding wings, and high speed, even at the cost of ceiling and armament.

It was also recommended that semi-permanent task groups be organized, each consisting of one large aircraft carrier, a division of cruisers, and a division of destroyers. These ships were to be trained as a unit in frequent exercises.

The 1931 Fleet Problem (XII), conducted in the Pacific-Panama Bay area, had among its tasks exercises in strategic scouting, in the employment of carriers and light cruisers, and refueling at sea.

Primarily, this problem dealt with actions between a fleet strong in aircraft and weak in battleships, and in a reverse situation where the fleet was weak in aircraft. At its conclusion, it was considered that two cruisers and two destroyers were minimum protection for an aircraft carrier in a carrier group. Further, the commander of that group should be stationed in the air-



LANGLEY'S ROLE in the war games became decreasingly important as new aircraft carriers were added to the Fleet. Aboard are an assortment of O2U, SU, and F6C aircraft. Note port stack.

craft carrier, rather than in a cruiser or destroyer, so that he could fully understand the mission of that group and obtain its quickest cooperation. Also, it was pointed out, escorting vessels must maintain the speed and proportionate fuel capacity of the carrier.

At the end of the problem, the three carriers transited the Canal and headed



CANAL ZONE- based aircraft, such as this early Corsair, participated in the games.

for Cuban waters and more exercises. On the last day of March, Capt. Ernest J. King, commanding *Lexington*, was ordered to assist Navy and Marine units in relief operations in Nicaragua. An earthquake had destroyed most of the city of Managua. When *Lexington* launched five aircraft with medical personnel and supplies aboard, in addition to provisions, she inaugurated carrier aircraft relief operations in the U.S. Navy. This was to become a frequent peacetime mission.

During Fleet Problem XIII, held in the Pacific-West Coast area in 1932, the vulnerability of submarines to air detection and attack, at that time, was clearly demonstrated. Four out of five submarines of one force, assigned scouting missions, were detected by land and carrier-based planes and "sunk." C.O.'s of these submarines reported their own vulnerability when operating in an aircraft-screened area.

Aircraft carriers assigned to the problem were forced to exercise in widely separated areas of the Pacific. RAdm. H. E. Yarnell, who commanded the "U. S." aircraft during the exercise, noted that in event of actual war in the Pacific, the number of aircraft carriers on hand would be totally inadequate to meet the needs.

Also, the admiral pointed out, this problem was not greatly dissimilar from all other problems conducted in the past, in that when one aircraft carrier was assigned to each of the forces in the war games, each of the forces invariably made the destruction of the other's carrier the prime tactic. This



MORE MODERN Consolidated P2Y-1's replaced older flying boats in the mid-Thirties.

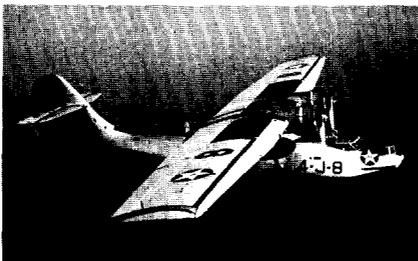
resulted in both forces losing their carriers early in the game.

It was therefore obvious, he repeated, that the side with the greater number of carriers had a tremendous advantage. In time of war, this would be critical. He suggested that at least six or eight more aircraft carriers be added to the Navy's inventory.

THE NEXT problem, XIV, was conducted in the same area the next year, 1933. Its conditions were that "during preparation for escorting an expeditionary force overseas in a campaign, an outlying possession was in danger of a raid, and important industrial, military and mobilization centers of a long coast line were threatened by carrier raids."

The *Blue* force was to protect the West Coast while *Black* was ordered to make at least one raid in the San Diego-San Pedro, San Francisco, and Puget Sound areas. *Black* divided its force into three groups. Its Northern Carrier Group was to raid San Francisco and then proceed to Puget Sound to the north. The Southern Carrier Group was to raid San Pedro and then San Francisco, rendezvousing later with *Black's* Support Group.

The first four days were uneventful. On the fifth day, a *Lexington*-based plane of the Northern Group spotted an enemy submarine, causing the carrier to change formation for the approach to the launching point of the



WITH THE PBV's, VP squadrons made the change to monoplanes. This one was a target tow-er.

raid. Weather worsened, forcing the suspension of flight operations. Early the next morning, as *Lexington* warmed up her planes, a *Blue* battleship was sighted at a 4500-yard range. As the carrier tried to escape, a second enemy battleship came into view and the Northern Carrier Group was declared out of action, caught unexpectedly between two enemy battleships at close range.

The Southern Carrier Group had better luck. On the seventh day of the problem, *Saratoga*-based planes successfully launched the attack. *Black* reported that 12 scouts had attacked the oil refinery at Venice with 24 100-lb. bombs, five scouts attacked a power house at Long Beach with ten equally powerful bombs, encountering no enemy force and sustaining no losses. The force lost three bombers to the enemy's two fighters during an 18-bomber attack on an enemy transport, an oil field at El Segundo and docks at Long Beach. *Saratoga* sustained slight damage. The force moved north for the San Francisco raid.

When she arrived in the San Francisco area, *Saratoga* launched her planes. Before she completed, aircraft from the cruiser *Richmond* and the carrier *Langley* bombed her flight deck. After *Sara's* planes returned from the raid, 37 per cent of her flight deck was assessed damaged, 36 planes lost, and her flight deck out of commission for 38 hours. The CV-2 aircraft had succeeded in making a dive bombing attack on the *Langley*, temporarily dis-



BOEING F3B-1 was typical of the light fighter bombers which used dive bombing tactics.

abling her flight deck, and attacked Crissy Field, San Francisco docks, San Andreas reservoir, and the drydock at Hunter's Point.

This exercise underscored the urgent requirement for the development of better planes, particularly carrier bomber and torpedo planes. Adm. Yarnell again pleaded for three addi-

tional 18,000-ton carriers which were permitted under existing treaties.

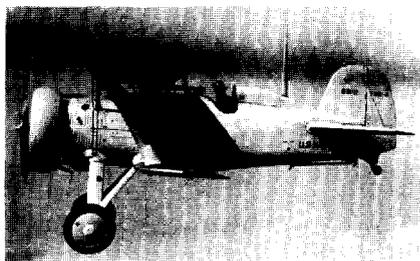
In the period 1933-34, the Fleet conducted a series of 20 tactical exercises. The last three of these comprised Fleet Problem XV, which also proved the last of the war games of the three-carrier period.

In his official monograph "Aviation in the Fleet Exercises, 1911-1939," historian LCDr. James M. Grimes, USNR, described the war games: "The primary effort of the Commander-in-Chief when drawing them up had been to introduce realism into fleet tactics and to simulate as nearly as possible actual wartime operations. For this reason, the opposing fleets represented actual navies of the period. Carrier operations were extensive throughout the problem. . . ."

"There were several important results of Fleet Problem XV as regards the development of Naval Aviation. The most important, perhaps, was the realization brought out by air operations during the problem, that if the carrier was to be the offensive weapon it was considered to be, carrier-based planes would have to be so armed that they could carry the offensive to the enemy.

"It was seen that planes carrying 100-lb. bombs were obsolete and of little use against an enemy force equipped with planes capable of carrying 500- and 1000-lb. bombs. The Commander-in-Chief, in his remarks at the critique held on Fleet Problem XV, stated that at least three-fourths of the carrier-based planes should be so equipped. "

USS *Ranger* joined the Fleet for the next war game, Fleet Problem XVI, conducted in 1935. Actually, this game consisted of five separate exercises, none of them related, spread over



BOEING F4B-4's were famous carrier fighters. One is now in National Air Museum collection.

the Pacific from the Aleutians to Midway, to Hawaii. Both the Army and Coast Guard participated.

The major air operations took place during the third phase of the problem. Unfortunately, these were marred by a series of plane and personnel casualties that, unfortunate in themselves, also seriously affected later air and sea operation. Although valuable experience was obtained in mass flight of patrol squadrons, nothing of significance developed in the operation of aircraft carriers.

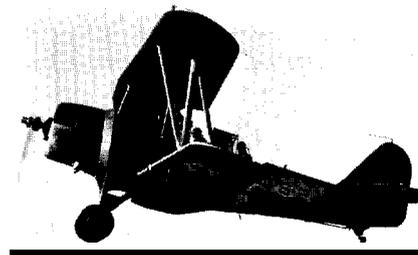
Fleet Problem XVII was conducted in the Panama-Pacific area in 1936. The exercises (again five) saw extensive use of patrol planes and the effective use of automatic pilot, but there was no major contribution to, or effect on, the evolution of carriers, either in design or tactics.

The question of proper employment of aircraft carriers was brought up again in Fleet Problem XVIII of 1937: Should they operate with the main body of a fleet or should they operate at a distance?

Black's aircraft commander held that a carrier tied down to a slow main body formation was certain to be destroyed. "Once an enemy carrier is within striking distance of our Fleet,"

he said, "no security remains until it, its squadrons, or both, are destroyed, and our carriers, if with the main body, are at a tremendous initial disadvantage in conducting necessary operations."

But his force commander took a different view. He felt that carriers should be an integral part of the main body and defended his decision to em-



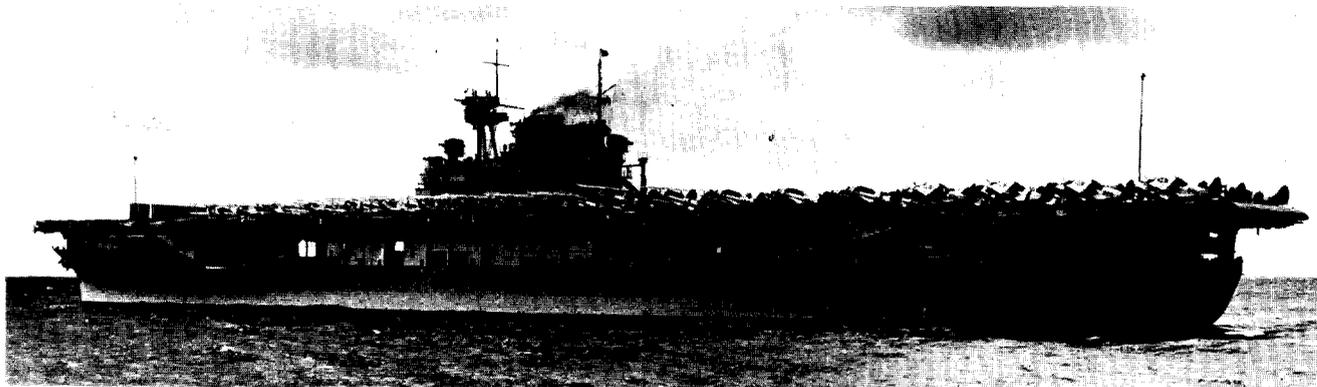
VOUGHT SBU-1's, last fixed gear biplane dive bombers, flew in late Thirties war games.

ploy them in such a way, as he did in this problem. He suggested that *Ranger*, because of her small size could provide scouting and spotting with less chance of being detected. He hoped that when *Yorktown* and *Enterprise* joined the Fleet, such an employment of *Ranger* might be possible.

Fleet problem XIX was the last of the *Ranger* phase of the war games. It was conducted in 1938 and consisted of Parts II, V, and XI of the Annual Fleet Exercises.

In the first phase, the outstanding performance was a long-range San Diego-based patrol plane bomber attack which successfully eliminated Lexington as a carrier unit in the game.

The notable development of the second phase of the war game, Part V, was an attack on Pearl Harbor, launched from *Saratoga* some 1000 miles off the coast of Oahu. *Sara's*



WITH THE ENTRY of the USS *Enterprise* (CV-6), above, and USS *Yorktown* (CV-5) into the war games in 1939, the Fleet problems entered their final phase. Tactics and ships' operations were refined in the tense years immediately prior to the United States' entry in WW II

recon group flew over Lahaina area, photographing beaches and reporting the enemy's strength there.

At the same time, *Sara* sent an attack group which bombed Fleet Air Base, Hickam Field, Wheeler Field, Wailupe Radio Station, and returned to the carrier. This tactic was to be employed by the Japanese some three years later, in December 1941.

In phase three (Part XI), the outstanding air operation was an unopposed air attack by *Lexington*- and *Saratoga*-based planes launched against Mare Island and Alameda.

"Excellent experience was provided in planning and executing a fast carrier task force attack against shore objective," says Grimes. "The problem of defending a coast line, or even an isolated portion thereof, against fast enemy raiding forces equipped with large carriers and protected by powerful surface ships was seen to be one difficult of solution."

Yorktown and *Enterprise* entered into the 1939 exercises of Fleet Problem XX, which were conducted in the Caribbean area and off the northeast coast of South America. The war games entered their final phase. Neither *Langley* nor *Saratoga* participated.

As a result of this game, reports indicated that carrier operations reached a new peak of efficiency; particular credit was given the two new carriers which, despite inexperience,

contributed significantly to the success of the problem. These exercises studied employment of planes and carriers in connection with convoy escort, development of coordinating measures between aircraft and destroyers for anti-submarine defense, attack on mobile patrol plane bases, scouting and attack by patrol planes, defense of surface ships against aircraft attack, and trial of various forms of evasion tactics against attacking aircraft and submarines.

The last war game, XXI, was played in 1940 in the Hawaiian-Pacific area. It consisted of two separate exercises. Historian Grimes describes them:

"The first exercise was designed to afford training in making estimates and plans; in scouting and screening; in the coordination of various types of fighting units; in employing standard and fleet dispositions; and finally to train the opposing forces in decisive engagement."

"The second major exercise of the problem was designed to afford training in scouting, screening, communications, coordination of types, protection of a convoy, seizure of advanced bases and finally, decisive engagement."

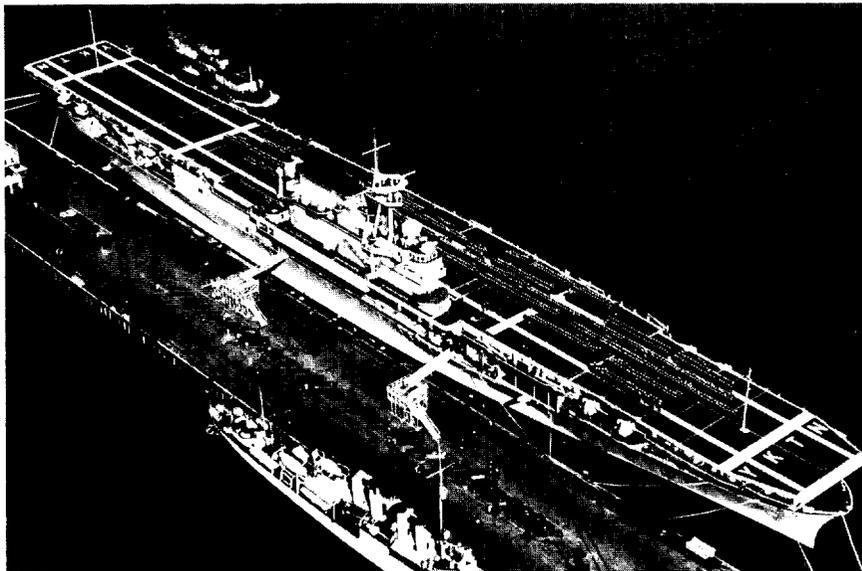
Between the two major parts of the problem were two minor exercises in which air operations played a major part: Fleet Joint Air Exercise 114A and Fleet Exercise 114. Exercise 114A underscored the need for greater coop-

eration between the Army and Navy in organizing the defense of the Hawaiian area. Exercise 114 compared patrol plane attacks on surface units with use of planes in high altitude tracking. The former proved the planes vulnerable, while the latter met with great success.

Few new difficulties emerged from this war game. Reiterated was the question of latitude given carrier commanders by force commanders. *Yorktown's* commanding officer stated his belief that success could best be achieved when aircraft personnel in carriers operated under a broad directive. The exercise proved again—as it did in Fleet Exercise 114—that low-level horizontal bombing attacks had little chance of success—especially against a ship that was not otherwise engaged.

By 1940, the war games were halted. Although one was planned for the next year, worsening of world tensions caused their cessation. Various tactical exercises were held instead.

Naval Aviation grew with the war games. The first phase—the pre-aircraft carrier years—employed "constructive" carriers and merely indicated to the Navy the potentials of this new weapon. The *Langley* phase was an

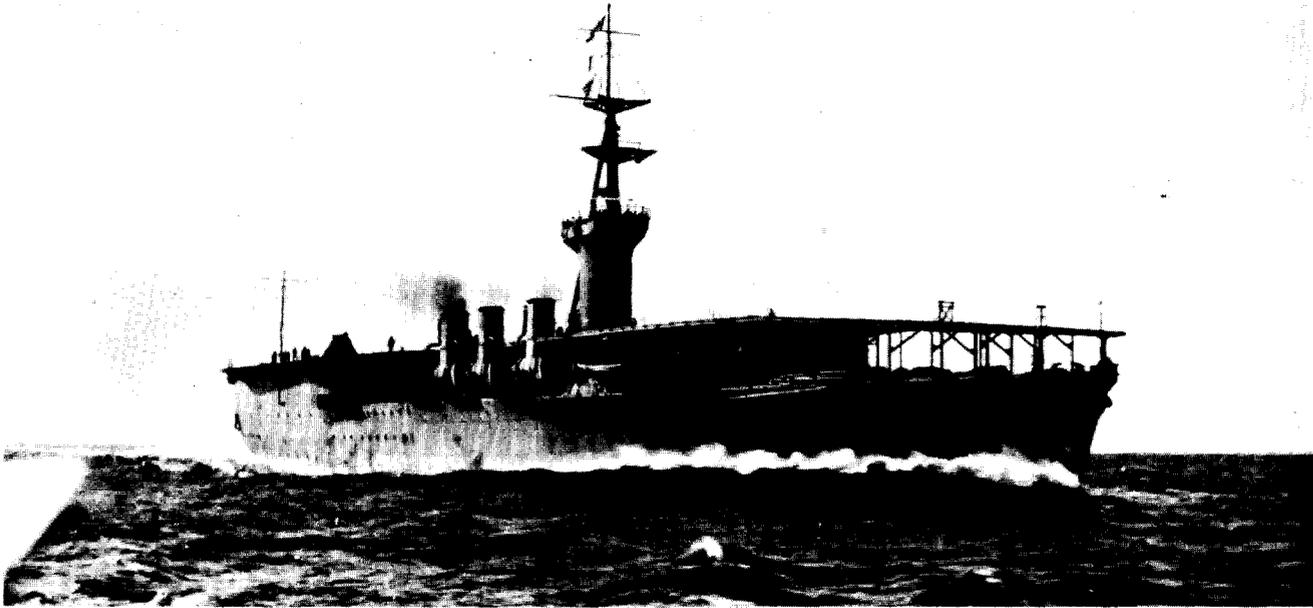


DURING COMMISSIONING ceremonies at the Naval Operating Base, Norfolk, in 1937, men lined up on the flight deck of USS *Yorktown* (CV-5). It entered the war games two years later.



GRUMMAN F3F biplanes were mainstay of carrier fighters until shortly before WW II.

informative one, but this was more an experimental ship than an aircraft carrier. The games reached fruition with the addition of the *Lexington* and *Saratoga* in Fleet Problem IX. It saw the employment of an aircraft carrier as a separate striking force and introduced a new tactic in the book of naval strategy. The *Ranger* phase showed the potentials of small aircraft carriers, employed with telling effect in WW II. And the final phase, the addition of *Yorktown* and *Enterprise*, increased and refined carrier operations in the critical years prior to WW II.



IMPERIAL JAPANESE Navy's first aircraft carrier, the *Hosho*, was built as such from the keel. She appears here in her original rig three hinged funnels were placed in a fixed position, bending aft.

Evolution of Aircraft Carriers

THE JAPANESE DEVELOPMENTS

'In the last analysis, the success or failure of our entire strategy in the Pacific will be determined by whether or not we succeed in destroying the U.S. Fleet, more particularly, its carrier task forces.'—Adm. Isoroku Yamamoto, IJN, 1942.
'I think our principal teacher in respect to the necessity of emphasizing aircraft carriers was the American Navy. We had no teachers to speak of besides the United States in respect to the aircraft themselves and to the method of their employment. . . . We were doing our utmost all the time to catch up with the United States.'—FAdm. Osami Nagano, IJN, 1945.

BY CHRISTMAS EVE 1921, the Washington Disarmament Conference had already been going on for a month and a half. Participating were Great Britain, Japan, France, Italy, and the United States. It was on this day that Great Britain refused any limitation on auxiliary vessels, in view of France's demand for 90,000 tons in submarines. The delegates then began to consider confining the treaty to capital ships and aircraft carriers.

The Washington Naval Treaty, signed February 6, 1922, established a tonnage ratio of 5-5-3 for the capital ships of Great Britain, the United States, and Japan, respectively, assigning a smaller tonnage to France and Italy. The same ratio for aircraft carriers was set, with an overall limitation of 135,000 tons each for Great Britain and the U. S., and 81,000 tons for Japan. It also limited any new

By Scot MacDonald

carrier to 27,000 tons, with a provision that, if total carrier tonnage were not thereby exceeded, nations could build two carriers of not more than 33,000 tons each, or obtain them by converting existing or partially constructed ships which would otherwise be scrapped by the treaty.

December 27 that year, Japan commissioned its first aircraft carrier, the *Hosho* ("Flying Phoenix"). This was a remarkable *hoku boku* (literally, mother ship for aircraft). Though the British were the first to operate aircraft onto and off a ship especially designed for that use, their first aircraft carriers were conversions. *Hosho* was a carrier from the keel, the first of its kind completed in any navy of the world.

Laid down in 1919 at the Asano Shipbuilding Co. of Tsurumi, the ship

was fitted out at Yokosuka Navy Yard at a standard displacement of 7470 tons, a speed of 25 knots, with the capability of handling six bombers (plus four reserve), five fighters (in addition to two in reserve), and four reconnaissance planes, a total of 21 aircraft.

Hosho was indeed a strange looking craft. She was all flying deck. Originally, she had an island structure and a tripod mast, but either because of the small width of her flying deck (and its attending hazards) or because some turbulence might have been caused by it, the island was taken off.

The carrier sported three funnels on the starboard side. These were of the hinged type, held upright when not in use, and swung outboard to provide additional safety from stack gas. Later, they were placed in a fixed position, bending aft and slightly downward.



UNDER THE WASHINGTON Naval Treaty, Japan converted a battle cruiser to aircraft carrier characteristics. In 1928, that country's 2nd carrier was completed and named Akagi, after a mountain.

Hosho's original armament consisted of from 14cm single mount guns and two 8cm single mount high angle guns. At the outbreak of WW II, her high angle guns were replaced by four 25mm twin mount machine guns. Later, the 14cm guns were removed and 25mm double or single mount machine guns were added.

Before continuing with Japanese development, an explanation of the naming of their aircraft carriers is in order.

"Transliteration of the names of Japanese aircraft carriers into American equivalents is a pretty risky business," said Mr. Roger Pineau, a frequently published writer on the Japanese Navy after World War II. "It becomes misleading. The names should be treated as such and should not be taken too literally. For instance, when we speak of astronaut Carpenter, we don't visualize a man walking around with hammer and saw in hand."

Mr. Chris Beilstein, another expert on Japanese aircraft carriers, concurs. "The *Shokaku* becomes 'Flying Crane,' for that is the closest we can translate the original Japanese. The first Japanese CV's carried names of mountains and provinces. These, in turn, were frequently named after mythological characters. *Shokaku*, for example, could have been a flying crane in an age-old story, a crane that was named *Shokaku*. This is very much like our real life Misty, the wild horse. Certainly, to translate 'Misty' to literal Japanese would be meaningless to them, or at best, misleading. It would be more accurate to translate it 'Wild Horse.' Thus, 'Misty,' to the Japanese, would mean 'Wild Horse,' just as we would erroneously translate *Shokaku*



MODERNIZATION in the mid-Thirties saw Akagi undergo extensive changes. Flight deck area was extended forward. Other changes forced a reduction in carrier's speed from 31 knots to 28 knots.

as 'Flying Crane.'

"Think of the problem in transliterating *Shangri La* into Japanese," said Mr. Pineau. "To paint the picture accurately, it would be necessary to describe Hilton's book and then go into President Roosevelt's fascination with it. That would be rather difficult to do in one or two words. Perhaps the closest would be 'Paradise of the Ageless'—and this would, in the Japanese mind, seem a pretty silly thing to name an aircraft carrier.

"But transliteration has a very real value—especially to those who have difficulty in pronouncing Japanese words. Many competent researchers don't even speak the language. The transliteration is a handy reference point, but should not be taken seriously, at face value."

Japanese Naval Aviation dates back to 1912 when the Navy sent officer trainees to the U.S., Great Britain, and France. They returned from France with two Farman seaplanes, and from the U.S. with two Curtiss seaplanes. A beach on the west side of Tokyo Bay, Oppama, was selected as a site for a seadrome in the fall of that year and placed into commission. The first class at Oppama consisted of four officers and 100 men.

From 1912 to 1917, ¥3-400,000 (about \$150-200,000) was allotted to the fledgling air arm. In 1918, this sum was increased to ¥1 million (about \$500,000), and the next year to ¥2 million.

The first landing on the *Hosho* was made by a British civilian, a Mr. Jourdan, on February 22, 1923. States the

Japanese Year Book of 1924-25: "... our Naval flight officers are making similar experiments with good results."

(In chronological comparison, Eugene Ely landed on a platform on the armored cruiser USS *Pennsylvania* January 18, 1911; USS *Langley*, the U.S. Navy's first aircraft carrier, a converted collier, was commissioned March 20, 1922; the first U.S. aircraft carrier



LATER CODE-NAMED *Claude*, Mitsubishi Type 96 fighters replaced Japanese Navy's 90's.



ALSO OPERATING from carriers in the Sino-Japanese War were Type 96 attack aircraft.



NAKAJIMA TYPE 90 fighter biplanes operated from Japanese carriers in the mid-Thirties.

built as such, from the keel, USS *Ranger*, was not commissioned until June 4, 1934.)

A naval expansion program, decided upon in 1920, was completed by March 1923. Under the limitations set by the Washington Naval Treaty, Japan turned her attention to the conversion of the battle cruiser (then eight months under construction at the Kure Naval Arsenal). This, in 1928, became Japan's second aircraft carrier, the *Akagi* ("Red Castle," actually the name of a Japanese mountain).

Akagi displaced over 30,000 tons standard when completed, had a speed of 31 knots, and carried 60 aircraft. She was armed with ten eight-inch and 12 4.7-inch guns.

A sister ship, the *Amagi* ("Heavenly Castle"), was also scheduled for conversion at that time, but sustained severe damage in the earthquake of September 1, 1923. She was scrapped in July 1924 at Yokosuka. In her place, Japan converted the *Kaga* (the name of an old Japanese province) to an aircraft carrier. Originally, she was laid down as a 39,000-ton battleship, but was scheduled for the scrap pile as a result of agreed disarmament limitations. Conversion was completed in 1928 and she was commissioned the following year. The 1929 Japanese

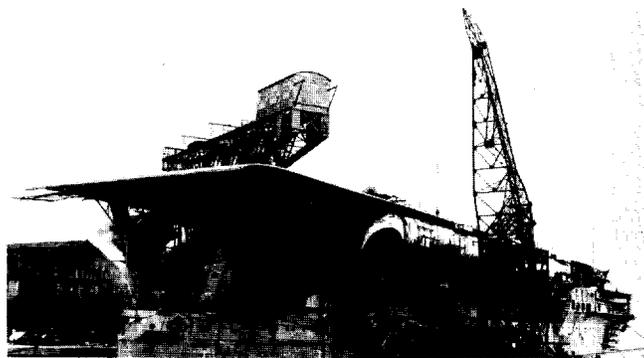
in power. Final decision on the size of the Navy lay in the competence of the civilian government. Most career officers were hostile to the treaty; those officers, who supported the civilian government in the bitter fight that ensued concerning ratification of the 1930 London Treaty, were either forced to resign within the next few years or were placed in unimportant posts. Militarists, ascending in power, referred contemptuously to the ratification as "the May 15th Affair."

The London Treaty carried forward the general limitations of the earlier Washington agreement and provided for further reductions of naval armament. Under terms applicable to Naval Aviation, the definition of an aircraft carrier was broadened to include ships

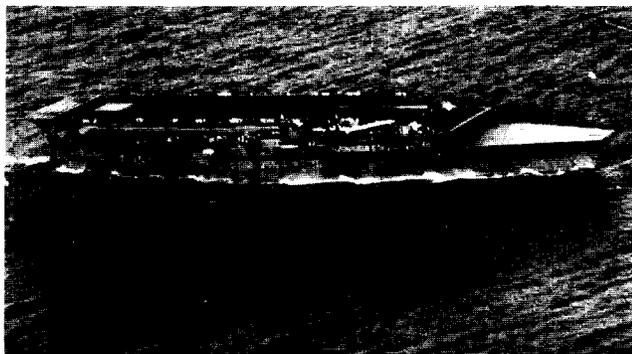
United States Navy's fourth carrier.

In 1932, naval authorities referred a second naval replenishment plan to the Ministry of Finance for study. The plan called for a total expenditure of ¥460,000,000 (about \$230 million), covering the construction of one aircraft carrier of 8000 tons, other capital and auxiliary ships, and the establishment of eight flying corps on land: all this to be completed by the end of 1936. This aircraft carrier was never built.

In 1934, preliminary disarmament conferences were held in London. Congress had already passed and President Roosevelt authorized an act that popularly became known as the Vinson-Trammell Act. This permitted the U.S. to construct naval ships to the



SISTER SHIP to *Akagi*, the *Kaga*, is shown here shortly after her commissioning in December 1928. Note the unusual stack arrangement.



AN AERIAL VIEW of *Kaga* shows the chopped-off bow configuration and the starboard stack. *Kaga*, even after refitting, had no island.

Year Book states of *Akagi* and *Kaga*:

"They are the pride of the Japanese Navy, and though slightly inferior to the *Saratoga* of the U.S. Navy in respect of speed, the *Akagi* surpasses the other in point of the range of her high angle guns, of which she carries 12 4.7-inchers. The *Hosho* . . . [is] by far smaller than the *Akagi*, but in the mode of construction [it possesses] special features of [its] own. The completion of the *Kaga*, only second to the *Akagi*, is a powerful addition to the Japanese Navy."

Kaga was reported as displacing 26,900 tons standard, but actually displaced over 30,000 tons, had a speed of 27 knots and carried 60 aircraft.

As the signatories of the Washington Naval Treaty reconvened in London in 1930, Japanese naval officers began to chafe under the ship construction restrictions imposed upon their nation. At that time, the armed forces were unpopular with the liberal government

of any tonnage designed primarily for aircraft operations. It was agreed that installation of a landing-on or flying-off platform on a warship designed and used primarily for other purposes would not make that ship an aircraft carrier. It also stipulated that no capital ship in existence on April 1, 1930 would be fitted with such a platform or deck.

The Japanese Navy expanded rapidly after 1930, at such a rate that it became necessary to conscript men. In 1931, a replenishment plan was authorized the Navy, permitting it to complete construction of the *Ryujo* ("Galloping Dragon"), a small aircraft carrier of about 10,000 tons laid down in 1929. It was completed in 1933, its limited deck free of an obstructive island. *Ryujo* had a speed of 29 knots, carried 36 aircraft, and was armed with 12 five-inch guns. She was Japan's fourth aircraft carrier. In June 1934, USS *Ranger* became the

tonnage limitations prescribed by the previous Washington and London Naval Treaties. Under this authorization, USS *Wasp* (CV-7) was laid down in 1936.

Japanese militarists were not eager to continue in the disarmament pacts. Wrote U.S. Ambassador to Japan, Joseph C. Grew, "Japanese attitude toward the coming Naval Conference in 1935 London Treaty is intensely unpopular among the Japanese Naval officers high and low;" and in separate correspondence, "The situation is entirely different from that in 1930. . . . Under present conditions the Navy alone will have the final say [as to the size of the Imperial Japanese Navy]."

It boiled down to this: Japan wanted quantitative as well as qualitative parity in ship power, equal to the United States and Great Britain. The 5-5-3 ratio was no longer acceptable. Neither the U.S. nor Britain favored such an increase in Japanese strength, for,



THE SHOKAKU CLASS consisted of two carriers, *Shokaku* (shown here) and *Zuikaku*. They were authorized under the Fleet Replenishment Program of 1937, displacing 25,675 tons standard. *Zuikaku* was first to have a bulbous bow configuration. Both were completed in 1941.

granted equality in armored ships, Japan would be the major power in the Pacific, greater than the U.S. and Great Britain combined; their Fleets were divided geographically.

Japan persisted. The Japanese Year Book of 1935 enumerated that country's "official" reasoning:

"(1) The progress and development made recently in battleships, aeroplanes, etc., have made it extremely difficult to effectuate defence operations.

"(2) The remarkable increases in the air forces of the U.S.S.R. and China, and the revival of the Far Eastern naval forces of the former.

"(3) The establishment of the naval port of Singapore by Great Britain, and the extension and strengthening of the naval port of Hawaii by the U.S.A. have had a great effect on the naval plan of operations in Far Eastern waters.

"(4) The birth of Manchoukuo [independence of Manchuria, February 18, 1932] has brought forth vast changes in Far Eastern policies. It has increased the responsibility of the Japanese Empire as the stabilizing power in the Far East."

These were political arguments the world's two top naval powers could not buy. But Japan was adamant, refused compromise and, on December 29, 1934, gave the required two years' formal notice that after December 31, 1936, she would no longer be bound by

the terms of the Washington and London Naval Treaties. Her act of abrogation unleashed the restraints on international shipbuilding.

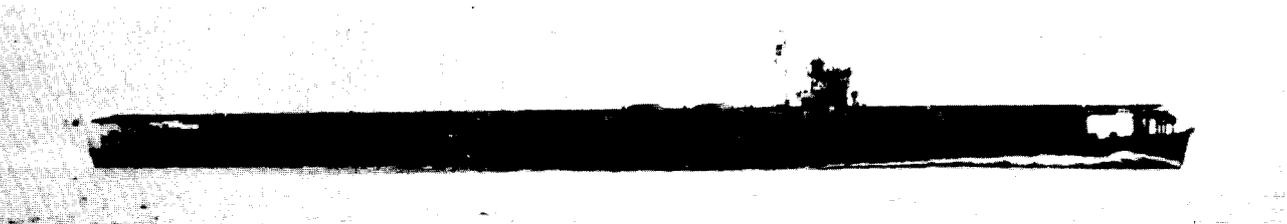
Two more aircraft carriers were laid down in Japanese ways in 1934 and 1936, the *Soryu* ("Blue Dragon") and *Hiryu* ("Flying Dragon"). *Soryu* displaced about 18,000 tons standard, had a speed of 34.5 knots, and handled 63 aircraft. *Hiryu* was heavier, 18,500 tons standard, and had a speed of 34.3 knots. Officially, both ships were carried on the books as of 10,050 tons standard; the true tonnage was not revealed until after WW II. Both ships carried the same number of planes and had the same armament, 12 five-inch guns.

It was sometime between 1935 and 1937 that naval ship designers configured carriers to provide a surprising technical innovation. *Akagi* and *Kaga* underwent major modernization at this time. The lower flight decks were suppressed, the upper flight decks were extended forward, and the eight-inch gun turrets and mountings were reduced in *Akagi* from ten to six, while *Kaga* replaced her 12 4.7-inch guns with 16 five-inchers. *Kaga's* unwieldy funnels were also reduced. The modernization of *Kaga*, which included new machinery, added about 1½ knots to her speed, giving her 28.3, but *Akagi's* modernization cost her several knots, bringing her down to 28.

But the startling innovation was the introduction of small islands on the port side of the carriers *Akagi* and *Hiryu*. The remaining carriers had islands on the starboard (standard) side—of those that had them at all. Strategists planned to use these carriers in a formation that was unique. The lead carriers in the basic formation were to be the port-islanded *Hiryu* and *Akagi*, followed by the *Soryu* and *Kaga*. This would supposedly allow for a more compact formation with non-conflicting aircraft traffic patterns. This formation was used in the Battle of Midway.

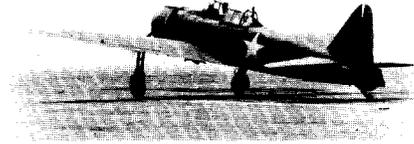
Japan's next venture into aircraft carrier construction was the *Shokaku* ("Flying Crane") and *Zuikaku* ("Lucky Crane"). These carriers were kept fairly well under wraps, insofar as specifications are concerned. They were authorized under the very ambitious Fleet Replenishment Program of 1937, the same program under which the famed super battleships *Yamato* and *Musashi* were built.

Shokaku was laid down December 12, 1937 at the Yokosuka Navy Yard, while *Zuikaku* was started at Kawasaki Dockyard May 25, 1938. Basically, the ships had similar specifications. They displaced 25,675 tons standard, had a designed speed of 34.2 knots, carried 16 five-inch guns in twin mounts, and could carry up to 84 aircraft, although a normal complement



THE SORYU CLASS was first laid down in 1934 and 1936, displacing about 18,000 tons standard, at a speed of 34 knots. The *Soryu* had her island on the starboard (conventional) side. She, with other IJN aircraft carriers, participated in the Dec. 7, 1941 Pearl Harbor raid.

was 73. There were no major differences between the ships. *Zuikaku*, however, was fitted with a bulbous bow, the first Japanese warship so designed. *Shokaku* was launched June 1, 1939, and completed August 8, 1941; *Zuikaku* was launched November 27,



CAPTURED ZERO, Mitsubishi Type O, has U.S. markings here, for U.S. tests early in war.

1939, and completed September 25, 1941.

Completion of both carriers was delayed when the original funnel arrangement was changed in mid-construction by the Aeronautical Headquarters. As designed, the funnels were to appear one on each side of the island bridge, fore and aft on the starboard side. This was changed by placing the two funnels immediately aft of the island.

The Japanese did not give either ship much publicity. Both ships, *Zuikaku* and *Shokaku*, were to figure prominently in most sea battles of WW II involving naval air. Their design was based on the best material gathered from experiences in *Akagi*, *Kaga*, and the *Soryu* types. Later Japanese carriers (i.e., multiple ship design classes) were constructed in two groups: the large to be like *Taiho* (with armored flight deck), and the medium to be repeats of the *Soryu* class. *Zuikaku* and *Shokaku* comprised an entire class.

Japan's next aircraft carrier was a conversion. In 1936 the submarine depot ship *Takasaki* was under construction. While she was still in the ways, the decision was made to com-



FIRST USN monoplane fighters, Brewster F2A-1's, did badly against Japanese Zeros.

plete the ship as a carrier. Work on this project was not started until January 1940, but was completed in December that year. The carrier was renamed *Zuiho* ("Happy Phoenix"). She displaced 11,200 tons standard, sailed at 28 knots, and carried 30 aircraft. She was armed with eight five-inch guns.

A sister ship, *Shoho* ("Lucky Phoenix"), converted between January 1941 and January 1942, was originally named *Tsurugisaki*, launched as a submarine depot ship in 1934. *Zuiho* and *Shoho* particulars were similar.

Other aircraft carriers were under construction or conversion. At least 15 more would be commissioned during the war years, produced in growing restrictions of limited materials, and, after the Battle of Midway in 1942, in desperation.

IN THE FIVE-YEAR period preceding December 7, 1941, the military of Japan grew stronger in power. March 1936 the cabinet was dominated by men in uniform and the development of heavy industry was pushed. An extraordinarily ambitious and successful expansion of the Navy was launched in 1937, the same year hostilities broke between Japan and China. That same year, the *Panay* was sunk. In 1938, the National Mobilization Bill was passed. In September 1940, Germany, Italy and Japan concluded a three-power pact. November 1941, Japanese Prime minister, Gen. Hideki

Tojo, stated that British and American influence must be eliminated from the Orient.

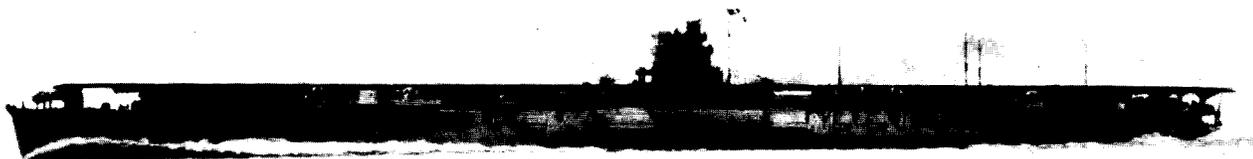
The Japanese Navy had been conducting intensive training of its officers and men during this period. Most of the training, including war games, was



MITSUBISHI TYPE 97 carrier attack aircraft is typical of early Japanese monoplanes.

conducted in out-of-the-way gulfs and in the stormy northern reaches of the Pacific. The men were hardened by the elements and drilled continuously. To avoid antagonizing the Japanese, the U.S. Navy at the same time was instructed to hold all of its fleet problems in the less satisfactory areas west of the International Date Line.

By 1941, Japan was determined to wage war. On November 10, VAdm. Chuichi Naguma, placed in charge of the initial attack, issued his first operation order on the mission. The Striking Force of *Akagi*, *Kaga*, *Soryu*, *Hiryu*, *Shokaku* and *Zuikaku*, as well as other capital ships, sortied from Kure navy base between November 10 and 18, rendezvousing on the 22nd in Takan Bay in the Kuriles. Adm. Yamamoto ordered the force to sortie on November 26. On December 2, he broadcast a prearranged signal that would launch the attack on Pearl Harbor: *Niitaka Yama Nobore* ("Climb Mount Niitaka"). Five days later, December 7, the Japanese Navy launched its surprise attack by aircraft, launched from carriers, at Pearl Harbor and the Philippines. The next day, the United States and Japan were officially at war.



HIRYU, SISTER to the *Soryu*, had her island on the port side, as did *Akagi*, the only two IJN aircraft carriers so configured. *Hiryu* was heavier by some 500 tons. Exact displacements of IJN carriers is in doubt, owing to the burning of official records at the end of WW II.

THE EARLY ATTACK CARRIERS

'We have hit the Japanese very hard in the Solomon Islands. We have probably broken the backbone of the power of their Fleet. They have still too many aircraft carriers to suit me, but soon we may well sink some more of them. . . . We are going to press our advantages in the Southwest Pacific and I am sure that we are destroying far more Japanese airplanes and sinking far more of their ships than they can build.'—Franklin D. Roosevelt, President of United States, 1942.

AT THE OUTBREAK of World War II, the United States had in commission seven aircraft carriers and one escort carrier. USS *Langley*, the experimental ship officially classed as CV-1, had been assigned to duty as a seaplane tender on September 15, 1936.

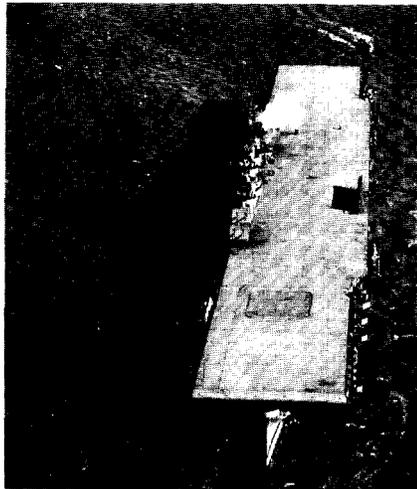
After the abrogation by Japan from disarmament treaties, the U.S. took a realistic look at its naval strength. By Act of Congress on May 17, 1938, an increase of 40,000 tons in aircraft carriers was authorized. This permitted the building of USS *Hornet* (CV-8) and USS *Essex* (CV-9). On June 14, 1940, another increase in tonnage was authorized. Among the ships built under this program were the *Intrepid* and the new *Yorktown*. On July 19, an additional 200,000 tons for carriers was authorized.

Adm. H. R. Stark, then Chief of Naval Operations, reported to the Secretary of the Navy: "In June 1940, the Congress granted the Navy an 11% increase in combat strength and, in July, a further increase of approximately 70%. When these ships and aircraft are completed, the U.S. Navy in underage and overage ships will include 32 battleships, 18 aircraft carriers, 91 cruisers, 325 destroyers, 185 submarines, and 15,000 airplanes. . . .

By Scot MacDonald

"From 1921 to 1933, the United States tried the experiment of disarmament in fact and by example. This experiment failed. It cost us dearly in relative naval strength—but the greatest loss is TIME. Dollars cannot buy yesterday. Our present Fleet is strong, but it is not strong enough."

Additional tonnage was authorized December 23, 1941 and July 9, 1942.



USS ESSEX (CV-9) was first of a series of early attack aircraft carriers of World War II.

CV-9 was to be the prototype of an especially designed 27,000-ton (standard displacement) aircraft carrier, considerably larger than the *Enterprise* and smaller than the *Saratoga*. These were to become known as the *Essex* class carrier, although this classification was dropped in the '50's.

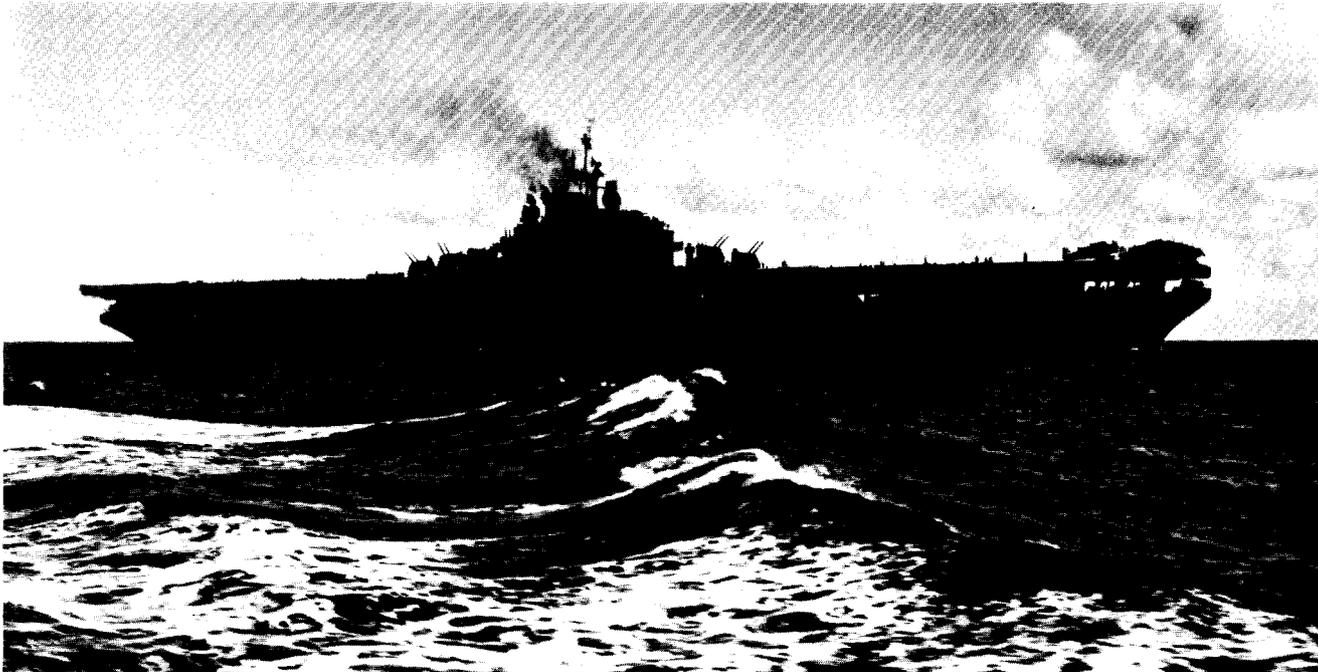
On September 9, 1940, eight more of these carriers were ordered and were to become the *Hornet*, *Franklin*, *Ticonderoga*, *Randolph*, *Lexington*, *Bunker Hill*, *Wasp* and *Hancock*, CV-12 through -19, respectively. Re-use of the *Lexington*, *Wasp* and *Hornet* names was in line with the Navy's intent to carry on the traditions of the fighting predecessors: *Lcxington* (CV-2) was lost in the Battle of the Coral Sea in May 1942; *Wasp* (CV-7) was sunk September that year in the South Pacific while escorting a troop convoy to Guadalcanal; *Hornet* (CV-8) was lost the following month in the Battle of Santa Cruz Islands.

It is appropriate to comment here that the ships' names at commissioning date did not all bear the same name at the date of their programming. Names were changed during construction. *Hornet* (CV-12) was originally *Kearsarge*, *Ticonderoga* (CV-14) was



FIGHTER AIRCRAFT of Air Group 9 are parked aboard the aircraft carrier *Essex* during her shakedown cruise in the Caribbean in 1943.

During WW II, U.S. shipyards built and Navy commissioned 16 sister ships. Including post-war production 24 *Essex* class were commissioned.



USS RANDOLPH (CV-15) was the 13th Essex class carrier to be commissioned. She was the first of these carriers to enter combat without returning to the builder for post-shakedown work. She participated in the Iwo Jima, Okinawa, and Third Fleet operations against Japan in 1945.

the *Hancock*, *Lexington* (CV-16) was *Cabot*, *Wasp* (CV-18) was *Oriskany*, and *Hancock* (CV-19) was originally *Ticonderoga*.

Last two of the 13 originally programmed CV-9 class aircraft carriers, *Bennington* (CV-20) and *Boxer* (CV-21), were ordered on Dec. 15, 1941.

In drawing up the preliminary design for USS *Essex*, particular attention was directed at the size of both her flight and hangar decks. Aircraft design had come a long way from the comparatively light planes used in carriers during the Thirties. Flight decks now required more takeoff space for the heavier fighters and bombers being developed. Most of the first-line carriers of the pre-war years were equipped with flush deck catapults, but owing to the speed and size of these ships very little catapulting was done—except for experimental purposes. With the advent of war, airplane weights began to go up as armor and armament got heavier; crew size aboard the planes also increased. It was inevitable, noted the Bureau of Aeronautics toward the war's end in 1945, that catapult launchings would become more common under these circumstances. Some carrier commanding officers reported that as much as 40 per cent of launchings

were effected by the ships' catapults.

The hangar area design came in for many conferences between Bureaus and much more official correspondence. Not only were the supporting structures to the flight deck to carry the increased weight of the landing and parked aircraft, but they were to have sufficient strength to support the tricing up of spare fuselages and parts (50 per cent of each plane type aboard) under the flight deck and still provide adequate working space for the men using the area below.

"At present," noted the Bureau of Construction and Repair in April 1940, "it appears that a few of the smaller fuselages can be triced up overhead in locations where encroachment on head-room is acceptable, and that the larger fuselages will have to be stowed on deck in the after end of the hangar. The number to be stowed will depend upon the amount of reduction in operating space in the hangar which can be accepted."

Capt. Marc A. Mitscher, then Assistant Chief BUAER, answered: "The question of spare airplanes is now under reconsideration in correspondence with the Fleet and the results decided upon will have a bearing in the case of CV-9."

A startling innovation in CV-9 was

a port side deck edge elevator in addition to two inboard elevators. Earlier, BUAER experimented with a ramp arrangement between the hangar and flight decks, up which aircraft were hauled by crane. This proved too slow. BU SHIPS and the Chief Engineer of A.B.C. Elevator Co., designed the engine for the side elevator. Essentially, it was a standard elevator, 60 feet by 34 in platform surface, which travelled vertically on the port side of the ship. Capt. Donald B. Duncan, *Essex's* first commanding officer, was enthusiastic. After the first four months of operation after commissioning, he wrote to BUAER:

"The elevator has functioned most satisfactorily in all respects and it is desired to point out some of the operational advantages realized with this type of elevator.

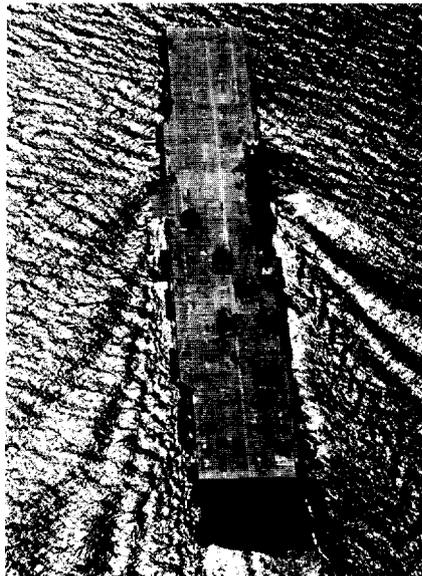
"Since there is no large hole in the flight deck when the elevator is in the 'down' position, it is easier to continue normal operations on deck, irrespective of the position of the elevator. The elevator increases the effective deck space when it is in the 'up' position by providing additional parking room outside the normal contours of the flight deck, and increases the effective area on the hangar deck by the absence of elevator pits."

The elevator performed well, its machinery less complex than the two inboard elevators, requiring about 20 per cent fewer man-hours of maintenance. Capt. Duncan recommended that consideration be given using two deck edge elevators, one on each side. BUAEER, in forwarding the recommendation to BU SHIPS, offered another advantage for consideration: a conventional elevator suffering a casualty while in the "down" position "would leave a large hole in the flight deck while the deck edge type would cause only minor and non-critical loss of flight deck area."

BU SHIPS, obviously pleased with the operational performance of the new elevator—the first of its kind—reluctantly turned down the recommendation, however. The Bureau noted that the addition of a starboard deck-edge elevator would not permit an *Essex* class aircraft carrier to transit the Panama Canal. Any other location for a second such elevator would involve structural and arrangement changes too extensive to be considered.

On April 28, 1941, keel for the USS *Essex* was laid at Newport News Shipbuilding and Dry Dock Co. On October 2, the following year, her prospective commanding officer filed his first weekly progress and readiness report to the Chief of Naval Operations. He noted that there was marked speed-up of work on the ship during the preceding month and estimated that the ship would probably be delivered on February 1, 1942.

"There are certain items that have been authorized for installation on the CV-9-19 class carrier," he said, "but will not be accomplished on this vessel



USS YORKTOWN (CV-10) was third *Essex* commissioned, sponsored by Mrs. F. D. Roosevelt.

prior to delivery." The ship was launched July 31, 1942.

RAdm. Walter S. Anderson, president of the dock trials and inspection team of CV-9 on December 23, 1942, noted a few of these discrepancies in his report:

"Due to late authorization of a number of changes arising out of recent war experiences, the volume of uncompleted hull work was greater than normal. . . . The Board regrets that the catapults for this vessel were not delivered in time for installation, as military value of the vessel would be much improved thereby. . . . Only the starboard flight deck track was installed. . . . This class of carriers is designed to include cruising turbines as part of the main drive turbine installation. However, due to produc-

tion difficulties and as a result of efforts to expedite delivery, cruising turbines were omitted. Space and connections for their future installation are provided and this can be accomplished with very little alteration. . . ."

Nevertheless, the Board was pleased and impressed with progress on construction of the *Essex*. Adm. Anderson recommended acceptance of the ship. "On 31 December 1942," he said, "only slightly over 20 months will have elapsed since keel-laying, which is, in the opinion of the Board, a record worthy of commendation. This indicates a high degree of cooperation between the Supervisor of Shipbuilding, the Newport News Shipbuilding and Dry Dock Co., and representatives of the officers and men of the ship's company." On the last day of 1942, USS *Essex* was commissioned.

Capt. Duncan was proud of his new command, but not so impressed as to ignore certain discrepancies that still existed. The ventilation system, for instance, was less than satisfactory. BU SHIPS sent representatives to the ship to assist in correcting discrepancies, during sea trials March 1 in the North Atlantic and, a month and a half later, when the ship was again at Norfolk and still had complaints.

As other CV-9 carriers were launched, the complaints continued to be registered. BU SHIPS investigated the ventilation system as installed in USS *Intrepid* (CV-11) and outlined corrective measures in future carriers of the class.

Requested to comment on the adequacy and operation of the trash burner installed in the *Essex*, Capt. Duncan started off quietly enough. "It is most unsatisfactory," he said. Then



VIEWS IN FEBRUARY 1944, her flight deck covered with parked aircraft, USS Lexington (CV-16) had already been commissioned one year.

Her namesake, CV-2, was sunk in the Battle of the Coral Sea. CV-16 earned the Presidential Unit Citation, 11 battle stars, and other awards.

he warmed to his subject. "It is doubtful if it could be worse. It is in the very center of the office spaces. There is no satisfactory place for collection of trash waiting its turn to be burned. All of it has to be carried through the passageways in the vicinity of the departmental offices. The heat from the trash burner when it is operating (which is not often because it is usually broken down) is such as to make the surrounding spaces almost untenable.

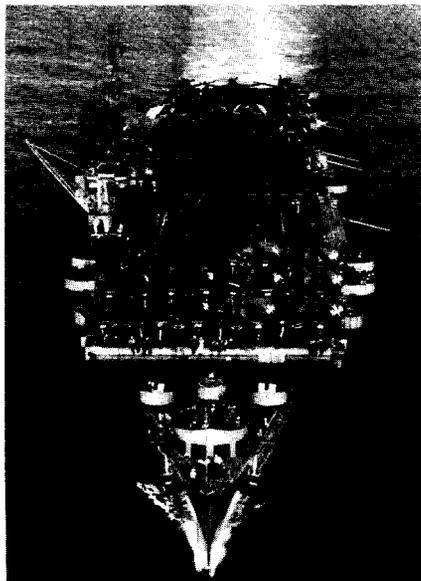
"The design of the trash burner is poor. Its construction is worse. The ship had not been in commission a month before it practically fell apart. The brick work fell down, the door fell off and it suffered other casualties too numerous to mention. It has taken constant attention from the Engineer's force to keep it operating at all and the heat generated in the compartment in which it is located is such that it is physically impossible for men to stay in it for continuous operation."

The trash burner was redesigned.

Lexington was commissioned on February 17, 1943, followed by *Yorktown* on April 15, *Bunker Hill* on May 25, *Intrepid* on August 16, *Wasp* on November 24, and *Hornet* on November 29 that year. In 1944, *Franklin* was commissioned on January 31, *Hancock* on April 15, *Ticonderoga* on May 8, *Bennington* on August 6, and *Randolph* on October 9. The last of the programmed 13 CV-9's, *Boxer*, was commissioned on April 16, 1945.

The lighting system installed in the *Lexington* came under the scrutiny of BUShIPS. Generally, it was considered inadequate—"in intensity and quality"—in many passageways and compartments, in addition to the running, signal, and anchor lights. A survey of the system produced the following action on the outside lights: the ahead masthead light was relocated to the forward edge of the foretruck (frame 92), the ahead range light was moved forward and shielded from illuminating the deck below, the astern masthead light was moved higher, so as not to interfere with gunnery, and the astern range light was removed.

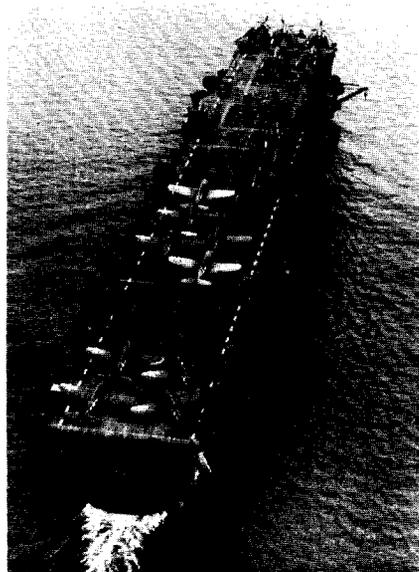
Nineteen more Essex-class ships were ordered or scheduled, starting with ten of them on August 7, 1942. They were *Bon Homme Richard* (CV-31) *Kearsarge* (CV-33), *Oriskany* (CV-34), *Reprisal* (CV-35), *An-*



THE USS COWPENS (CVL-25), was one of nine cruiser-to-aircraft carrier conversions.

tietam (CV-36), *Princeton* (CV-37), *Shangri La* (CV-38), *Lake Champlain* (CV-39), *Tarawa* (CV-40), and *Crown Point* (CV-32)—later renamed *Leyte*. The last three ordered were *Valley Forge* (CV-45), *Iwo Jima* (CV-46), and *Philippine Sea* (CV-47). The keels were laid for *Reprisal* and *Iwo Jima* on July 1, 1944 and January 29, 1945, but both were cancelled on August 11, 1945. Six additional 27,000-tonners, CVs 50 through 55, were canceled on March 27, 1945.

In recap, after WW II erupted and



USS INDEPENDENCE (CVL-22) has SBD's and TBF Avengers on deck in July 1943 in Pacific.

until its successful conclusion by Allied forces, the U.S. Navy ordered 32 aircraft carriers of the CV-9 class, of which the keels of 25 were laid down. A total of 17 were actually commissioned during the war years. The total number of CV-9's commissioned—including those commissioned after the war—was 24.

Several characteristics marked the *Essex* class carriers upon their introduction to the Fleet. The pyramidal island structure, for instance, rose cleanly from the starboard side, topped by a short stack and a light tripod mast. The port elevator was also a distinguishing feature, along with the two inboard elevators. *Ticonderoga*, *Randolph*, *Hancock*, *Bennington* and *Boxer*, as well as hull numbers from CV-31 on, had rounded bows extending beyond the flight deck.

Overall lengths varied within this class; they were either 872 feet long or 888. It is interesting to note that they had a uniform water line length of 820 feet. All were armed with 12 five-inch .38 caliber dual purpose guns, but some had 17 quadruple 40mm anti-aircraft mounts while others had 18. A few also had 20mm AA armament. Generally, there were accommodations aboard each for 360 officers and 3088 enlisted men.

Except for CV-2 and CV-3, *Lexington* and *Saratoga*, the power plants were increased over other aircraft carriers in the Fleet. The machinery was "entirely modern in design and arranged so as to gain the maximum resistance to derangement and battle damage. There are eight control superheat boilers arranged in four fire-rooms. Steam lines are such that the boilers in each fireroom can be connected to one main machinery unit so that the plant can be operated as four separate units." They had four screws.

These carriers had better protecting armor than their predecessors (again excepting *Lex* and *Sara*), better facilities for handling ammunition, safer and greater fueling capacity, and more effective damage control equipment.

THE TACTICAL employment Of U.S. carriers changed as the war progressed. In early operations, through 1942, the doctrine was to operate singly or in pairs, joining together for the offense and separating when on the defense—the theory being that a

separation of carriers under attack not only provided a protective screen for each, but also dispersed the targets and divided the enemy's attack. Combat experience in those early operations did not bear out the theory and new proposals for tactical deployment were the subject of much discussion. As the new *Essex* and *Independence* class carriers became available, these new ideas were put to the test.

The *Independence* class carriers—light carriers, designated CVL's—were products of an effort to increase this country's sea-going air strength in the early days of the war. Nine keels to light cruisers of the Cleveland class were laid down at the New York Shipbuilding Corp. yard at Camden,

name was changed to USS *Langley* and she was given the designation CVL. (Actually, all these cruiser-to-carrier conversions were originally designated CV's when the decision to convert was made; all were redesignated CVL's on the same day.)

The *Newark* (CL-100) had a rougher time of it. On June 2, 1942, she was changed to CV-30; on June 23, her name was changed to *Reprisal*, which she kept for a little over six months. On Jan. 6, 1943, her name was again changed, to *San Jacinto*.

The light carriers displaced 11,000 tons standard. In design, the bridge was box-like in appearance, with a small crane forward. They had four stacks, paired off in twos, on the star-

board side of the island. Task Force 15, which conducted the raid, consisted of *Yorktown* (CV-10), *Essex* (CV-9) and *Independence* (CVL-22), the cruisers *Nashville* and *Mobile*, the battleship *Indiana*, and ten destroyers. Aircraft were launched from the carriers at a point approximately 130 miles north of the island.

On October 5-6, 1943, RAdm. Alfred E. Montgomery led Task Force 14 on a second raid on Wake Island. The task force was comprised of two task groups, operating a total of six aircraft carriers—*Essex*, *Yorktown* (CV-10), *Lexington* (CV-16), *Independence*, *Belleau Wood*, and *Cowpens*—seven cruisers and 24 DD's, the largest carrier task force yet assembled.



FAST CARRIER task forces included both *Essex* and *Independence* class carriers, shown above, and viewed from USS *Lexington* in January 1945.



ON A PHOTO mission, a TBM passes USS *Shangri La* (CV-38), named in honor of the Doolittle raid on Japan and paid in full by War Bonds.

N. J., three of them before the war started. They were to have been the *Amsterdam* (CL-59), *Tallahassee* (CL-61), *New Haven* (CL-76), *Huntington* (CL-77), *Dayton* (CL-78), *Fargo* (CL-85), *Wilmington* (CL-79), *Bufalo* (CL-99), and the *Newark* (CL-100). They eventually became the *Independence*, *Princeton*, *Belleau Wood*, *Cowpens*, *Monterey*, *Langley*, *Cabot*, *Bataan*, and the *San Jacinto*, CVL's 22 through 30, respectively.

Naming and designating these last four sometimes went through a rigorous and confusing metamorphosis. Neither *Cabot* nor *Bataan* encountered any difficulty. The names and designations were reached in June and July 1943 without attending problems. But *Fargo* was named *Crown Point* (CV-27) when the decision was reached to convert her to an aircraft carrier. Then, on July 15, 1943, her

board side, aft of the island. These stacks angled out from the hangar deck and rose vertically above the flight deck level.

As the *Essex* and *Independence* class carriers joined the Fleet in increasing numbers, it was possible to operate several carriers together, on a continuing basis, forming a carrier task group. Tactics changed. Experience taught the wisdom of combined strength. Under attack, the combined anti-aircraft fire of the task group carriers and their screen provided a more effective umbrella of protection against marauding enemy aircraft than was possible when the carriers separated. When two or more of these task groups supported each other, they constituted a fast carrier task force.

The first attempt to operate a multi-carrier group occurred on August 31, 1943, during a raid on the

In the course of the two-day strikes, ship handling techniques for a multi-carrier force, devised by RAdm. Frederick C. Sherman's staff, were tested under combat conditions.

Adm. Chester W. Nimitz, then Commander in Chief, Pacific Fleet, dispatched his congratulations. "The thorough job done on Wake by planes and ships of your task force will have results reaching far beyond the heavy damage inflicted."

The words were prophetic. Lessons learned from operating the carriers as a single group of six, as two groups of three, and three groups of two, provided the basis for many tactics which later characterized carrier task force operations. With the evolution of the fast carrier task force and its successful employment in future operations, the rising sun of the east began slowly to sink in the west.



ESCORT CARRIERS file in formation during World War II. Viewed from the Manila Bay (CVE-61) are sister Casablanca class carriers Coral Sea (CVE-57), later renamed USS Anzio, Corregidor (CVE-58), and Natoma Bay (CVE-62), followed by Bogue class carrier Nassau (CVE-16)

Evolution of Aircraft Carriers

EMERGENCE OF THE ESCORT CARRIERS

'The story of the escort aircraft carriers is like a story with a surprise ending. When the United States began to build them, there was a definite purpose in view—fighting off submarines and escorting convoys. But as the war progressed, the small carrier demonstrated surprising versatility. It became a great deal more than its name implies. From a purely defensive measure, the escort carrier emerged as an offensive weapon.'—FAdm. Chester W. Nimitz, USN, CinCPacFlt/CinCPOA, 1945

TOWARD THE END of World War I, Great Britain experimented in converting light cruisers to airplane carriers—notably in HMS *Cavendish* of 32 knots and about 10,000 tons displacement. But with the signing of the Armistice, the project was abandoned. Despite this, it was a subject of interest in the following years.

In 1925, the General Board seriously considered the conversion of cruiser hulls to aircraft carriers. Although treaty limitations restricted the building up of carrier strength, there was sufficient uncommitted construction tonnage to permit the building of more carriers than the U.S. Fleet had. Could this uncommitted tonnage be best employed in building small carriers? The Board's answer can best be summed up in this excerpt from its report:

"Incomplete studies of the subject by the Bureau of Construction and Repair and the meagre information available concerning the performance of airplanes from carriers of approximately 10,000 tons displacement does not justify building them at this time."

But the subject of "light" carriers

By Scot MacDonald

was of recurrent interest to the U.S. Fleet. In May 1927, LCdr. Bruce G. Leighton prepared a paper in which he analyzed the problem. He titled it, "Light Aircraft Carriers, A Study of their Possible Uses in So-Called 'Cruiser Operations,' Comparison with Light Cruisers as Fleet Units." Though the title may have been cumbersome, the document was impressive. He forecast every fundamental combat requirement of the later-day CVL's and CVE's, including the bombing of capital ships, support of fleet operations, anti-submarine work, scouting and reconnaissance, and the reduction of enemy shore bases. He concluded that "all things considered, it might well be considered as a worthy substitute for the light cruiser, or even distinctly preferable to the cruiser."

For the next dozen years, the subject interjected itself spasmodically and unsuccessfully into Navy thinking. But in March 1939, Capt. John S. McCain, Sr., then commanding the *Ranger*, wrote to the Secretary of the Navy

advocating the building of at least eight "pocket-size" carriers of cruiser speed. These were not meant to replace the CV's, but to supplement them, giving force commanders much more flexibility in the use of ship-based aircraft at sea, without jeopardizing the much more costly heavy carriers. RAdm. Ernest J. King, in his endorsement to the letter, was not at all enthusiastic about this scheme. He suggested that existing aircraft carriers carry the maximum number of planes permissible as a better solution than the construction of smaller carriers.

The matter was not entirely dropped, however, for the Bureau of Construction and Repair was considering, and even drawing plans for the conversion of 20- or 21-knot passenger ships, creating experimental carriers with short flight decks. By November 1940, the Chief of Naval Operations brought these considerations to an abrupt halt, basing his decision on a letter from SecNav to the Chairman of the U.S. Maritime Commission. SecNav wrote:

"The characteristics of aircraft have changed, placing more exacting de-

mands upon the carrier. These demands are such that a converted merchant vessel will no longer make as satisfactory an aircraft carrier as was the case when the plans for those vessels were being drawn."

In commenting on the beginning of escort carriers, historian Lt. William G. Land, USNR (*Functional Development of the Small Carrier* [CVE]) says, "The escort carrier was forced upon the Navy by the President."

Indeed, President Franklin D. Roosevelt did actively enter the "light" carrier controversy. Great Britain had been at war with Germany since September 1939. Since that time and before the U.S. entered the war, large numbers of U.S.-built military aircraft were sold to the British. The U.S. had need for an aircraft-carrying ship to speed delivery. By mid-February 1941, RAdm. W. F. Halsey (later Fleet Admiral) had written to Commander-in-Chief, U.S. Fleet:

"A previously stated expectation, that the Navy would be called upon to provide transport for Army aircraft, has now materialized in the current diversion of *Enterprise* and *Lexington* to transport 80 pursuit planes from the West Coast to Hawaii. To continue with primary reliance on aircraft carriers for such work, as is our present necessity, seriously endangers the availability of air-offensive power in the Fleet."

Adm. Husband E. Kimmel, in endorsing this letter from his Commander Aircraft Battle Force to the Chief of Naval Operations, fully concurred and pointed out that on five separate occasions in the past he had himself urged such action.

Earlier, on October 21, 1940, CNO had received a memorandum from the President's Naval Aide advising him that President Roosevelt proposed the Navy acquire a merchant ship and convert it to an aircraft carrier, accommodating 8 to 12 helicopters (not yet operated by the Navy) or airplanes capable of landing or taking off in a small space. The purpose of this type carrier was to "provide quick conversions for carrying small planes which could hover ahead of convoys, detect submarines and drop smoke bombs to indicate their locations to an attacking surface escort craft."

CNO decided on the last day of 1940 that the Chairman of the Maritime Commission would be consulted to de-

termine the availability of ships for this purpose. On January 2nd, it was found that two Danish ships might permit conversion, but later investigation proved this would not be possible. The results of this January 2 conference determined that the ships (two—one was to be sold to Great Britain) selected "should be of the same or very similar design in order that the plans made for one could be applicable to both; that the airplanes should be further investigated to determine the type and availability; that an armament of four AA pom-poms and one 5" surface gun should be such as to insure stability at all stages of loading." These converted merchant ships were to fill the need later expressed by Adm. Halsey, the transport of aircraft, as well as to provide protection to Allied convoys.

On January 6, 1941, Adm. Harold R. Stark, CNO, convened a conference in his Washington office to discuss merchant-conversion. The autogiro type aircraft was considered of dubious usefulness because of its inability to carry any load other than smoke bombs; an aircraft, to meet the purpose designed, must have some offensive characteristics. An abbreviated deck was ruled out. The converted ship should be diesel-driven in order to eliminate smokestacks. The decision was made to obtain from the Maritime Commission, if possible, C-3 cargo ships.

On the following day, CNO was informed that two diesel-driven C-3 type ships, the *Mormacmail* and the *Mormacland*, would be suitable for conversion and were available. He was told by President Roosevelt that any plan which would take more than about three months to complete conversion would be unacceptable. This, in effect, placed pressure on the project. The idea of substituting "blimps" for autogiros or heavier-than-air craft was flirted with but, by January 15, was "out of the picture."

The *Mormacmail* was acquired on March 6, 1941. On June 2—just within the three-month limitation set by the President—she emerged from conversion and was placed in commission as the aircraft escort vessel USS *Long Island* (AVG-1), commanded by Cdr. Donald B. Duncan who, on December 31, 1942, was to be the first commanding officer of USS *Essex*.

Early plans for the conversion called for the installation of a 305-foot flight

deck on the *Mormacmail*, but the Bureau of Aeronautics required at least 350 feet to safely land SOC *Sea Gulls* aboard. Upon commissioning, *Long Island* had a deck length of 362 feet. She had one elevator, handled 16 planes, had a trial run speed of 17.6 knots, and berthed 190 officers and 780 men.

The *Mormacland*, acquired at the same time, was similarly converted and was turned over to the British as HMS *Archer* (BAVG-1) when it was completed the following November. Experience with the BAVG and the two British conversions led the British to believe that the diesel-driven ships were too slow for their purpose as special escort vessels—although they were no slower than the later *Bogue* carriers.

Long Island was used primarily as a training ship during the remaining peacetime months of 1941. She was subjected to tests and experiments—much the way USS *Langley* had been in her early days—to obtain data needed for the construction of later escort carriers. As a result of the Navy's experiences with this ship, other CVE's were outfitted with two elevators instead of one, the flight decks were lengthened, and the anti-aircraft power was increased.

On December 26, 1941, SecNav approved the conversion of 24 merchant hulls for the 1942 shipbuilding program and, in March, ordered the conversion of cruiser hulls which became the CVL's. Cdr. Leighton's 1927 paper was proving its farsightedness.

Naval Aviation historian, Dr. Henry Dater, traced the next developments in a paper published in *Military Affairs*:

"There were only 20 C-3 hulls available for conversion, ten of which were earmarked for the Royal Navy and ten for the United States. The new ships were improved by the substitution of a steam turbine power plant for the diesel engines employed in the *Long Island* and *Charger* [the latter was redesignated CVE-30 and replaced CVE-1 as a training ship when the *Long Island* was pressed into service, ferrying planes and pilots at the outbreak of war], and by the addition of a slightly larger flight deck (436 by 79 feet), a small island, and a considerably larger hangar space.

"They were referred to either as the CVE-6 class, from the numerical designation of HMS *Battler*, or as the *Bogue* class, from the first ship to operate with the U.S. Navy.

"The remaining four CVE's authorized for the 1942 program were converted from *Cimarron* class fast fleet oilers and were known as the *Sangamon* (CVE-26) class. These were considerably larger, having a flight deck of 503 feet by 85 feet, and were able to accommodate two small squadrons of aircraft. Because of their size, work was rushed on them during the summer of 1942 so that they would be available for the North African invasion in the autumn."

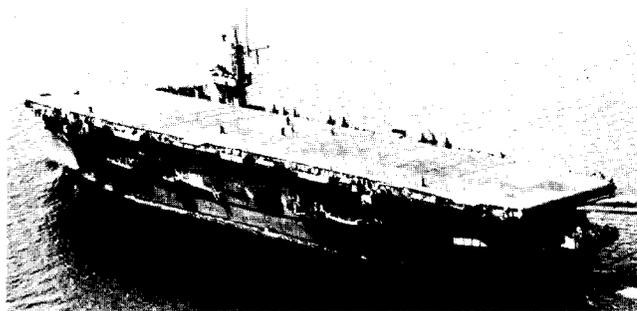
Before the U.S. entered the war, German U-boats hovered near British coastal ports and picked off merchant ships with ease. Land-based RAF planes drove the German submarines further out to sea. To make matters more difficult for the enemy, convoys sailed

They left a double space in the middle in the center of which they placed the *Bogue*. The other escorts were placed around the convoy in a half circle. The idea was, if possible, to use our catapults and to stay in our center position when launching our planes so there wouldn't be any wide separation. As it happened, we had westerly winds on the East-bound convoy so we had to turn around to launch planes and to take them aboard. Consequently, the separation was fairly large due to the fact that it was what is called a high speed convoy, 'nine knots!'"

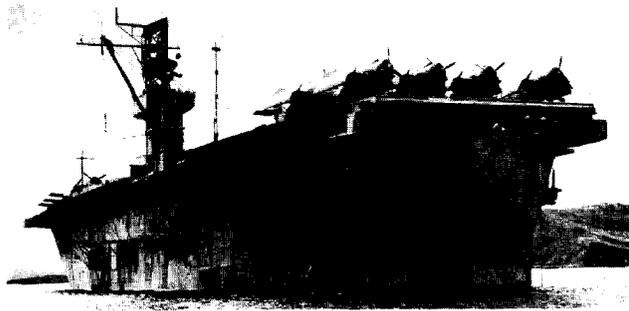
Though this tactic met with considerable success at first, it was primarily defensive. A new technique was found more effective. A small task group took up a position where it could throw

length of 553 feet, a speed of 18.3 knots, a trial displacement of 23,235 tons, and carried 120 officers and 960 men. They were armed with two five-inch, 38 calibre guns, two quad and ten twin 40mm AA mounts. They were equipped with two hydraulic catapults forward.

"With the CV's, except *Ranger*, being employed in the Pacific," wrote historian Land, "planning for the North African landings depended on the completion of the AO conversions of *Suwannee*, *Sangamon*, *Chenango*, and *Santee*. For this reason, *Suwannee* had to cut down on its pre-commissioning period, fitting out, and shakedown in order to be substituted in the final plans for the much smaller *Charger*,



BOGUE CLASS escort carriers were products of the 1942 shipbuilding program. They were converted from Maritime Commission C-3 hulls.



USS SUWANEE was one of four escort carriers converted from Cimarron class fleet oilers. They were rushed to completion for battle duty.

closer together, opening up larger areas of the North Atlantic for the German subs to search. The Germans solved this problem by developing the "wolf pack" technique of operating in groups, then concentrating for the kill when convoys were sighted.

"It was this technique which created the British desire for aircraft escort vessels in late 1940 and 1941," wrote Dr. Dater. "With the entry of the United States into the conflict the Germans found easy picking off the American coast, but it was only a matter of time until land-based air on this side of the Atlantic drove them out to sea once more. There in mid-ocean was a vast area in which the convoys did not have the assistance of aircraft. By early 1943 it became evident that the decisive campaign was to be fought in that area."

The air officer of the *Bogue* described escort procedures during March and April 1943:

"The ship was stationed inside the convoy for this work. The convoys were in columns of five ships each with about 700 yards between columns.

its support to either of two convoys in a general area. Escort carrier-based aircraft scouted ahead, searching out German U-boats before the submarines could make contact. This permitted the carriers to be released from the difficult maneuver necessary in the central slot of the convoy. Out of this technique emerged the successful hunter-killer tactic that eventually freed Allied shipping in the North Atlantic.

The *Sangamon* class escort carriers, built as fleet oilers under the Merchant Marine Act of 1936, were completed in 1939, but in the 1942 shipbuilding program were slated for reconfiguration to aircraft carrier characteristics. Only four hulls were on hand. "Had more oiler hulls been available," wrote Lt. Land, "they would have become the prototype of the small carrier for the ensuing year's program. But the overwhelming need for fleet oilers—to make possible our logistic advance—prevented this type of hull from being again used for carriers, until 1944."

The *Sangamons* had an over-all

the ex-BAVG which had been doing regular duty as qualification carrier in Chesapeake Bay. *Santee*, likewise, was barely completed in its essentials and had had hardly any exercise with its air group before its first combat operation was to begin."

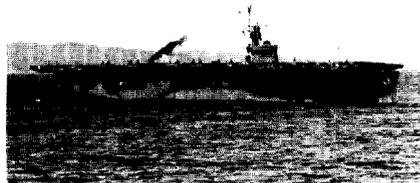
Capt. William D. Sample, commanding *Santee*, wrote of the hectic early days aboard:

"*Santee* left Norfolk Navy Yard 13 September 1942 with Yard workmen still on board and her decks piled high with stores. During that first month, the *Santee* returned to the yard twice and was never free of the Yard workmen. The completion of the ship continued while the fitting out and shakedown were proceeding together. At the end of the month, the air group had operated aboard only a day and a half and guns had been fired only for structural tests

"The Navy Yard had done an almost impossible task in getting the ship out in time for the pending operations but, in so doing, only the essentials had been completed, and it was then necessary for the ship to install, adjust, calibrate and repair until the ship could



ARMY P-40 Warhawk fighter catapults from the deck of a Sangamon class to North Africa.



CASABLANCA (CVE-55) was first of 50 escort carriers mass-produced by Kaiser shipyard.



COMMENCEMENT BAY class was concerned to provide trans-ocean convoys with air cover.

use her battery and equipment The service experience necessary to test many of the questionable features of the ship's design was soon obtained in a wintry gale encountered en route to Bermuda. The two forward boats were carried away, the new upper decks proved to be sieves and the repair work of the ship's force got underway in earnest."

The carrier *Chenango* was used, in the North African operation that followed, as a ferry carrier for Army P-40's on the outward trip, as a fuel supply ship while moored at Casablanca, and as a fleet escort—with a borrowed air group furnishing air cover-on the return trip.

Her sister ships, however, launched TBF-1 *Avengers*, SBD-3 *Dauntless* and F4F-4 *Wildcat* aircraft in support of landing operations for the capture of Casablanca and Port Lyautey. They were units of Task Force 34. As part of the Northern Attack Group, *Sangamon* and *Chenango* assisted troops landing at Mehedia, not far from Port Lyautey. *Ranger* and *Suwanee* provided air cover for the Center Attack Group at Fedhala, northeast of Casablanca. *Santee* was the only carrier assigned to the Southern Attack Group, providing combat air patrol and anti-submarine patrol for the landing force at Safi—the only port in Morocco, other than Casablanca, that would permit the landing of 28-ton General Sherman tanks. It was for the capture of Casablanca that these tanks were needed.

Between November 8-11, 1942, *Suwanee* launched 255 combat sorties; *Santee*, 144, and *Sangamon*, 183.

During *Sangamon's* participation in the Northern Attack Group operation, her planes were called upon to neutralize a Kasba or citadel, which guarded the Port Lyautey airdrome. Several

SBD's delivered bombs on target. "The garrison then," wrote Samuel Eliot Morison, "came out with their hands up and our infantry walked in." By November 15, *Sangamon's* part in the invasion of North Africa was completed and she sailed for Hampton Roads.

Planes in the *Suwanee* joined those based in the *Ranger* in bombing missions during the Battle of Casablanca. The *Suwanee*, like the *Santee* at Safi, encountered light winds. Many landings were made aboard with only 22-knot winds across the deck.

Despite the greenness of the crews in the *Sangamons*, generally, they gave a good account of themselves. Commented CinCLant: "The CVE's proved to be a valuable addition to the Fleet. They can handle a potent air group and, while their speed is insufficient, they can operate under most weather conditions and are very useful ships."

Their missions in the invasion of North Africa completed, *Sangamon*, *Chenango*, and *Suwanee* were dispatched to the Pacific. By the end of 1942, U.S. carrier strength in the Pacific had been reduced to the *Enterprise* and the *Saratoga*.

In the meantime, President Roosevelt announced a need for more escort carriers. Shipbuilder Henry J. Kaiser had impressed the President with the merits of a plan which would permit the mass production of escort carriers, under a program to be supervised by the Maritime Commission.

The first of these, USS *Casablanca* (CVE-55), was commissioned July 8, 1943, and gave its name to the class—CVE-55 through CVE-104. They were also referred to as Kaiser class escort carriers. The Kaiser yard completed its 50-ship program on July 8, 1944. This was an impressive achieve-

ment in wartime production program.

The *Casablanca* class had an over-all length of 512 feet, 3 inches, a speed of 19.3 knots, a trial displacement of 9570 tons, and carried 110 officers and 750 men. They had one five-inch, 38 calibre gun and eight twin 40mm AA mounts. The aircraft complement consisted of 12 TBM's and 16 FM-2's; in the flight deck was a single hydraulic catapult, forward.

Final details were worked out for a new class escort carrier during the trials of the *Sangamon* and *Santee* and during the planning for the 1944 building program. These ships were the first Navy-designed escort carriers for which hull and propeller model tests were carried out at the David W. Taylor Model Basin. The design was formally approved by CNO on December 10, 1942 and the contract was let on January 23, 1943. The first of these carriers was the *Commencement Bay* (CVE-105) from which the class got its name. It had an over-all length of 557 feet, a speed of 19 knots, and a trial displacement of 23,100 tons. Few of these ships saw action in the war—the *Commencement Bay* was commissioned in November 1944. Only nine others were commissioned before V-J Day the following September. They incorporated all lessons learned since the *Long Island* was commissioned.

As the escort carriers gained experience, they earned the respect of the Fleet by proving themselves versatile in anti-submarine warfare. The *Sangamon* class first demonstrated combat capability in the support of the North African invasion. The first major carrier-supported amphibious landing in the Pacific was the capture of the Gilberts and Marshalls. Eight escort carriers participated, two of the *Bogue* class, three of the *Sangamon* class, and

three of the *Casablanca* class. The changing status of these vessels is reflected in their redesignation. Originally identified as aircraft escort vessels (AVG's), they were redesignated on August 20, 1942, auxiliary aircraft carriers (ACV's), and finally, on July 15, 1943, a directive changed the escort carrier symbol to CVE, reclassifying them as combatant ships.

At the end of the North African invasion, RAdm. Calvin T. Durgin (then Capt.) evaluated the effectiveness of the escort carriers when he presented his report:

"Due to their low speed, lack of protection and light armament, it is considered hazardous to employ a CVE group in operation where there is likely to be an effective enemy opposition. Such a group can, however, be used to advantage, and is capable of inflicting substantial damage to the enemy in assault where the enemy air and sea opposition is negligible or when it is being contained by other superior forces. When this situation exists, the CVE is well equipped to provide all support until landing strips are established ashore, and it can be effectively employed for bombardment spotting, combat air patrols over beaches and surface forces, for all forms of air reconnaissance missions and for bombing, rocket and strafing attacks."

His experience with escort carriers was to stand him in good stead. On December 13, 1944, the functional type command, Escort Carrier Force, Pacific, was created; RAdm. Durgin was placed in command.

The establishment of this force was

made possible by the increasing number of carriers—notably of escort design—made available to the Fleet. Experience at Palau and Morotai and the difficulties encountered later at Leyte all pointed to the need for better planning in advance of operations if the CVE's were to perform efficiently their enlarged responsibilities. Adm. Durgin's command held administrative control over all escort carriers operating in the Pacific, except those assigned to training and transport duty.

On December 15, 1944, the escort carriers provided direct support for landings on Mindoro, and in the assault area on the next two days. Between January 3-22, 1945, 17 escort carriers covered the approach of the Luzon Attack Force against serious enemy air opposition from Kamikaze pilots. This force of ships, Task Group 77.4, conducted preliminary strikes in the assault area, covered the landings in Lingayen Gulf, and supported the inland advance of troops ashore.

In 1945 the CVE's saw a great deal of action. On the last three days of January, six escort carriers under RAdm. Sample (as Capt., first C.O. of *Santee*) provided air cover and support for landings by Army troops at San Antonio near Subic Bay, and at two other nearby Philippine beaches. In February, Adm. Durgin directed his carriers in the battle for the capture of Iwo Jima. In March, the Okinawa campaign began, the last, and, for naval forces, the most violent major amphibious campaign of World War II. As Task Group 52.1, Adm. Durgin,

with an original strength of 18 escort carriers, conducted pre-assault strikes and supported the occupation of Kerama Retto, joined in the pre-assault strikes on Okinawa, and, from a fairly restricted operating area southeast of the island, supported the landings and flew daily close support for operations ashore until the island was secure on June 21.

The U.S. suffered few losses to the enemy in these ships. Five carriers of the *Casablanca* class were lost in the Pacific; one *Bogue* class was torpedoed in the Atlantic. During the war years, 76 CVE's of various classes were commissioned, in addition to the *Long Island*, commissioned months earlier. Seven more *Commencement Bay* class were commissioned during the post-war years. During the war, four sister ships to *Long Island* were transferred to the British, as were 34 additional escort carriers of the *Bogue* class. Four were sunk; at the end of the war, the rest were returned to the U.S. from Lend-Lease and were either sold or placed in the reserve fleet.

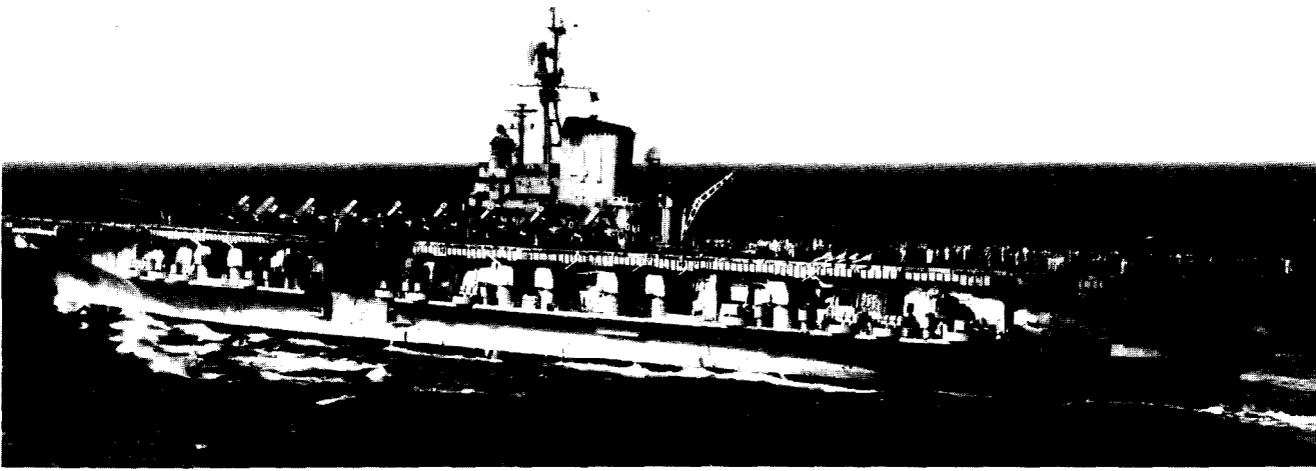
Through fulfilling a basic need of transporting large numbers of assembled aircraft to various theaters of war, the quickly conceived and executed escort carrier developed into an anti-submarine warfare weapon that defeated the German U-boat threat in the North Atlantic. They provided combat capability in the support of fleet operations in both the Atlantic and the Pacific. In short, they displayed a versatility, proved under the pressures and urgencies of a war that engulfed the world.



VADM. (THEN RADM.) Calvin T. Durgin was the Commander Escort Carrier Force, Pacific.



NINE ESCORT CARRIERS break formation in the Pacific to take up stations. Originally designed for escort ASW work in the North Atlantic, they were designated combatant ships in July 1943.



USS MIDWAY (CVB-41) was the first of six planned carriers of a new design. Construction began during World War II. Toward the end of hostilities, three of the new carriers were cancelled. Upon delivery, the Midways were the mightiest aircraft carriers in the world.

Evolution of Aircraft Carriers

CVB'S: THE BATTLE CARRIERS

'The life of the *Midway* also demonstrates the progress of our Navy; the accommodation of our ships to aircraft of high performance; the use of missiles; exploitation of electronics; the capability to employ a whole family of weapons unheard of when her keel was first laid. No other navy, no other service of any country, has a single military unit as powerful, as versatile and as mobile as this great ship.'—VAdm. George W. Anderson, Jr., Chief of Staff, U.S. Pacific Command, 1957.

LIKE THE CVE's, the CVB's were a direct product of World War II needs and experience, though their missions were different. The former were to be most effective in providing close-in support of troop landings. The latter was designed to pit against the enemy the most potent aircraft carrier the world had yet seen.

The CVB's were to provide a solution to the problem of designing a tough rugged ship which would have good aircraft operating features as well as every possible characteristic that would enable it to both give and take punishment. Our early war losses were caused by our failure to adequately control damage sustained. It was obvious that we needed a much sturdier aircraft carrier than we operated in the early years of the war, one with an armored flight deck and improved compartmentation. The resulting design gave us a new breed of ship, battle-cruiser fast, battleship rugged, and with more aircraft operating capacity than anything we had known.

At the same time, aircraft design-

By Scot MacDonald

ers were producing larger, heavier types to be operated off sea-going carriers. These higher performance planes, heavier, faster, would place great demands on the flight decks of the proposed CVB's. The planes would require greater room, and these considerations added to the over-all weight of the constructed carrier.

On July 9, 1942, Congress authorized their construction. Already, the toll on both U.S. and Japanese carriers had been heavy. In January that year, the *Saratoga* was damaged by submarine torpedo and forced to a yard for repairs. In the Battle of the Coral Sea in May, the light carrier *Shoho* was sunk by U.S. carrier-based planes which, the next day, also damaged the *Shokaku*. In this battle, the *Yorktown* was damaged; the *Lexington*, ravaged by uncontrollable fires, sank. During the decisive Battle of Midway, the Imperial Japanese Navy lost the *Akagi*, the *Kaga*, the *Hiryu*, and the *Soryu*, *Yorktown*, already damaged at Coral

Sea, was hit again at Midway and on June 7 was sunk.

Midway was a significant victory for the Allied forces. While proving a turning point in the war, it again conclusively demonstrated the warfare potential and, in fact, superiority of carrier aviation. To commemorate the occasion, the escort carrier CVE-63 was named USS *Midway*, but on September 15, 1944, her name was changed to USS *St. Lo*, relinquishing her name to the first of a new class aircraft carrier then being built, USS *Midway* (CVB-41). This battle carrier was laid down on October 27, 1943. A sister ship, CVB-42, was laid down as USS *Coral Sea* on December 1, 1943, but upon the death of the President, was renamed USS *Franklin D. Roosevelt*. The third large aircraft carrier built, CVB-43, became USS *Coral Sea*.

Contracts for the new carriers were signed August 7, 1942, and by September 18, plans for them were well under way. On that date, the Chief of the Bureau of Ships wrote to the Commander in Chief, U. S. Fleet, to

the Vice Chief of Naval Operations and to several Bureau chiefs, discussing the proposed contract design:

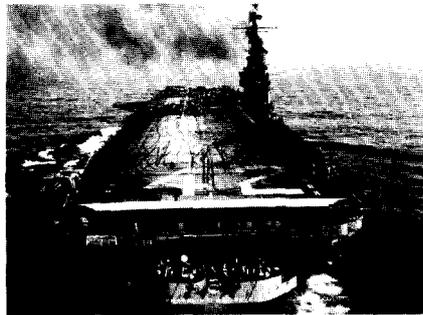
"It will be noted that the island is shown offset from the side of the flight deck to the maximum extent permitted by clearance for passage of . . . the Panama Canal," he wrote. "This location of the island has the obvious advantage that a straight fore and aft flight deck runway for airplanes is interfered with to the least possible extent. It gives a flight deck width in way of the island of 107 feet."

This was one of the last times the Panama Canal was a limiting factor in the construction of aircraft carriers. The "Canal block" was broken when it was later decided to construct a carrier not to go through it.

Concerning the island structure, BuShips continued: "Extensive wind tunnel model tests of the CV-9 class island with a large number of modifications involving various degrees of streamlining and attempts to reduce smoke nuisance on the flight deck caused by stack gases have been performed. These studies showed clearly that the details of island contour were of negligible importance in effect upon air-flow patterns as compared with the bulk of the ship and of the island itself. In view of these conclusions, attempts to streamline the various essential protuberances on the island and of the island itself were discarded in the case of the CV-9 class and, therefore, have not been incorporated in the present plans."

The island structure was the subject of considerable correspondence in the months and years following. There was an obvious effort by most bureaus to keep the island as small as possible. In this there was general agreement. Comment and discussion became extensive when locations of specific spaces in the island were brought up, as well as uses to which they would be put. Occasionally, proposed requirements threatened to bloat the island structure, but as alternate locations were found, it was possible to keep it to a reasonable size. In October 1942, for instance, the Chief of the Bureau of Aeronautics, RAdm. John S. McCain, noted:

"Location in the island of the following space, the functions of which do not necessarily require island space



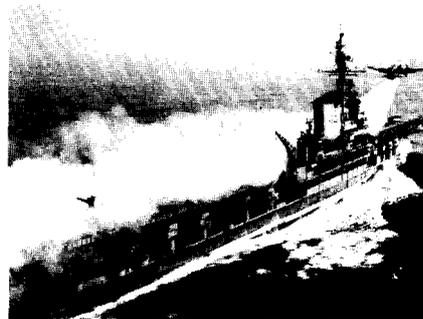
STERN VIEW of the FDR shows increased flight deck space and small island arrangement.

is noted: Pilot balloon room, two squadron lockers, repair I, flight deck crew, flight deck control, flight deck equipment, and one unassigned space. . . . This bureau considers that effort should be continued to reduce island size."

The original proposals called for the installation of two flushdeck type catapults capable of launching VT type aircraft and one double action type in the hangar, capable of launching fully loaded VSB type aircraft. But by October 1942, the General Board considered the complications involved in the installation of a hangar catapult and decided against it. Within the year, the decision was reached to eliminate hangar catapults from *Essex* class carriers, then either under construction or planned.

Hangar fires resulting from combat damage offered particular danger in both Japanese and U. S. aircraft carriers during the early days of the war. In designing the CVB-41 class carriers this danger was considerably lessened by the introduction of four bulkheads in the hangar, dividing it into three spaces connected by sliding doors.

Underwater subdivision of compartments and spaces was given considerable attention, in event of torpedo



JATO TAKEOFF is made by a P2V Neptune from the deck of USS Franklin D. Roosevelt.

or mine hit, and was described as "excellent." To provide additional protection, the flight deck was armored with 3½ inches of solid steel, and the deck side belt armor at the waterline tapered from 7½ inches to 3.

In 1943, the wave of war in the Pacific turned against the Japanese as Allied forces made a concerted offensive, capturing Rendova Island in July. The Japanese-held airfield at Munda in New Georgia island was taken by the Allies, who invaded Bougainvillea in October and landed on the Gilberts in November.

That same year, U. S. shipyards launched and the Navy commissioned 15 CV's and 24 CVE's.

In early 1944, the Marshalls were taken. On the first day of this operation, complete control of the air was obtained and maintained by carrier-based aircraft. The Marianas were invaded in June and Guam recaptured in August. Leyte was occupied in October-November, the opening blows struck by Task Force 38 under VAdm. Marc Mitscher. American shipyards, mass production well organized, launched 7 more CV's, 33 more CVE's.

March 18 to June 21, 1945, the Okinawa campaign raged. The desperate Japanese had already turned to the *Kamikaze* strikes and now introduced the *Baka* bomb, seriously damaging the carrier *Franklin*. Between May and August, carrier-based aircraft were launched against the Japanese home islands, destroying or immobilizing the remnants of the Japanese Navy. On September 2, the formal terms of surrender were signed and World War II was over. Eight days later, on September 10, USS *Midway* was commissioned, the first of the CVB's, Capt. Joseph F. Bolger commanding. In the following month, on October 27, 1945, USS *Franklin D. Roosevelt* (CVB-42) was commissioned. Construction on USS *Coral Sea* (CVB-43) was delayed, the ship finally being commissioned on October 1, 1947. Three additional CVB's, the 44, 56 and 57, were cancelled.

The *Midway* was a giant among aircraft carriers. She had an over-all length of 968 feet, an extreme beam of 136 feet at the flight deck, and had a standard displacement of 45,000 tons. *Midway* had a trial speed of 33 knots, four propellers and a shaft horsepower of 212,000. She was armed

with 18 five-inch, 54 caliber single double-purpose guns, and 21 quad 40mm A.A. mounts. Like the *Essex* class carriers, CVB-41 had a deck-edge elevator in addition to her forward and aft elevators. She accommodated 379 officers and 3725 enlisted.

These general characteristics held true for her sister ships. But there were subtle differences, especially in the case of the *Coral Sea*. Comments in correspondence during construction of the *Midway* indicated that a large



CAMERAMAN records the first takeoff from USS *Coral Sea* (CVB-43) December 11, 1947.

number of minor modifications, learned in the construction of the CV-9 class carriers, the *Midway* herself, and from wartime experiences, would be incorporated in the final design of CV-43.

Midway had her shakedown in November 1945. Her aircraft aboard consisted of 57 F4U-4 *Corsairs*, 59 SB2C-4E *Helldivers*, and 4 F6F *Hellcats*, totalling 120 aircraft, 17 fewer than her full complement of 137.

The carrier's nucleus crew came from a Carrier Aircraft Service Unit (CASU) under ComAirLant. Plane handlers were sent to Great Lakes where they boarded the training ships *Sable* and *Wolverine* for an approximate six-week period during which they learned basic carrier work. The February *Naval Aviation News* of 1946 described their later training:

"The men then proceeded to a CASU, where they awaited shakedown of a carrier other than their own. Their own still was building. Most of the *Midway's* original crew leaders shook down on the USS *Antietam* and the USS *Charger*. On this shakedown, embryo plane handlers stood battle stations, observed the regular crew at work and finally assisted. They were supervised by a training officer from ComAirLant who expedited their progress.

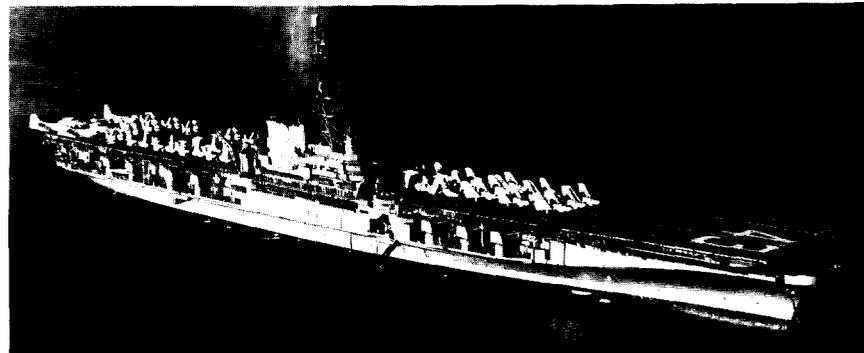


CORAL SEA is shown in Mediterranean waters during last tour before modernization work.

"Following this shakedown, the *Midway's* nucleus crew returned to a CASU near where the ship was building. Here they were groomed in taxiing, spotting and parking aircraft. The work [was] accomplished on a runway painted to simulate a flight deck. Also, they familiarized themselves with the aircraft they would be using."

Midway conducted her shakedown in the Caribbean, devoting 51 out of 57 days to air and gunnery operations, simulating all types of wartime conditions. Exercises included fueling escort ships at sea, damage control drills and problems, A.A. tracking and firing at towed spars and drones, emergency lube-oil drills for engineers, arming planes, gassing, and use of inert gas.

Air operations involved all types of flying and battle exercises, climaxing the tour with a two-day strike against the Caribbean island of Culebra—a well-pummeled three-mile tract of land used by U. S. warships for shakedown training at that time.



AT ATHENS, GREECE, USS *Coral Sea* makes an official visit in October 1956. Commissioned in October 1947, CVB-43 incorporated features learned in WW II and in other carrier construction.

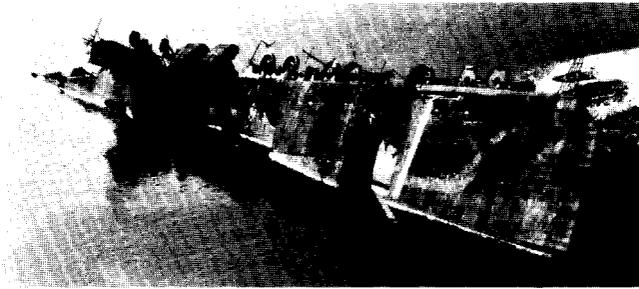
USS *Franklin D. Roosevelt* also conducted her shakedown training in the Caribbean, under command of Capt. Apollo Soucek. After post-shakedown alterations in New York, she was shifted to Norfolk, where she became flagship of Adm. Marc Mitscher during the first large-scale training operations since the end of World War II. These maneuvers of the Eighth Fleet took place in the western Atlantic between April 19 and May 27, 1946.

In the following year, during Caribbean maneuvers, Sikorsky H03S helicopters were operated. Noted *Naval Aviation News* in June 1947:

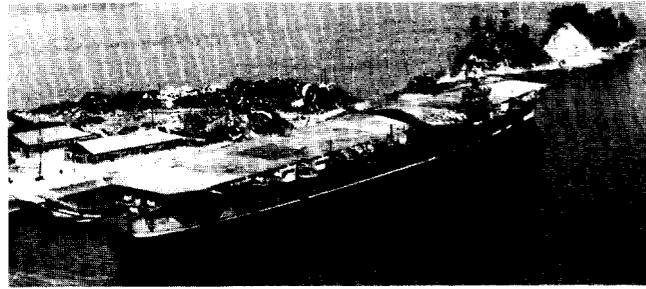
"It was not the first time a helicopter had operated off a carrier deck. Four (of them) were with the Byrd Antarctic expedition. . . . But the helicopter really proved its worth as a utility and rescue plane off the *FDR*, a showing which may have an effect on fleet operations of the future."

Activity of the *FDR* in the early post-war years was typical of that of her sister ships. After an extended yard period between March 1947 and July 1948, she completed refresher training in the Caribbean before leaving for her second tour in the Mediterranean. At this time, the "Berlin blockade" was formed and the presence of CVB-42 in that area provided a "show of strength." This was her mission for the next five years, as the Berlin blockade was followed by crises in eastern Mediterranean countries and armed aggression in Korea.

In October 1952, the CVB's were re-designated attack aircraft carriers (CVA's). In 1953 the fleet modernization program was authorized. First aircraft carrier to undergo rework was the *FDR*. The ships were equipped with steam catapults, hurricane bows, and the angled-deck design of Project 110.



JAPAN'S SECOND aircraft carrier to be named Amagi was of the Unryu class; the first was sunk at Midway. She accommodated 65 planes.



KATSURAGI CAME under attack at Kure, first by planes of TF 58 and then by TF 38. Note the buckled flight deck aft of island structure.

Evolution of Aircraft Carriers

THE END OF THE 'BOKUBOKAN' IN WW II

Japan is beaten, and carrier supremacy defeated her. Carrier supremacy destroyed her army and navy air forces. Carrier supremacy destroyed her fleet. Carrier supremacy gave us bases adjacent to her home islands. . . . Carrier supremacy demolished the island air bases and eliminated the air force which was using them. Carrier supremacy made the island naval bases untenable for such shipping as escaped our subs. Carrier supremacy permitted us to give close, tactical air support to the troops who stormed the island fortresses.—VAdm. Marc A. Mitscher, USN, quoted in *Naval Aviation News*, October 1945

WHEN JAPAN struck Pearl Harbor on December 7, 1941, she had the strongest aircraft carrier force in the Pacific. This supremacy lasted until June 1942, when the Battle of Midway was fought and won by the U.S. Thereafter, the *bokubokan* ("mother ship for aircraft"), though an effective and dangerous fighter, was an ever weakening force; ships sunk by U.S. planes and submarines were not replaced in sufficient numbers and strength. The study of the Japanese maritime wartime construction is a study of desperation in the face of an inevitable defeat.

At the outbreak of war, Japan had six fine *bokubokan*, the carriers *Akagi*, *Kaga*, *Soryu*, *Hiryu*, *Shokaku* and *Zui-kaku*, in addition to three lighter carriers, the *Zuiho*, *Hosho* and *Ryujo*. The keels were already laid for others and some conversions were being made. At that time, the U.S. had only seven carriers, widely dispersed. At the Battle of Midway, Japan lost *Kaga*, *Akagi*, *Hiryu* and *Soryu*—and never fully recovered from this decisive defeat.

Japan's first wartime constructed carrier was the *Taiho* ("Big Lucky Bird"), a 29,300-ton ship authorized under the 1939 estimates. Built at Kawasaki Dockyard, she was laid down in July 1941, launched in April 1943,

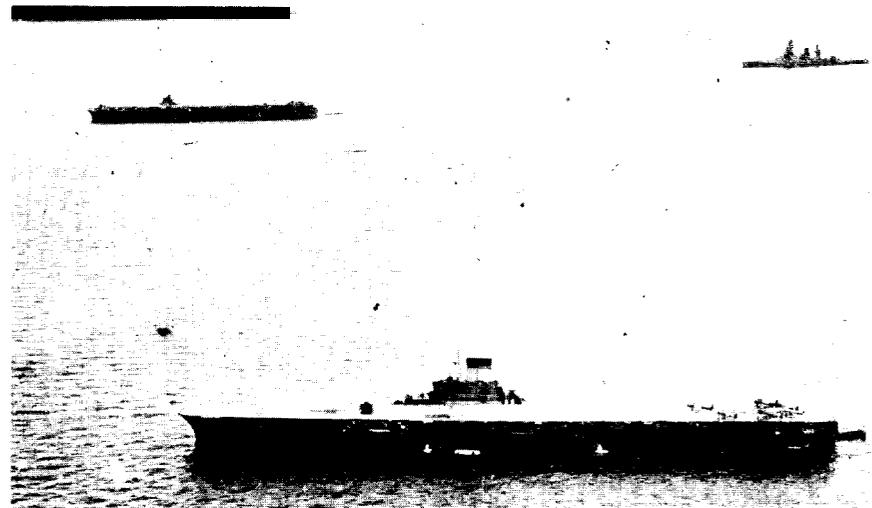
By Scot MacDonald

and delivered in March 1944. She had a cruising range of 10,000 miles at 18 knots, but could reach 33 knots with ease. Kawasaki claims her to have been the most heavily protected flattop in the world at the time of her delivery. And well she might have been; her armor was impressive.

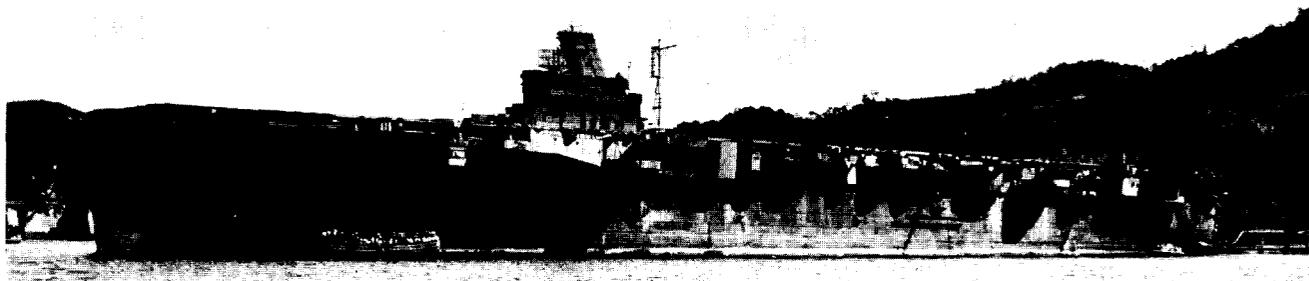
Taiho had 3¾ inches of plating on the flight deck between her two ele-

vators, covering a distance of some 164 yards. The platforms on these elevators were two inches thick and weighed 100 tons. Such weight required a low center of gravity for the ship, resulting in a very short distance between the water line and the flight deck, the same height as that of the *Hiryu*, a carrier some 12,000 tons lighter.

In designing and constructing this carrier, the slanting, low smokestacks of her predecessors were abandoned and



CARRIER TAIHO, foreground, accommodated 53 aircraft. She was sunk 180 miles north northwest of Yap 3 months after commissioning. *Shokaku* class carrier in background (1) with BB *Mutsu*.



CONVERTED TRANS-PACIFIC liner, the *Junyo*, was originally the *Kashiwara Maru*, displaced over 24,000 tons standard, had 12 five-inchers and accommodated 53 aircraft. Sister ship, *Hiyo*, was ex-*Izumo Maru*. Both were badly damaged by U.S. subs, *Hiyo* sunk by CVL-24 planes.

she returned to the "stack in island" type, the stack emerging high on the island and inclining outwards at 26°.

Taiho was an excellent carrier, but she had a short life: three months. On June 19, 1944, during the Battle of the Philippine Sea, she was hit by a torpedo from the U.S. submarine *Albacore*, damaging gasoline pipes and crippling her bow elevator while it was in the down position. Though her speed and maneuverability were not seriously affected, she did lose the ability to launch aircraft because of the elevator difficulty. Gas fumes spread through the ship. In a few hours she exploded and sank.

Five modifications of the *Taiho* class were ordered in the 1942 program, but none was laid down, owing to shortages and crowded shipyards.

The *Unryu* ("Cloudy Dragon") class was next to enter the scene. This ship was constructed under the 1941 estimates. Seven sister ships were ordered in the 1942 program. Two were never named and never laid down.

Unryu was a modification of the *Soryu's*, the plans simplified for quicker construction. She displaced 17,150 tons standard. Sister ships *Katsuragi* and *Aso* were slightly heavier, displacing 17,400 tons, while *Ikoma*, *Kasagi* and *Amagi* were heavier yet, 18,300 tons. They had a speed of 34 knots, except for *Katsuragi* and *Aso* which, because of shortages, were equipped with destroyer type engines and could

only reach a relatively slow 32 knots.

Not one of these ships took an important part in any engagement. Both *Unryu* and *Amagi* were completed in August 1944 and were used for transport duty. Exactly 105 days after her commissioning, *Unryu* was sunk by a torpedo from the submarine *Redfish*. *Amagi* suffered two attacks from U.S. carrier-based aircraft while the ship was at Kure. The second attack, on July 24, 1945, capsized her.

Katsuragi also came under attack by U.S. carrier planes four days later, also at Kure. She suffered minor damage because she was protected by camouflage. After the war, she was used for repatriation and was scrapped in 1947.

Neither *Aso*, *Kasagi* nor *Ikoma* was completed by the end of the war. *Aso* was launched November 1, 1944, *Ikoma* on October 17, and *Kasagi* two days later. They were 60% to 80% complete when work on them was halted because of material shortages. *Aso* was used as a target ship for Kamikaze training attacks and did not survive this abuse. *Ikoma* was moored at Shodo Jima where she sustained bomb damage toward the end of the war. She and *Kasagi* were scrapped. Seven more *Unryu* class ships were added to the 1942 program, but they never got beyond the paper work.

The Japanese wartime carrier construction program, though ambitious, was not at all successful. What few successes they did enjoy were short

lived. Since the pressure was on—especially after the Battle of Midway—it was natural that they would turn to quick conversions. In this area, too, the results were discouraging.

The submarine depot ships *Taigei*, *Tsurugisaki*, and *Takasaki* were the first to be converted. They became the *Ryuhō*, *Shohō* and *Zuihō*.

Ryuhō's structure was weak when she entered the yard for conversion. While being strengthened and given carrier characteristics, she was hit by several bombs from one of the B-25 bombers led by Jimmy Doolittle and launched from the USS *Hornet*. This, of course, delayed completion. When conversion was completed, she displaced over 15,000 tons standard. She had a speed of 26.5 knots, was armed with eight five-inchers, and accommodated 31 aircraft. *Ryuhō* saw much action, participating in the battles of the Philippine Sea and Leyte Gulf in 1944. In March 1945, she was moored at Kure, bombed by carrier-based U.S. aircraft, and gutted by fires.

Shohō and *Zuihō* both displaced over 13,000 tons standard upon completion of conversion. *Zuihō* was completed in December 1940, while *Shohō* was completed nearly two years later. Both had a speed of 28 knots, were armed with eight five-inchers, and accommodated 30 aircraft.

Shohō's first battle was her last: she was sunk by carrier-based aircraft of the *Lexington* and *Yorktown* on May 7, 1942, during the Battle of the Coral Sea. *Zuihō* was not much luckier. Her contributions to the Battle of Midway and the Aleutians campaign were negligible. At the Battle of Leyte Gulf, she was sunk by carrier-based aircraft.

The conversions of the *Ise* and *Hyuga* from battleships proved to be one of the most puzzling experiments undertaken by the Japanese after the



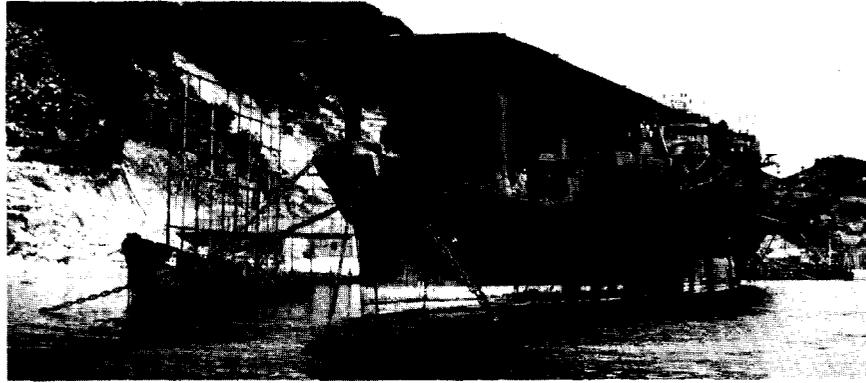
IN WAR PAINT here, the light carrier *Ikoma* was laid down at Kawaaki dockyard in 1943 but was never completed. Work on her stopped January 1945. TF 38 planes damaged hull the next July.

Battle of Midway. Their aft turrets were removed and abbreviated flight decks were installed. A large hangar, an elevator, and two catapults were added, permitting the ships to launch all her aircraft in 20 minutes.

The planes scheduled for these ships were sent to Formosa before the ships were completed. The conversions were employed in the Battle of Leyte Gulf. By this time, Japan had run out of aircraft to supply them, and the ships were used solely in their capacity as battleships. They were later sunk, in July 1945, by U.S. carrier-based planes.

Another conversion, that of the *Ibuki* from an improved *Mogami* class cruiser, also had a rough time of it. She was authorized under the 1941 program, but shortly after her launching in May 1943, work on her was halted for six months while authorities haggled with the possibility of reconverting her into a fast oil tanker—much needed by the Japanese navy. The decision made, work renewed, this time at a furious pace. Four of her eight boilers were pulled out and this space used for the storage of fuel oil. A hangar and two elevators were installed, and a bridge was placed on her starboard side. She was capable of 29 knots and could carry 27 aircraft. But work stopped again, this time when the construction of small submarines took priority in the shipyards. She was never finished; at the end of the war the *Ibuki* was scrapped.

The most ambitious conversion and the most disappointing career was that of the *Yamato* class battleship *Shinano*. Laid down as a battleship but not completed when hostilities broke, the possibility of converting her to a carrier was entertained. This possibility became a necessity after the Battle of Midway. Survivors of this battle pointed out serious deficiencies in car-



THE RYUHO was officially classified as an aircraft carrier of the *Zuiko* class but characteristics differed considerably. During her conversion, she was damaged by *Hornet*-based B-25 bombers.

rier construction and designers at the Naval Technical Bureau listened well. Heavier armored flight decks were needed to protect them from dive-bombing attacks. Fuel and ammunition stowage spaces needed redesign.

Originally, plans for the conversion of the *Shinano* called for her to act as a "hotel ship," supporting land- or other carrier-based planes; she was not to carry aircraft of her own. This plan was changed and by September 1942 the new design was completed and construction began.

Shinano, basically, was to be a CVB. Heavy emphasis was placed on armor. Large bulges below the water line were to minimize torpedo damage. At the water line, an eight-inch thick belt of armor was retained. Four-inch thick armored deck had already been installed before conversion started and this deck became the hangar deck. Rolling metal curtains opened up the forward two-thirds of this deck for night operations and rough seas. The remaining third was closed completely when the curtain was rolled into place. Her flight deck and elevators were designed to withstand 1000-lb. bombs. With this weight, *Shinano* displaced

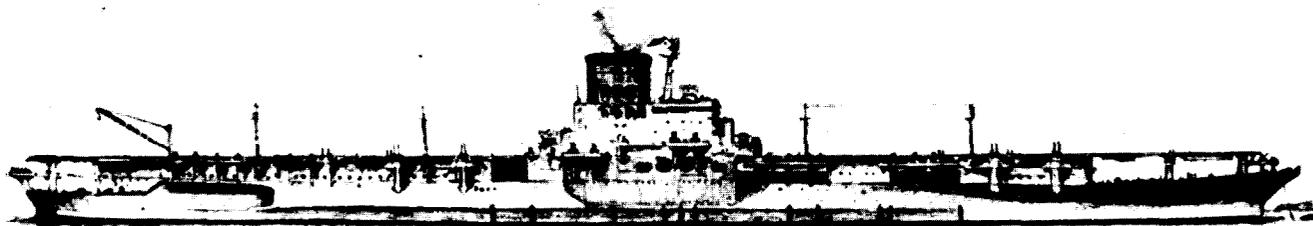
68,000 tons during her trials at sea.

The Battle of Midway also called attention to the ship's ventilation system. All ducts were protected with 1½-inch armor. Wood was eliminated from the ship wherever possible. A fire-resistant paint was introduced, and a bubble fire-extinguishing system was installed.

The carrier was launched on November 11, 1944 and commissioned November 19th. On the 20th, yard workers still aboard, crewed by green hands, she got underway for Kure where the air complement was to board.

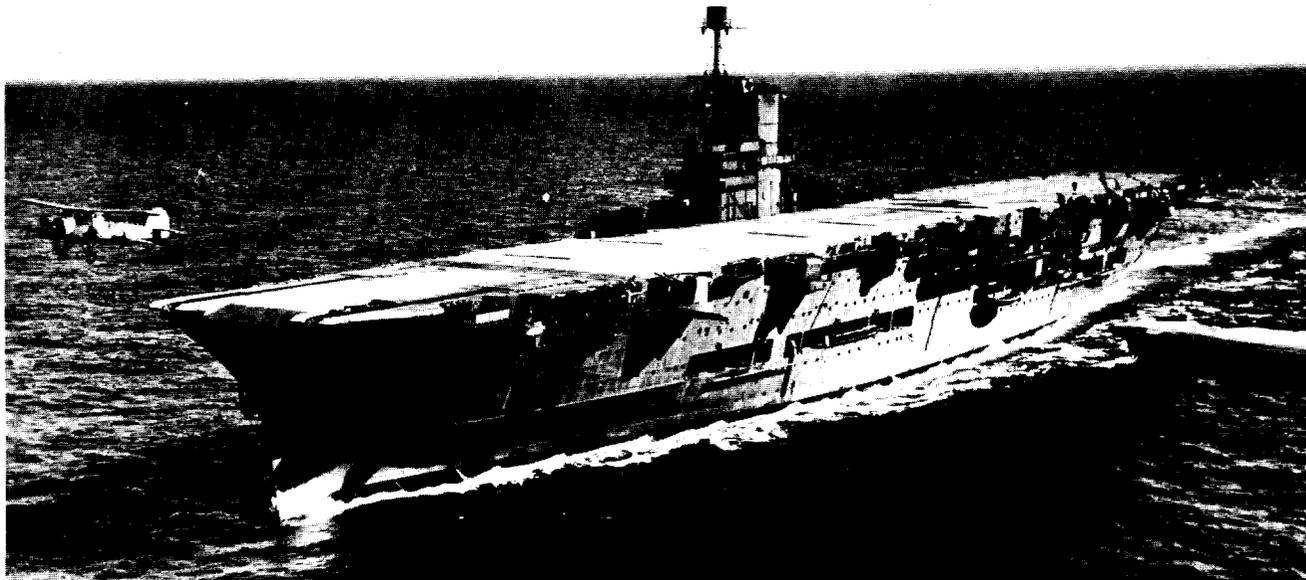
It was at this point that USS *Archerfish* picked her out on radar while surfaced. The submarine maneuvered for position and waited until the carrier and her three-destroyer escort crossed her line of fire. *Archerfish* fired six torpedoes; four hit the carrier. Slowly, she flooded and listed; by 1018 the following morning, all hands were ordered to abandon ship. A few minutes later, *Shinano* capsized and sank—with half her crew still aboard.

For many in the Japanese Navy, the powerful *Shinano* was the last hope. With her sinking, Japanese carrier aviation died, never to operate again.



JAPAN'S MOST ambitious conversion was the CVB *Shinano* from the hull of a *Yamato* class battleship. Pre-surrender burning of the Imperial

Naval Technical Bureau archives destroyed existing photographs of top secret ship. This 1950 drawing was made by LCdr. Shizuo Fukui, IJN.



HMS ARK ROYAL, a 22,000-tonner, had large hangars on two decks, three elevators. She boasted the largest wardroom in the Royal Navy. In war, her fighters downed or damaged more than 100 enemy aircraft, her bombers wrecked Sardinian airfields, hit Italian Navy.

Evolution of Aircraft Carriers

THE WARTIME EUROPEAN CARRIERS

'Experience with regard to the suitability of the present type of aircraft carrier must still be evaluated. Examination of enemy naval strategy in ocean warfare leads, however, to the clear recognition of the fact that aircraft carriers or cruisers with flight decks for use in warfare in the Atlantic definitely cannot be dispensed with.'—Grossadmiral Erich Raeder, Commander in Chief *Kriegsmarine*, during a mid-1940 conference with the Fuehrer on matters dealing with the German Navy

DURING WORLD WAR II, four European nations designed, constructed and/or operated aircraft carriers, or attempted conversions of other type ships to carrier characteristics: Great Britain, France, Germany, and Italy. Great Britain met with extraordinary success, especially in the design of carriers. Among the advances made were the prototype of the WW II-produced CVE (structurally, USS *Langley* qualifies as the first unintended CVE) and experiments that eventually led to the perfection of the "steam slingshot" catapult. Her experiments have a continuing effect on the design of modern carriers. France operated a converted battleship, the *Béarne*, and was building two carriers, *Joffre* and *Painlevé*, when war started. These two carriers were never completed and France fell to the Axis too early in the war for her Navy to make any advancements in carrier aviation. At the same time, Germany's efforts were fit-

By Scot MacDonald

ful, frustrated and fated to failure. And Italy, tardily entering carrier-conversion efforts, found the war ended with her ships unfinished.

A starting point in the catalogue of incredible events that launched the nations of the world into global war was the assumption as Chancellor of Germany by Adolph Hitler on January 30, 1933. In the following October he withdrew his country from the disarmament conference and from the League of Nations. Nearly five years later, Germany invaded and annexed Austria. Next on his list was Czechoslovakia in September 1938 which, by skilled "brinkmanship" on the part of the Fuehrer, ended in the Munich agreement. Overconfident now, Hitler zeroed in on Poland. This was too much for both England and France and, on September 3, 1939, they declared war on Germany, and World War II began.

When war began, Britain had six aircraft carriers in commission and six more under construction. Of those operating, the 22,000-ton *Ark Royal* (most recent addition to the Fleet, 1938) and the converted large light cruiser *Courageous* operated with the Home Fleet. The *Furious*, stationed at the Firth of Forth, was used for carrier deck training (but immediately took up convoy duty in the North Atlantic). *Glorious*, sistership to *Courageous*, was assigned to the Mediterranean, while the *Eagle*, laid down as the dreadnought battleship *Almirante Cochrane* for Chile in 1913, converted and commissioned an aircraft carrier in 1924, covered the China Station. *Hermes*, the first ship in the world designed from the keel up as an aircraft carrier, also completed in 1924 (the Japanese *Hosho* was completed December 1922), was conducting anti-submarine warfare in home waters.

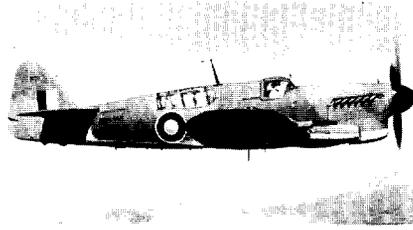
In addition to the tactical carriers,

Britain had one other carrier of lesser, but still significant, capabilities: the *Argus*, worked on between 1916 and 1918 from the Italian liner *Conte Rosso*, was employed on convoy escort duty.

As the political climate changed in Europe and war clouds gathered, Britain made a substantial effort to reinforce her modest and generally venerable carrier fleet. She ordered six new carriers. When the storm broke, these six were in various stages of construction: *Formidable*, *Illustrious*, *Implacable*, *Indefatigable*, *Indomitable*, and *Victorious*. In addition, the 14,500-ton aircraft depot ship, *Unicorn*, under construction in 1939, was to be completed as a CVE.

The first years of World War II were expensive ones for Britain's small carrier fleet. *Courageous* was the first carrier casualty of the war. Tracking down a reported U-boat on September 17, 1939, she turned to receive her returning planes when the U-29 submarine plowed torpedoes into her. The carrier sank with more than half her crew still aboard.

Loss of the *Glorious* was particularly heartbreaking. In June 1940, she participated in the British withdrawal from Norway. Land-based RAF *Gladiators* and *Hurricanes* were embarked at Narvik. This was a particularly hairy operation, for none of the planes was configured for carrier landing and the Air Force pilots were not carqualled; all landed safely. Presumed low on fuel, she was ordered to proceed home independently. En route, the carrier was spotted by the German battleships *Gneisenau* and *Scharnhorst* on June 8, and attacked. "Chocked" with RAF



FAIREY FIREFLY was World War II two-place carrier fighter used by the British Navy.

aircraft, she was in no condition to launch defending planes. Pounded mercilessly by enemy guns, the ship developed a list and within an hour went down.

These losses were balanced in 1940 by the introduction of the *Illustrious* (first of her class) and *Formidable*. They displaced 23,000 tons each, had a length of 753 feet and a beam of 95 feet. They were soon joined by *Victorious*, of the same class, and *Indomitable*, a carrier in a class by herself. The latter had two hangar decks.

An early contribution to carrier operations by *Illustrious* came when she had installed a search radar system for the tracking of enemy aircraft. She was also the first carrier to have a fighter-direction officer aboard. With this effective teaming of men and electronics, *Illustrious*-based planes claimed 75 enemy aircraft in a little over six months of operation.

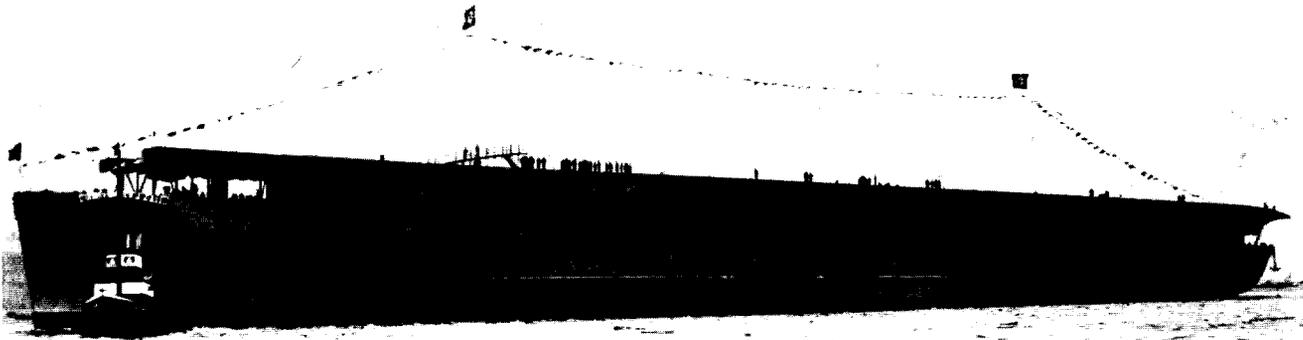
HMS *Eagle* was the first aircraft carrier to launch planes against enemy surface warships in WW II. On July 9, 1940, carrier-based *Swordfish* torpedo bombers attacked the Italian fleet in the Med. Defective torpedoes permitted only limited success: only one of the Italian destroyers was sunk.

The first successful wartime carrier strike in history occurred on the night of November 11, 1940 when two striking forces from the carrier *Illustrious* attacked the important Italian Naval base at Taranto. Winston Churchill said of this successful raid:

"By this single stroke the balance of naval power in the Mediterranean was decisively altered. The air photographs showed that three battleships, one of them a new *Littorio*, had been torpedoed, and in addition one cruiser was reported hit and much damage inflicted on the dockyard. Half the Italian Fleet was disabled for at least six months, and the Fleet Air Arm could rejoice at having seized by their gallant exploit one of the rare opportunities presented to them."

The defeats at Taranto and Cape Matapan (March 30, 1941) finally gave the Italian admirals, who had been pleading for an aircraft carrier since 1925, an effective argument in their dealings with the Italian Air Force which controlled military aircraft. Several plans were actually drawn up but the progress of war did not permit the laying down of keels. Material and manpower shortages forced the Italians to abandon the idea of building carriers from the keel up; instead, they attempted to convert merchant liners.

Early in the war, September 1939, Dr. Joseph Goebbels' Ministry of Propaganda jubilantly reported the sinking of *Ark Royal* by a German bomber. This widely publicized error caused the Third Reich considerable embarrassment, for the carrier escaped undamaged and operated effectively until November 11, 1941, when she finally fell victim to U-boat torpedoes.



GRAF ZEPPELIN, the only one of four aircraft carriers planned by the German navy to be launched, is shown as she appeared in 1939.

Never completed, she fell to the Soviets at the end of the war. Seacocks opened, she rested on the bottom of a shallow channel near Steffin.

A month later, HMS *Audacity* met a similar fate. This ship, converted from the German prize *Hannover*, became Britain's first escort carrier upon her completion in June 1941. She was sunk during a battle between U-boats and a Gibraltar-U.K. convoy. Her planes and surface escort destroyed five enemy subs and the decision was made to press for the building of more escort carriers.

Of the losses sustained by the British, *Hermes* was the only aircraft carrier sunk by the Japanese. Fleeing from Trincomalee just ahead of the expected Japanese carrier strike, on April 8, 1942, she was spotted by enemy carrier-based planes. *Hermes*, hit by some 40 bombs, sank in 20 minutes.

Five carriers of the *Majestic* class and seven of the *Colossus* were laid down, but only the first five of the *Colossus* were completed before V-J day; each displaced 14,000 tons. Four of eight of the new 18,300-ton *Hermes* were produced. They were appreciably longer and faster than the *Colossus* class, comparable to the U.S. Navy's first carrier named *Enterprise*. The remaining *Hermes* class was canceled.

Two of the four ships of the new 33,000-ton *Ark Royal* class were laid down but none was completed until well after the end of hostilities.

In addition, the British planned three 45,000-ton *Gibraltar* class carriers (others: *New Zealand* and *Malta*), but the project was canceled at the end of

buffer between U.S. amphibious forces and enemy air fields at Sakishima Gunto during the invasion of Okinawa.

OTHER European powers with carrier aspirations were less successful. France started the war with one converted carrier. The efforts of both Germany and Italy to become carrier powers were foredoomed to failure.

The French carrier *Béarn* was laid down in January 1914 as a battleship of the *Normandie* class. She was finally launched as a battleship in 1920, but three years later entered the yards for conversion to a *Bâtiment Porte-Avions* and was completed in May 1927.

Béarn displaced 25,000 tons, fully loaded, had an over-all length of 599



AQUILA, an attempt by the Italian Navy to convert a liner into an aircraft carrier, is shown as she appeared at LA Spezia in June 1951. Many of her parts were cannibalized from the Graf Zeppelin, but repeated bombings by Allied aircraft never permitted her completion.

Other losses sustained by the Royal Navy included the *Avenger* (November 1942) and the *Dasher* (March 1943), both *Archer* (U.S. *Long Island*) class escort carriers, *Nabob* was irreparably damaged by torpedo in August 1944 and *Thane* suffered the same fate in January 1945; both were of the *Smiter* (U.S. *Bogue*) class escorts.

Carrier construction of all types was not pushed in the United Kingdom during WW II in any way comparable to U.S. efforts. Anti-submarine warfare craft had the highest priority and the U.K. depended upon U.S.-built Lend-Lease CVE's (in all, 37) for most of its build-up. Completion of two of the 23,000-ton *Implacable* class was delayed until 1944. Her sister ship was the *Indefatigable*.

the war. These were to be the British equivalent of the U.S. *Midway* class.

During the war, the U.K. operated five light fleet aircraft carriers (the *Colossus* class, in 1945), six fleet carriers of various tonnages, and three escort carriers—all built in British yards—in addition to the ten carriers sunk and the CVE's lend-leased from the U.S. Her carrier-based planes played a vital role in defeating the U-boat offensive. In the Pacific, Adm. Sir Bruce Fraser, RN, commanded the newly established British Pacific Fleet. The 1st Carrier Squadron, comprising the *Indomitable*, *Victorious*, *Illustrious* and *Indefatigable*, was a unit of this fleet. Both *Indomitable* and *Victorious* had seen prior action in the Pacific. *Formidable* joined the squadron later. The British group acted as a flying

feet. She had a complement of 875 and carried 36 to 42 aircraft, including torpedo, reconnaissance and fighter planes. She was held in semi-internment at Martinique from the fall of France in 1940 until 1943. In early 1944 she was taken to the U.S. for rework and emerged as a *transport d'aviation*, operated by the French.

IN 1935, Adolph Hitler announced that his country would construct aircraft carriers to strengthen the *Kriegsmarine*, the German Navy. The keels of two were laid down in 1936. Two years later, Grand Admiral Raeder presented an ambitious shipbuilding program called the *Z Plan*, in which four carriers were to be built by 1945. In 1939, he revised the plan, reducing the number to be built to two.

The German Navy has always maintained a policy of not assigning a name to a ship until she is launched. The first German carrier, laid down as Carrier "A", was named *Graf Zeppelin* when launched in 1939. The second carrier bore only the title Carrier "B", since she was never launched. Various names, including *Peter Strasser* and *Deutschland*, were rumored, but no official decision was ever made.

A review of the Fuehrer's conferences on matters dealing with the German Navy, the minutes of which were captured after the fall of the Third Reich, reveals Hitler's vacillating interest in the carriers. Marshall Hermann Goering, Commander in Chief of the *Luftwaffe*, was resentful of any incursion on his authority as head of the country's air power and he frustrated Raeder at every opportunity. Within his own service, Raeder found opposition in Adm. Karl Doenitz, a submarine man.

By May 1941, the strain on manpower and raw materials was being felt in Germany. Raeder was still optimistic, however, and informed Hitler that the *Graf Zeppelin*, then about 85 per cent complete, would be completed in about a year and that another year would be required for sea trials and flight training.

Though Hitler continued to assure Raeder that the carriers would be built, the Admiral's war with Goering had no truce and became increasingly bitter. Goering showed his contempt for the naval air arm by informing Hitler and Raeder that the aircraft ordered for the *Graf Zeppelin* could not be available until the end of 1944. Goer-

ing's tactic was a delaying one—and it worked.

Construction on the carriers had been fitful from the start. Carrier "B" was abandoned in 1940 and broken up. Manpower and material shortages plagued the *Graf Zeppelin*.

Prodded by Raeder, Hitler ordered Goering to produce aircraft for the carrier and under this pressure, the air marshal offered redesigned versions of the JU 87B and the ME 109E-3 which were at that time being phased out of the *Luftwaffe* first line squadrons. Raeder was unhappy, but he had to accept them or none at all. This forced another delay in the construction of the carrier: the flight deck installations had to be changed.

By 1943, Hitler had become disenchanted with his Navy. Raeder was relieved at his own request and Doenitz, the submarine admiral, took the top naval post. This effectively ended the *Graf Zeppelin* and work on her stopped.

Had the carrier been completed, she would have displaced 23,000 tons, had a length of 920 feet and a beam of 88 feet. Powered by geared turbines, she was to have a speed of 33.8 knots. Her aircraft complement was to have been 42, consisting of ME 109T fighters and JU 87C dive bombers (new designations for the redesigned aircraft). She was to have four screws—unusual for the triple-screw-minded Germany.

The fate of the *Graf Zeppelin* was as stormy as her conception and berth pangs. Scuttled by the Germans, she was raised from the back-water channel near Steffin, by the Soviets in 1946-47. Loaded down with loot, she was towed into the Baltic in 1947,

headed for Leningrad. East of Rügen, the ship sank.

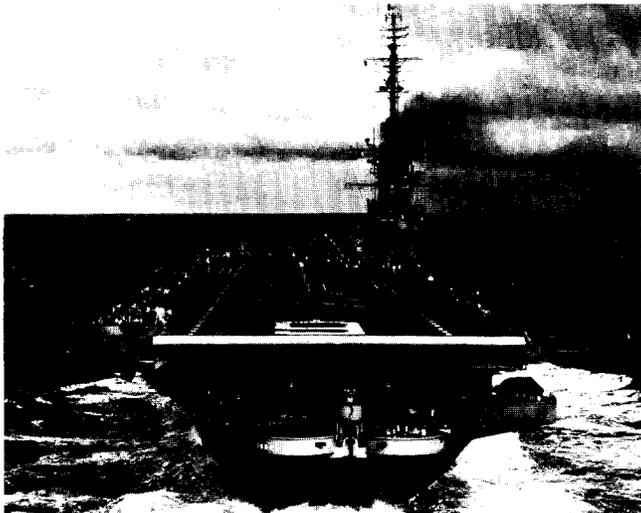
With Germany's abandonment of aircraft carriers came Italy's growing interest in them. The liner *Roma* was earmarked for conversion and many parts of the *Graf Zeppelin* were transported to Italy for use in the conversion. Of particular interest, according to eminent naval historian S. A. Smiley, were the new engines in the ship. Four independent sets of geared turbines from the light cruisers *Cornelio Silla* and *Paolo Emilio* were installed, giving her a designed speed of 30-31 knots. This, says Smiley, was "a unique marine-engineering pearl." The ship's name was changed to *Aquila* and was nearly ready for trials when Italy surrendered. *Aquila* was sabotaged to prevent the Germans from operating her. She was repaired later, but was damaged in two air raids, one in 1944 and the other in 1945. Finally, in 1949, she was towed to La Spezia and scrapped.

Another Italian effort to produce an aircraft carrier by conversion was made when the liner *Augustus*, a running-mate to the *Roma*, was put in hand for conversion in March 1944. She was first named *Falco* and then *Sparviero*, but was never completed. Her half-finished hull was bombed and sunk at Trieste at the close of the war.

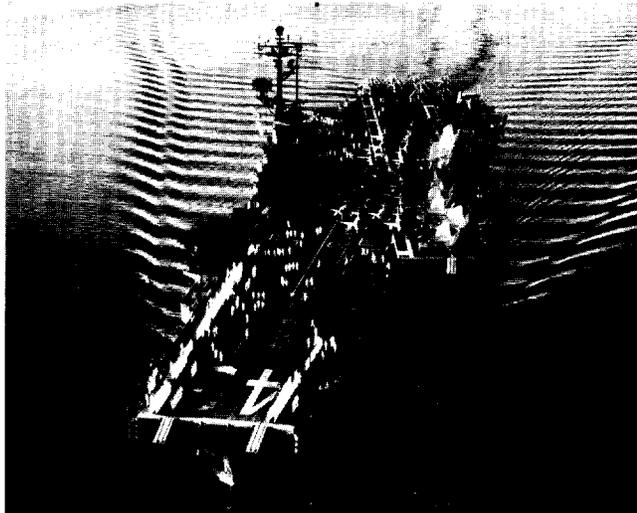
A condition of the peace treaty signed in 1947 after a five-week meeting of the Big Four Foreign Ministers in New York specified that no battleship, aircraft carrier, submarine or specialized assault craft could be constructed, acquired, employed or experimented with by Italy, blocking her efforts to be an aircraft carrier nation.



BÉARN WAS the only carrier France had completed before the start of WW II. Converted to aircraft carrier characteristics between 1923 and 1927, she had a speed of 21.5 knots, or a radius of 6000 miles at 10 knots. She spent most of the war years at Martinique.



ESSEX joined the *Oriskany* class after Project 27A. She is shown after Ship Improvement No. 1. CV-9 got her angled deck in Project 125.



CORAL SEA was the last WW II-built carriers to be reworked extensively in the modernization programs; shown here after Project 110A.

Evolution of Aircraft Carriers

THE TURBULENT POST-WAR YEARS

'There has been a spectacular advance in aircraft design technology. The transition from propellor-driven aircraft to jet power has been fast. We are now undergoing another evolution from subsonic to supersonic speeds at higher altitudes. . . . By modernization we have utilized our assets of World War II Essex class carriers to the maximum. This has been a military necessity in order to maintain an acceptable degree of combat readiness economically in about half the time required for new construction. Carrier modernization has been pushed vigorously.'—Adm. Arleigh Burke, U.S. Navy, CNO, 1957.

THE POST-WAR ERA was one of dynamic change. The aircraft carriers reflected that change with many modifications designed to equip them to operate the most modern aircraft capable of delivering nuclear weapons and launching guided missiles.

Technological developments were making the *Essex* class obsolescent. On June 4, 1947, the Chief of Naval Operations approved new aircraft carrier characteristics to be incorporated in an improvement program titled Project 27A. This was the first of a series of modernization efforts to modify the *Essex* carriers to meet changing operating requirements.

USS *Oriskany* (CV-34) was the first of the *Essex* class carriers modernized under Project 27A. She entered New York Naval Shipyard in October 1947. At spaced intervals, she was followed by *Essex* (CV-9), *Wasp* (CV-18), *Kearsarge* (CV-33), *Lake Champlain* (CV-39), *Bennington* (CV-20), *Yorktown* (CV-10), *Randolph* (CV-15), and *Hornet* (CV-12). These programs were conducted at Puget Sound

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and Newport News, in addition to the New York Navy Yard. The *Hornet*, last to be modernized under 27A, left the New York yard in October 1953.

The principal changes involved in the 27A project were directed toward a capability of operating aircraft of up to 40,000 pounds gross weight. The H4-1 catapults were removed and H-8's installed, permitting the launching of considerably heavier aircraft than the carrier had been capable of during the war years. The flight decks were strengthened and the five-inch guns on the flight deck were removed to decrease topside weight, to provide more deck space for parking planes, and to increase safety aspects of the landing area. A special weapon capability was given the last six of the nine carriers modernized under this project. Elevator capacities and dimensions were increased to accommodate heavier planes. And special provisions for jet aircraft were installed—such as jet blast deflectors, increased fuel capacity, as

well as some modern jet fuel mixers.

Three of the ready rooms for pilots in these carriers were moved down below the hangar deck, relocating them from spaces directly under the flight deck. This increased pilot comfort and provided better protection. To get the equipment-laden pilots up to the flight deck, an escalator was installed abreast of the island. This provided a single route for pilots manning their planes; it prevented confusion from ship's company rushing up the normal access routes to man battle stations.

In April 1947, *Franklin D. Roosevelt* entered the yards on Ship Improvement Program No. 1, which provided her with a special weapon capability. Her sister ships, the battle carriers *Midway* and *Coral Sea*, followed. This program was also extended to the *Oriskany*, *Essex* and *Wasp*, which had not received the capability under 27A.

Almost a year before the *FDR* entered the yards, the first U.S. testing of the adaptability of jets to shipboard operations were conducted aboard, on July 21, 1946. Successful landings and

takeoffs in an FD-1 *Phantom* were made by LCdr. James J. Davidson. (For background on the Navy's first jet pilots, see NANews, March 1963, pp. 6-13.)

The Navy continued to experiment with heavier aircraft launchings from carrier decks. In March 1948, carrier suitability of the FJ-1 *Fury* jet fighters was tested on board the *Boxer* (CV-21) off San Diego. A number of takeoffs and landings were made by Cdr. Evan Aurand and LCdr. R. M. Elder of Fighter Squadron 5A. The following month, Cdr. T. D. Davis and LCdr. J. P. Wheatley made JATO takeoffs in P2V *Neptunes* from the deck of the *Coral Sea* off Norfolk. This was the first carrier launching of planes of this size and weight.

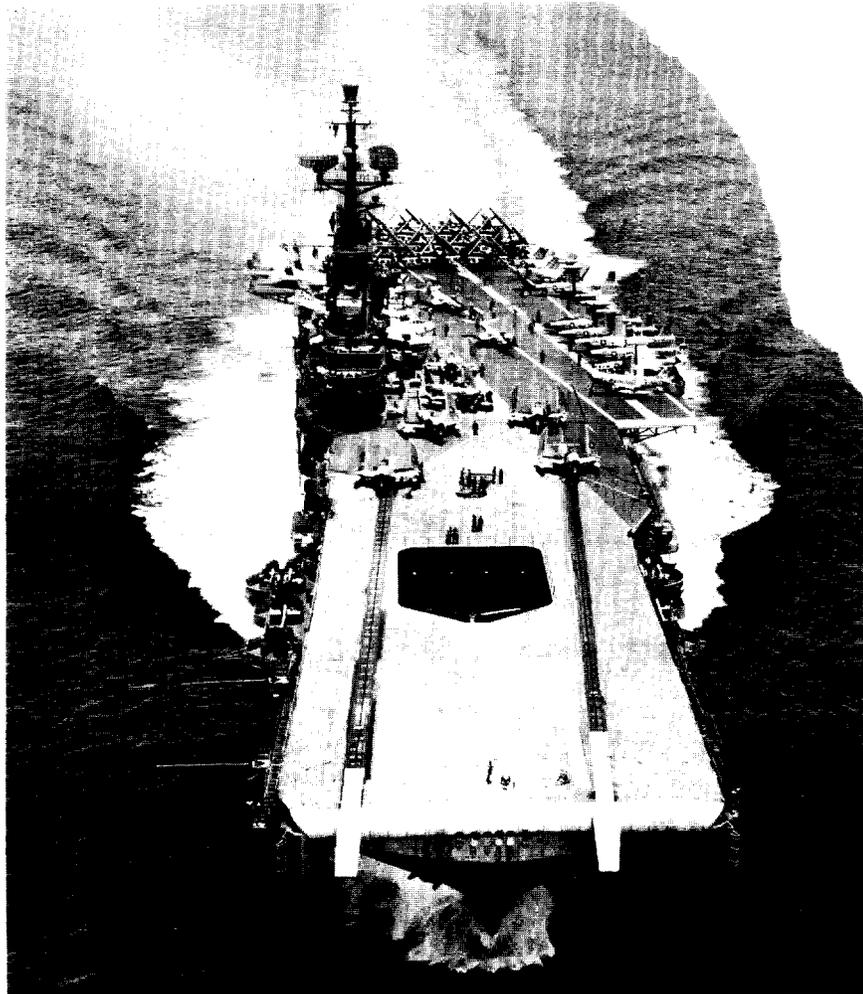
It was inevitable, then, that the Navy would introduce all-jet squadrons to carrier operations. On May 5, 1948, Fighter Squadron 17-A, equipped with 16 FH-1 *Phantoms*, became the first carrier-qualified jet squadron in the U.S. Navy. It took three days of operations to do it, but all squadron pilots, in addition to Commander Air Group 17, qualified on the USS *Saipan* (CVL-48), with a minimum of eight landings and takeoffs each.

Project 27A was originally intended for more than nine carriers, but development of the steam catapult and the prospective employment of more advanced types of aircraft made it apparent that this project had to be modified to meet future needs. Accordingly, Project 27C was initiated.

Hancock, *Intrepid* and *Ticonderoga* were slated for this program—later identified as Project 27C (axial deck). Most important of the changes was the introduction of the steam catapult developed by the British. In 1952, tests of the catapult installed in the Royal Navy carrier HMS *Perseus* were conducted at the Naval Shipyard, Philadelphia, at NOB Norfolk, and at sea during the first quarter of the year. Reported NANews:

"The new catapult fared so well during the tests that the Navy has already begun an investigation into the adaptability of it to their new flush deck carrier USS Forrester, which is now under construction.

"The new catapult, invented by a Royal Navy volunteer reserve officer, Cdr. C. C. Mitchell, O. B. E., of Messrs. Brown Brothers & Co., Ltd., Edin-



HANCOCK WAS the first carrier to receive the C-11 steam catapult. Note the TACAN "bucket" atop mast for homing, enlarged elevator, and the distinctive bridle catchers at end of catapults.

burgh, uses the principle of the slotted cylinder, and has no rams or purchase cables. A hook on the aircraft to be launched is connected directly to a piston which is driven along the cylinder by high pressure steam from the ship's boilers. A novel sealing device is used to keep the slotted cylinder steam tight.

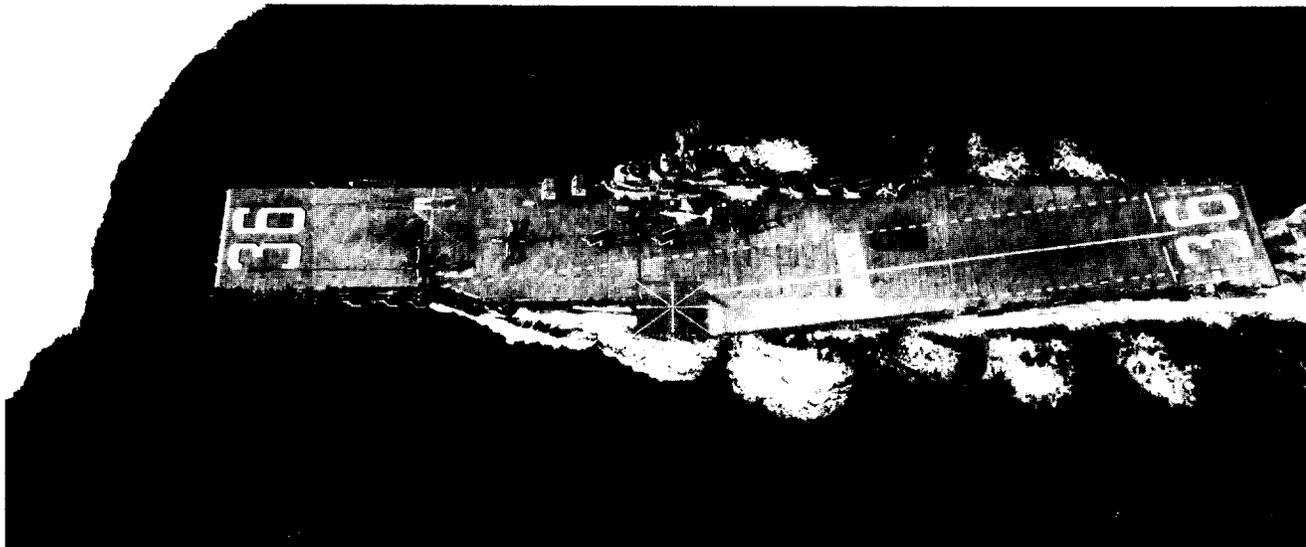
"While the amount of steam required for sustained operation is large, tests have shown that the boilers can meet the demand without interfering with the ship operations."

The *Hancock* was the first U.S. carrier to receive the new "steam sling-shot," designated C-11 by the U.S. Navy. On June 1, 1954, Cdr. H. J. Jackson, in an S2F-1, was catapulted from the *Hancock* in the initial U.S. operational tests. Throughout the month, testing continued. A total of 254 launchings were made with the

S2F, AD-5, F2H-3, F2H-4, FJ-2, F7U-3, and F3D-2 aircraft.

In addition to the C-11 steamcat, Project 27C (axial deck) also provided for a strengthening of the flight deck. The number three centerline elevator was replaced with a deck edge type of greater capacity. Other improvements were made, in addition to those proved efficient in 27A.

Even as these changes were being built in the *Hancock*, *Intrepid* and *Ticonderoga*, the Bureau of Aeronautics proposed, in mid-June 1952, that a new design flight deck be installed in the *Antietam*. The previous May, both jet and propeller type aircraft were tested on a simulated angled deck aboard the USS *Midway*. The idea was originated by the British and proved very effective for them. *Antietam's* deck was to extend outboard on the port side from the normal flight deck,



ANTIETAM TESTS British-designed angled deck in the Virginia Capes evaluation period. Pilots were enthusiastic, for it eliminated area in April 1953. Fifteen types of aircraft were used during barriers, barricades, and danger of parked planes at runway's end.

thus allowing aircraft landings to be angled 10° off the ship's centerline.

Pushed through the guidance design stage by the Hull Design Branch of BU SHIPS in early July, *Antietam's* new deck was completed in mid-December at the New York Naval Shipyard. At first called a canted deck, this term officially gave way to the more familiar angled deck by OPNAV Notice 9020 on February 24, 1955. It also outlawed the use of "slanted" and "slewed" in describing the deck design.

In December 1953, BU SHIPS *Journal* reported:

"The final detailed report on the evaluation of the canted flight deck installed in USS Antietam (CVS-36) reveals that the operational trials have met with a high degree of success. The canted deck aircraft carrier appears to provide the safest, most desirable, and most suitable platform for all types of aircraft—those currently in use as well as those still on the design board—and is superior to the axial flight deck carrier in these respects. . . ."

"The canted flight deck on Antietam was finally installed at an angle of 10.5° to the centerline of the axial flight deck. The landing area of the canted deck is 525 feet long with a width at the landing ramp of 70 feet and narrowing to 32 feet, 8 inches, at the extreme forward end of the takeoff area. This gives the effect of 'flying into a funnel,' causing the pilot to head toward the canted centerline. This effect aids him in maintaining the flight and deck path which fully utilizes the complete length of the

canted flight deck.

"Fifteen types of aircraft, both propeller and jet-propelled, participated in the tests which were conducted in four phases, extending from December 29, 1952 to July 1, 1953. A total of 4107 landings were made, including touch-and-go and arrested landings, during day and night operations. During the entire evaluation period there was no major accident and only a total of eight minor accidents, none of which could be attributed to the canted deck principle."

The advantages were immediately manifest. By eliminating the centerline elevators and using one or more deck edge elevators (not installed in the *Antietam*), more elevators would be available for bringing up spares from the hangar and striking "dud" aircraft below. Once landed, the plane could easily taxi onto a starboard deck edge elevator without impeding flight operations.

It was also possible to catapult aircraft and land them simultaneously, and to launch CAP and interceptors on short notice. This gave the carrier improved combat readiness.

The pilots were impressed. An extra margin of safety was given them by removing the danger of crashing into gassed and armed planes parked forward of the landing area. The BU SHIPS *Journal* commented:

"The clear deck ahead on every carrier pass relieved the pressure on the pilot. Primarily for this reason, pilots

who have flown from the canted deck are unanimous in their favorable enthusiasm. This was found to be especially true when Antietam's canted deck was rigged to simulate a CVE type carrier. Pilots flying AF type aircraft confirmed that part of the mental strain of carrier landings is relieved with removal of the barriers and that landings were much easier. . . ."

"Fewer cross deck arresting pendants and arresting gear engines are required for the canted deck. It is considered desirable to keep the landing area as far aft as is practical and safe, yet far enough forward to decrease rates of descent. This can be accomplished only by limiting the pendants to a minimum commensurate with safety and picking optimum pendant locations. Fewer pendants also result in a decrease in topside weight."

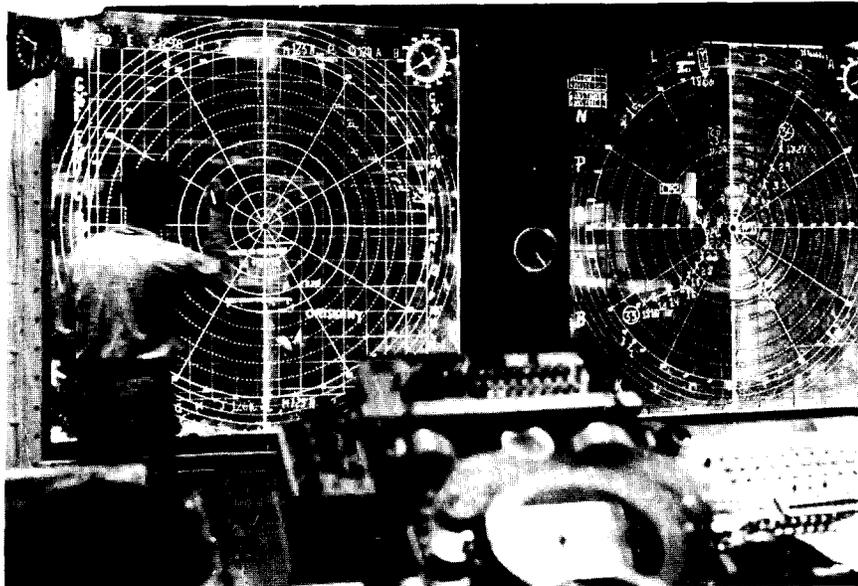
Project 27C (angled deck), which resulted from the *Antietam* tests and modified the original 27A, significantly changed the silhouette of the aircraft carriers. The canted or angled deck was installed and the hurricane bow of the original *Saratoga* and *Lexington* carriers reintroduced. The project also allowed for the improvement of the Mark 7 arresting gear by reducing the number of deck pendants by one-half and thereby cutting the ratio of arresting gear sheaves to two to one. The forward centerline elevator was enlarged. Air conditioning and sound proofing made the island spaces more comfortable and efficient. The latest advancements in deck lighting were also installed in these attack carriers.

Lexington, Shangri La, and Bon Homme Richard all received the improvements of this project and they were so successful that *Hancock, Intrepid* and *Ticonderoga* returned to the yards for this new conversion.

The trend extended, inevitably, to the *Midway* class. In September 1953, the Navy announced new modernization plans for these carriers under a new program called Project 110. In May 1954, the *Franklin D. Roosevelt* entered Puget Sound Naval Shipyard for the conversion. *Midway* followed in September 1955. These carriers received the best features of the 27C (angled deck) conversion which were incorporated in Project 110. Additionally, they had a modified steam catapult installed in the angled deck area; full blisters were added for maximum protection, liquid stowage, and stability, and the after starboard elevator was relocated to the starboard deck edge.

With the changes in carrier configuration ran a parallel change in missions and these changes were reflected in the redesignation of certain carriers as they appeared in the Navy Vessels Register.

On October 1, 1952, the very familiar CV and CVB designations went by the board. The ships were assigned the designation CVA, reflecting their reclassification as attack carriers. Prior to this, only the CV's were known as attack carriers, in the Fleet, to distinguish them from the CVB's. Anti-submarine Support Aircraft Carriers became a new classification in July 1953 and was applied to those attack carriers assigned to ASW; the follow-



DECISION AND DISPLAY room in first installation of Modular CIC is viewed in *Oriskany*. The concept proved so successful that it was later installed in *Coral Sea* and other aircraft carriers.

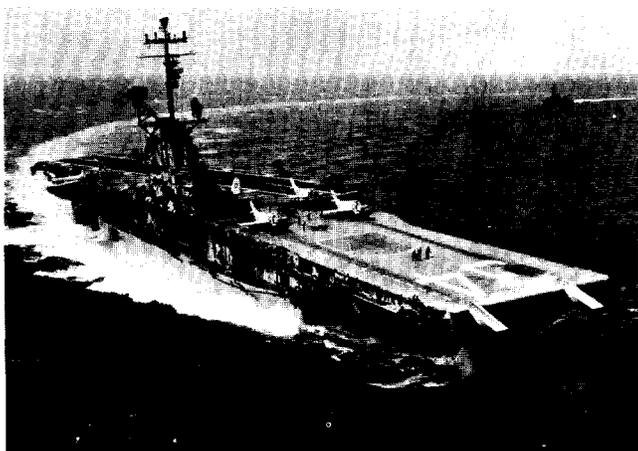
ing August 8, five CVA's were redesignated CVS's, ASW support carriers.

There were no further changes in designations over the next two years, but in July 1955, *Thetis Bay* (CVE-90) became CVHA-1. This proved the first move in the eventual disappearance of escort carriers from the operational Fleet. The attempt to modify CVE's for a new role in helicopter vertical assault operations was abandoned when the experiment proved too costly. On May 7, 1959, the classification of 36 escort carriers, designated CVE, CVU, and CVHE, was changed to AKV, for Cargo Ship and Aircraft Ferry. New hull numbers were assigned. This ended the role of escort

carriers as combat ships of the Fleet.

On December 30, 1957, USS *Saipan* (CVL-48), last of the light carriers, was decommissioned. On May 15, 1959, that designation was stricken from the register when the classification of four support carriers, CVS's, and seven light carriers, CVL's, was changed to Auxiliary Aircraft Transport, AVT.

The modernization of individual carriers reflected Navy thinking, Navy accomplishment, and Navy planning. The programs were successive steps in what somebody once called "a schedule of orderly retirement." As the carriers aged (some aged "faster" because of battle damage in WW II), they were transferred from the CVA designation



ORISKANY was the first of the carriers to be reworked in the post-war modernization program. Angled deck was installed in Project 125A.

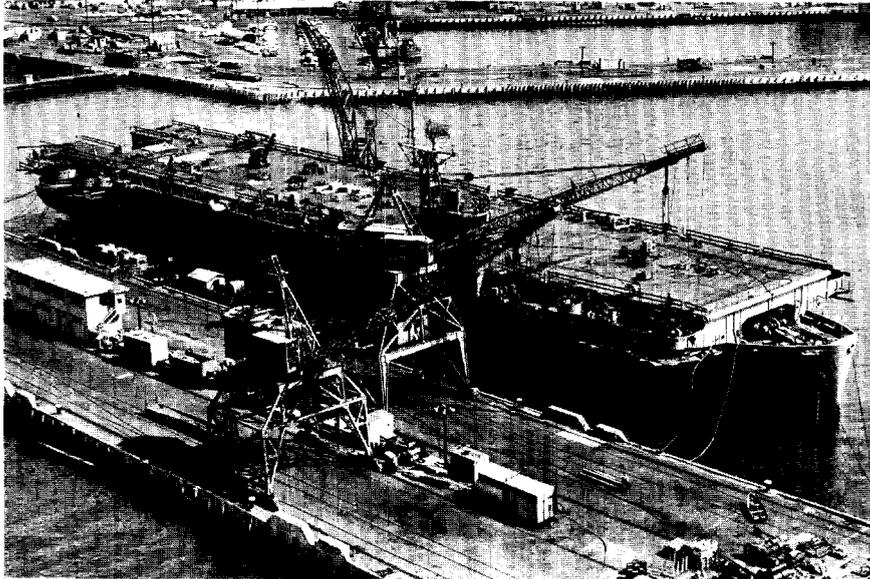


MIRROR LANDING SYSTEM, developed by British, was tested in Bennington by Cdr. R. G. Dosè, C.O., VX-3, Bennington's C.O. congratulates.

to the CVS, then to LPH and retirement, and it all was tied to new construction programs which made it possible to keep the number of operating CVA's up to the prescribed limits. As each new ship was acquired, it took the top position among the CVA's while the one in the bottom position moved to the top of the next lower class.

USS *Coral Sea* (CVA-43) was the

complete jet engine test facility; they are now installed in all new carriers. She had twice as much stowage for JP-5 fuel as her sister ships, over a million gallons, in addition to a 62,000-gallon capacity for avgas. And although *Ranger* was the first to have fuel centrifugal purifiers installed, she did not rely on them exclusively. When *Coral Sea* deployed to WestPac, she had



THETIS BAY (CVE-90) was redesignated CVHA-1 and started the phasing out of CVE's from the Navy's list of combatant ships. Here the ship is being converted for the operation of helicopters.

last aircraft carrier of World War II design to be extensively reworked during the post-war modernization program. She entered the Puget Sound shipyard on April 15, 1957, and was recommissioned January 25, 1960. In the interim, changes made in her configuration were contained in Project 110A, a modification of the 110 of her sister ships, *FDR* and *Midway*.

The basic changes were the same as those in Project 110, but 110A added new features. Of the three deck edge elevators installed, for instance, one was placed on the port side near the LSO platform. This eliminated the hazardous arrangement of having an elevator contiguous to the landing area. It also simplified maintenance problems and provided the capability of operating all three elevators during flight operations.

Existing arresting gear was replaced with five Mk 7-2 pendant and barricade engines with the new sheave and anchor dampers. *Coral Sea* was the first to have installed, in the fantail area, a

four of them installed and did use them exclusively. During the first 8½ months of operation, she burned approximately seven million gallons of JP-5, according to Air Officer Cdr. D. W. Houck, and did not experience one case of contaminated jet fuel.

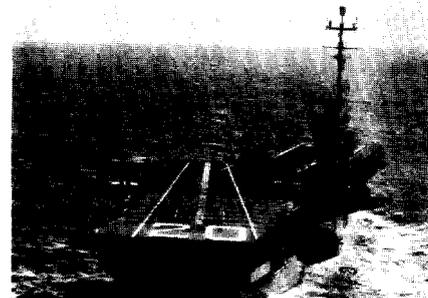
Modular CIC, a clock-like layout of communications, radar, and other CIC elements, had been tested in the *Oriskany* and proved successful. It was installed in *Coral Sea*, which became the second aircraft carrier to have such an arrangement.

The modernization program extended the lifetime usefulness of the *Essex*-class carriers built during WW II and permitted them and other class carriers to operate jet-powered aircraft of increasing designed power without compromising combat readiness of the Fleet. The important limiting characteristics of the planes operating from carriers are landing speed, landing weight and required end speed, and—in wooden deck ships—the wheel loading.

Many new developments have had a

profound effect on carrier aviation. In August 1955, for instance, the constant run-out method of controlling arrestment was used in the Mk. 5 arresting gear installed in USS *Bennington*. Its primary advantage was the ability to arrest a plane with a minimum amount of hook loads. With the earlier pressure types of controls it was necessary to stop the aircraft in shorter run-out in order to take care of inadvertent overspeed of the aircraft. This put a considerable strain on the planes. The new system is set for the weight of the landing aircraft, so that a 60,000-pound plane would pull out no more wire than a 10,000-pounder.

Other pilot aids include TACAN (Tactical Air Navigation System) which gives pilots bearing and distance from a carrier, the British-developed mirror landing system (improved by the use of Fresnel lenses), and PLAT (Pilot/LSO Landing Aid Television).

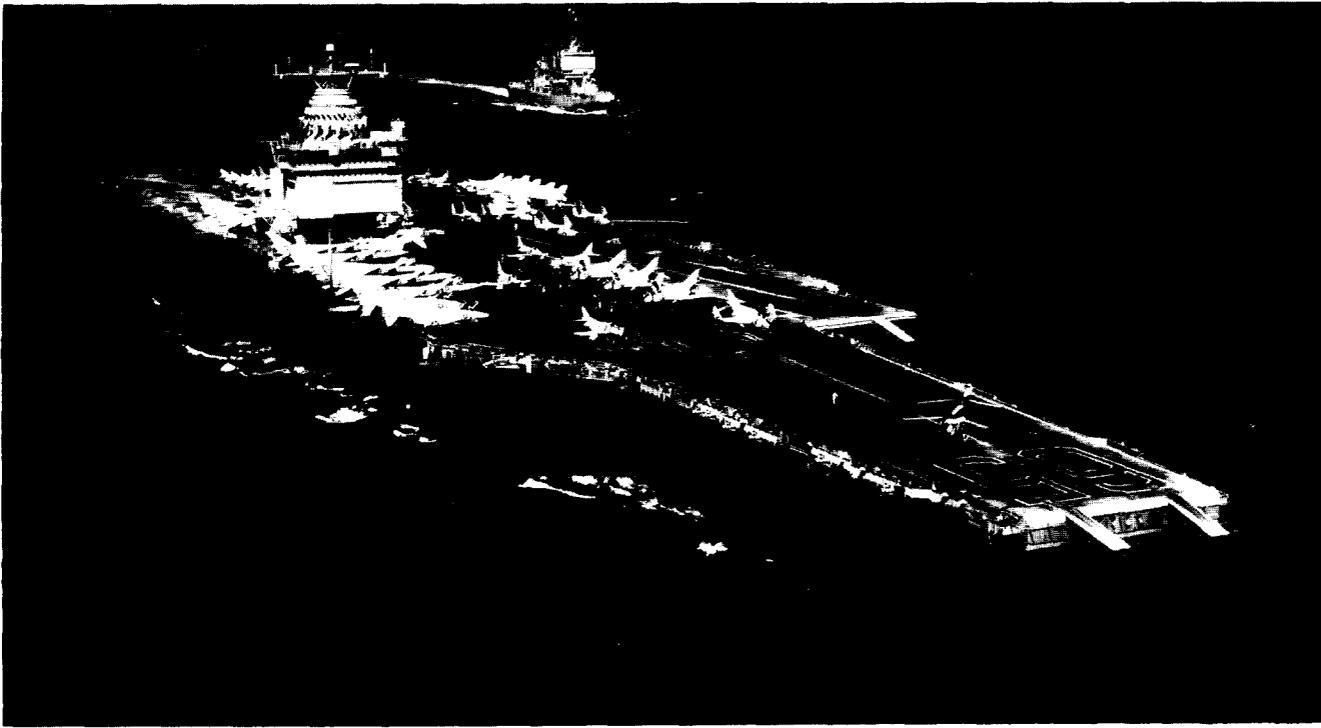


MIRROR LANDING system was first tested on the U.S. carrier *Bennington* in 1955.

"We are limited by how far we can go in modernization programs by the age of the ship," said Adm. Arleigh Burke in 1957. **"They are getting old. Their machinery is wearing out and they are becoming progressively more expensive to maintain. Like an old car, they must be replaced."**

"The modernization programs have been the proving ground for the advances which have been made in carrier operating techniques. But the full combat effectiveness of these developments can be realized only in new construction."

Two years earlier, in 1955, USS *Forrestal* (CVA-59) was commissioned, the first of a new class aircraft carrier. It was a logical step in the evolution of one of the Navy's proven and powerful aircraft weapons systems—the modern ship-of-the-line in the Fleet.



USS ENTERPRISE (CVAN-65), the most powerful aircraft carrier, (CGN-9) while in the Mediterranean. The nuclear-powered aircraft carrier is the first and only such carrier in any Navy of the world operates here with the nuclear-powered missile cruiser USS Long Beach

Evolution of Aircraft Carriers

CVA'S BUILT TO MEET MODERN NEEDS

'Events of October 1962 indicated, as they had all through history, that control of the sea means security. Control of the seas can mean peace. Control of the seas can mean victory. The United States must control the seas if it is to protect our security and support those countries which, thousands of miles away, look to you on this ship and the sister ships of the United States Navy.'—President John F. Kennedy, addressing the crew of USS *Kitty Hawk* (CVA-63) on June 6, 1963

THE DRAMATIC EVENTS of October 1962 to which President Kennedy referred were the missile build-up in Cuba and the immediate U.S. reaction to this threat. This was one of a series of incidents occurring since World War II that endangered the democratic way of life, incidents effectively neutralized by the presence of powerful U.S. carrier forces in the area.

The versatility of the current U.S. carrier fleet is largely due to the operation of what the press has labeled "super-carriers," heavy duty aircraft carriers of the size, power, and potency of the *Forrestals* and the nuclear-powered *Enterprise*. They had a difficult birth.

In April 1945, owing to lessons learned from their experience in com-

By Scot MacDonald

bat, Carrier Task Force Commanders requested heavier and larger aircraft to accomplish war missions. An informal board was appointed to consider the carrier requirements of the U.S. Navy. The hulking CVB's of the *Midway* class, which were readying for commission and combat duty, provided a stopgap supply to the needs of the Task Force commanders. The Ship Characteristics Board made various studies of the problem, and it was decided that the project should be made a design study for the 1948 shipbuilding and conversion program. Given the designation "6A Carrier Project," one of the carriers was slated to be built in the 1949 construction program.

Between 1945 and November 1948, some 78 different designs were made before final acceptance. On June 24, 1948 Congress passed the Naval Appropriations Act of 1949. This provided funds for construction of the carrier. The contract was awarded Newport News Shipbuilding and Dry Dock Company.

In the planning stage, the new carrier was to weigh 65,000 tons and have a 1030-foot flight deck, a 130-foot waterline beam, and four catapults. Architects went back to original *Langley*, *Ranger* and *Long Island* designs by sweeping the flight deck clear of an island structure. Instead, the carrier was to have had a small island on an elevator apparatus, to be lowered during flight operations. This was one

answer to a BU SHIPS objection to the flush deck design, predicated on the fact that a satisfactory method of disposing of stack gases had not been developed.

All elevators were to be along the sides of the ship, with a large elevator at the extreme after end of the flight deck. Added strength of the flight deck was to be made possible by reducing the openings in the hangar sides, so that the ship, from the keel to the flight deck, could be considered as a unit, from the standpoint of strength. This would permit the operation of aircraft well over 100,000 pounds. Adm. Marc Mitscher greatly influenced formation of the project, having been

aircraft carrier. At that time, criticism of the entire concept of carrier warfare was again voiced by some military leaders. The carrier's keel was laid at Newport News on April 18. On April 23, the views of the Joint Chiefs were sent to SecDef and on that same morning Secretary Johnson ordered work on the carrier stopped. Secretary of the Navy John L. Sullivan resigned in protest the next day.

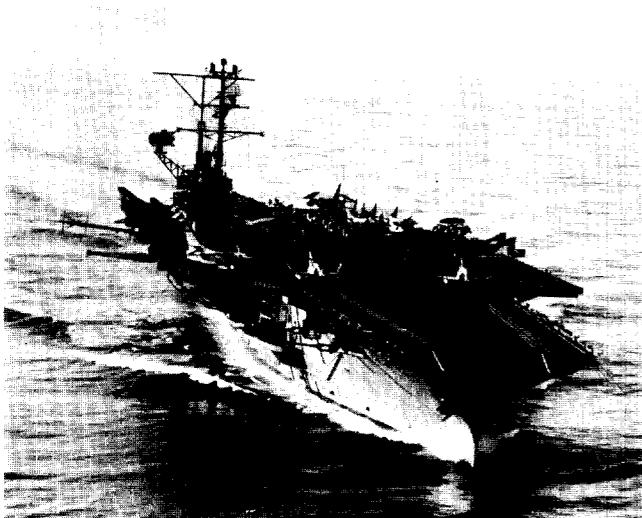
There was no new carrier construction in 1950. However, mid-year events caused Navy planners again to renew requests for heavy-duty carriers. On June 25, 1950, North Korean forces invaded the Republic of Korea. Two days later, President Truman an-

of the new aircraft carrier known as the *United States*, the construction of which was discontinued April 23, 1949, or the aircraft carrier authorized in Public Law 3, Eighty-Second Congress, first session, it shall be named the *Forrestal*."

At Newport News, the new carrier was designated Hull Number 506. Her keel was laid on July 14, 1952.

Mr. Charles P. Roane, Supervising Naval Architect, Aircraft Carrier Type Branch, BU SHIPS, commented on the *Forrestal* in the November 1952 issue of BU SHIPS *Journal*:

"The *Forrestal* incorporates all of the developments from the other carriers, plus those learned from the



THE FIRST of her class, *Forrestal* profited from lessons learned from post-war designs, particularly from the cancelled CVB-58.



A CRUSADER is launched by a powerful catapult system installed in *Forrestal*. Angled deck resulted from experiments in USS *Antietam*.

one of the Task Force commanders who recommended heavier, more versatile carrier aircraft.

In July 1948, construction of the carrier was approved by Congress and President Truman. In March the following year, the President authorized the name for the new carrier; when commissioned, she would become USS *United States* (CVB-58).

The events of April 1949 occurred with stunning swiftness and to this day are subject of discussion in some military and political circles. On April 13, funds were approved by the House of Representatives. Two days later, Secretary of Defense Louis Johnson wrote to General Eisenhower, then temporary presiding officer of the Joint Chiefs of Staff, requesting that the Joint Chiefs review the need for a new

nounced he had ordered sea and air forces in the Far East to give support and cover to Republic of Korea forces and ordered the Seventh Fleet to take steps to prevent an invasion of Formosa. On July 3, carrier aircraft went into action in Korea. USS *Valley Forge*, with Air Group Five, and HMS *Triumph*, operating in the Yellow Sea, launched strikes on airfields, supply lines and transportation facilities around Pyongyang, northeast of Seoul.

On July 12, 1951, the Navy Department announced a contract for a new large aircraft carrier (CVB-59), to be built at Newport News. On July 30, Congressional action approved the contract. A joint resolution from Capitol Hill proclaimed:

"Be it resolved that when and if the United States completes construction

United States. The increase in size of the *Forrestal* over the *Midway* class comes about as a normal development in aircraft carrier design. With four catapults instead of the usual two and four airplane elevators instead of the usual three, aircraft operations from this ship will be greatly improved.

"The new design was planned to meet added requirements, such as the servicing and starting of jet aircraft, maintaining the electronic appliances on the aircraft in a ready-to-go condition while the plane is on the deck, blending of aircraft fuels to get a fuel which can be used in jets without sacrificing the gasoline capacity, and a flush deck where the navigating bridge can be lowered or raised to suit operating conditions. Stacks comparable to the *Ranger* will be used. New type steels, the result of years of development, will go into the construction."



USS SARATOGA, sister ship to CVA-59, was designed to have greater hp than Forrestal.

The flush deck design barely left the drawing board before it was changed. This design was advanced to provide optimum landing area and to eliminate the hazard of island superstructure offered by the axial deck. At the end of W.W. II, however, the British developed the angled deck concept and operated lightly constructed twin-engine attack planes from the marked-off deck of a British carrier. U.S. Navy pilots conducted similar test on the *Franklin D. Roosevelt* and the decision to modify the flight deck of a U.S. carrier was made. Accordingly, the *Antietam* was reconfigured, landings and takeoffs were made using a variety of aircraft, and a final detailed report on the evaluation of the "canted" or angled deck revealed that the operational trials met with a high degree of success. As a result of these experiments, the Navy ordered a redesign of the deck and operating arrangements on the *Forrestal* and all future carriers, as well as reconfiguring many of the existing carriers during scheduled modernization periods.

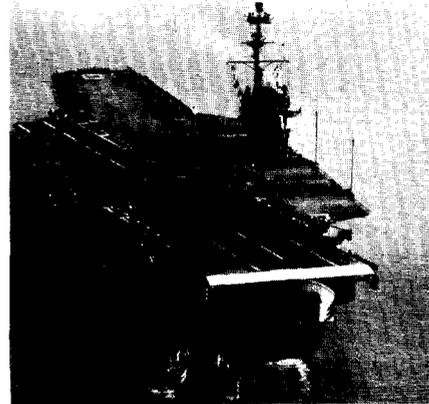
When Secretary of the Navy Dan A. Kimball announced the awarding of a contract to Brooklyn Naval Shipyard for the construction of USS *Saratoga* (CVA-60), he said it would be similar to the *Forrestal*. But design improvements in machinery since *Forrestal* installation were ordered to give *Saratoga* a somewhat higher speed.

"The importance attached to this carrier [*Saratoga*] by the Navy Department," Secretary Kimball said, "is emphasized by the Navy's sacrifice of other combatant ships in the 1953 program in order that a second large carrier can be added to the Fleet.

"Although the ships sacrificed are urgently needed to augment the battle readiness of the Fleet, the Navy decided that the need for the large aircraft carrier is even more urgent in terms of national security."

Forrestal was launched on December 11, 1954, and christened by Mrs. James Forrestal. The ship was commissioned at Norfolk Shipyard on October 1, 1955. The carrier had an overall length of 1036 feet, a width of 252 feet, and nearly four acres of flight deck. She displaced 59,650 tons and had a horsepower rated over 200,000, and a speed over 30 knots. Four steam catapults were installed. She had a complement of 3500 officers and men, including the air group.

Assistant Secretary of the Navy (Air) James H. Smith, Jr., spoke at the commissioning ceremonies. "If our way of life is to survive," he said, "we must maintain these two alternate military postures: the first is to maintain a powerful and relatively invulnerable reprisal force which will signal a potential enemy to stop, look and listen before he risks an all-out atomic war. The second is to insure that we ourselves will not be forced to change the character of a limited war because of fear of ultimate defeat in a series of them. Fortunately, we need not maintain a completely separate set of forces for each posture. In this ship and the variety of aircraft she can service we combine the two, and we add the multiplier of the ability to appear quickly



USS RANGER'S after flight deck was altered slightly to provide a longer overall length.

at any one of the many far-flung trouble spots. This is economy of force, achieved without sacrifice of our objectives."

USS *Saratoga* was christened at New York Naval Shipyard on October 8, 1955. A few token feet of water were splashed into the new ship's dry-dock to "launch" her officially. She was essentially similar to *Forrestal* but was designed to develop considerably more horsepower. She was commissioned April 14, 1956.

Sister ship *Ranger* (CVA-61) had one outstanding exception to distinguish her when she was commissioned August 10, 1957. The angle of the after flight deck was altered slightly, giving her an overall length of 1046 feet, as compared to the 1039 of *For-*



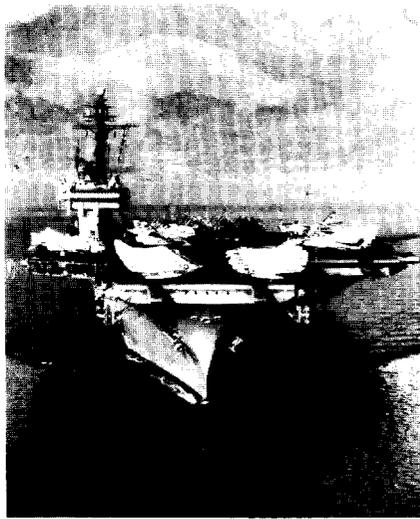
USS INDEPENDENCE was commissioned at New York Naval Shipyard, the fourth aircraft carrier of the Forrestal class. This aircraft carrier had increased arresting gear capability installed.

restal. Another innovation, an all-welded aluminum elevator, was installed on the port side, replacing the conventional steel types used on other *Forrestal*-class carriers. To expedite her building, work was started in a smaller dock. About four months later, when the *Forrestal* was launched, the partially completed *Ranger* hull was floated into the larger facility.

CVA-62, the *USS Independence*, was constructed in Drydock 6 at New York Naval Shipyard, her stem at the head of the drydock to facilitate material delivery over a truck ramp leading from the head of the dock to the hangar deck at the stern. The island and associated sponson "were not installed in order to avoid blocking off the large traveling crane. In August, the extraordinarily complex job of transferring her to Drydock 5 was accomplished smoothly and efficiently.

Independence was commissioned at the New York Naval Shipyard on January 10, 1959, the fourth carrier of the *Forrestal* class to join the Fleet.

Kitty Hawk (CVA-63) and *Constellation* (CVA-64) were essentially designed along the *Forrestal* lines but developed into a separate class, the *Kitty Hawk* class. The major difference is missile capability. Both CVA-63 and -64 are armed with *Terriers*. The fuel capacity in the *Kitty Hawks* is a little greater than the *Forrestals*, while avgas capacity is a little less. The angled part of the flight deck is some 40 feet longer and the catapults



USS KITTY HAWK, with *Terrier* missile capability, became the first of a new class CVA.

and elevators have greater capacities. *USS America* (CVA-66), now being built at Newport News, will have an even longer angled deck than any of the predecessors. Placed in the *Kitty Hawk* class, she is scheduled to be completed in late 1964.

On February 4, 1958, Secretary of the Navy William B. Franke announced that the world's first nuclear-powered aircraft carrier was to be named *USS Enterprise* to perpetuate the WW II carrier and her six predecessors. On that same day, the keel of the carrier was laid at Newport News.

On September 24, 1960, Adm.

Arleigh Burke, then CNO, delivered an address during launching ceremonies, in which he described the new carrier.

"This new *Enterprise*, the largest ship ever built, of any kind, by any nation, will be the eighth Navy ship to proudly bear that name. Her forbears have left an enviable record, a record of courageous, distinguished service.

"We are looking at a major advance in the art of nuclear engineering. . . . The problems which were solved, the know-how that was developed in order to build this ship, represent a tremendous contribution to our knowledge of the military and industrial uses of nuclear energy.

"Her eight powerful nuclear reactors would enable the *Enterprise* to cruise 20 times around the world without refueling. Her great endurance and her advanced hull design would allow the ship to make this extraordinary journey at sustained high speed, exploiting to its utmost the seagoing advantage of mobility."

From the very first, it was obvious that designers and builders of Newport's hull No. 546, the *Enterprise*, had hit the jackpot. For the first time, RAdm. F. S. Schultz, Assistant Chief BU SHIPS, noted the customary builder's trials of a major combat ship were eliminated, and the ship was presented to the Navy for acceptance trials on her first trip to sea.

Enterprise returned to the shipyard after her six-day Navy acceptance trials in the Atlantic. A giant broom



USS CONSTELLATION (CVA-64), sister ship to *Kitty Hawk*, fires a *Terrier* missile. Basic design of the *Kitty Hawks* is of the *Forrestal* class. The angled area of flight deck is some 40 feet longer than the *Forrestals*, and catapults and elevators installed have greater capacity.

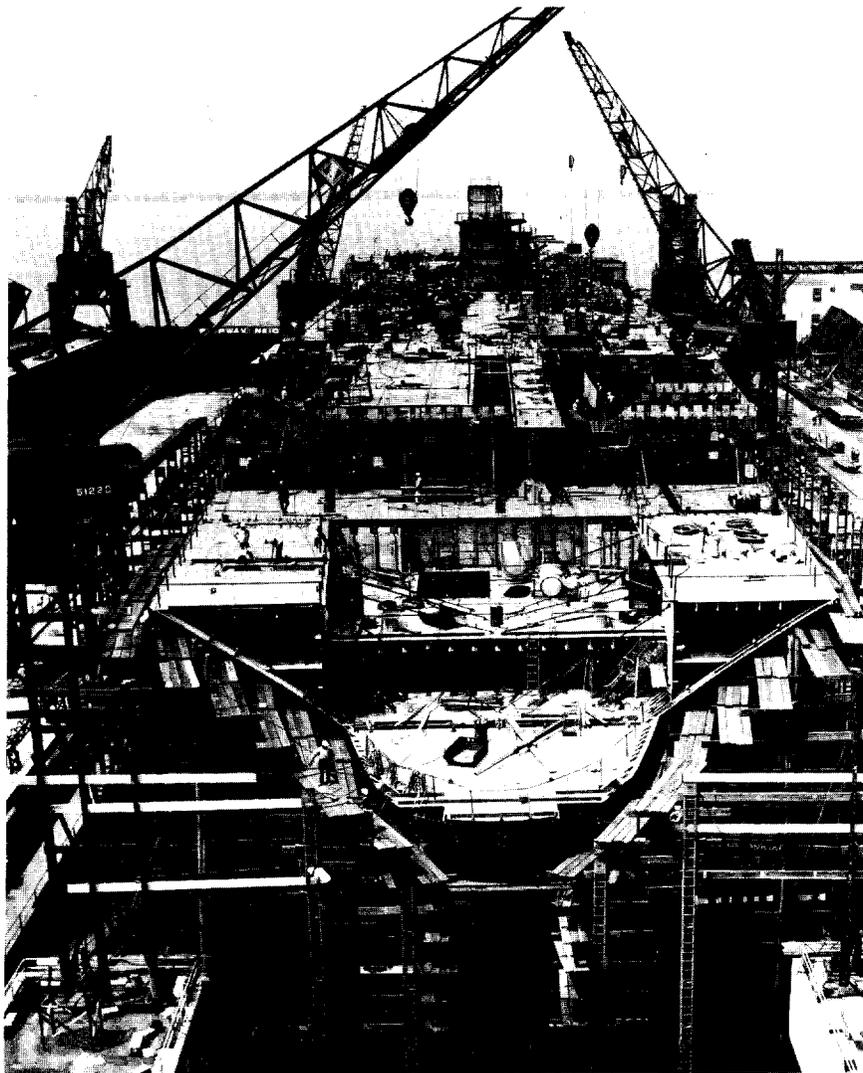
was affixed to her masthead to signify a clean sweep of the trials. Capt. W. M. Ryan, President of the Naval Board of Inspection and Survey, stated:

"The ship generally performed in an excellent manner. The cleanliness and upkeep were outstanding. The fine workmanship throughout the ship reflects great credit upon all hands concerned with its building. Like all new ships there are bugs which must be worked out, but we feel that there is nothing that cannot be overcome."

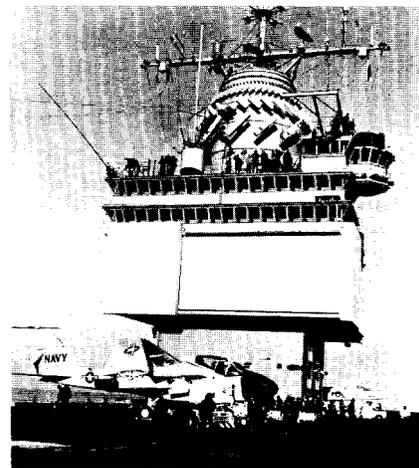
The plant for the nuclear-powered aircraft carrier was designed under supervision of VAdm. Hyman Rickover.

Designated CVA(N)-65, *Enterprise* was commissioned on November 25, 1961, at Norfolk, with Capt. V. P. dePoix commanding. The world's first nuclear-powered carrier has a length of 1040 feet between perpendiculars and an extreme breadth of 252 on the flight deck. Each of the four deck-edge elevators cover about 4000 square feet. *Enterprise* is the first carrier to have elevators for pilots in lieu of escalators. She displaces 85,350 tons.

The communications equipment on the carrier is believed to be the largest assortment ever assembled on any ship. Besides more than 1800 telephones, there is the complexity of numerous



UNDER CONSTRUCTION at Newport News is USS America (CVA-66). The island being built midships, will be moved to the starboard side of the carrier when sponsons are attached to hull



DOMINATING feature of *Enterprise's* silhouette is her box-like island, prickling antennae.

radio circuits, teletypes, a pneumatic tube arrangement to carry messages from one station to another, and numerous announcing systems, several of which have speakers throughout the ship. She is the first ship of the U.S. Navy's Atlantic Fleet to have the Navy Tactical Data System installed.

The *Enterprise* is equipped with four type C-13 steam driven catapults with an energy potential of 60,000,000 foot-pounds. With this power, an aircraft weighing 78,000 pounds can be accelerated to 160 mph from a standing start, in a distance of 250 feet. All of the aircraft aboard can be launched at the rate of one every 15 seconds while using all four cats.

The size of *Enterprise's* island structure was dictated by the size of the two radar screens that flank each of its four sides. This newly developed radar system is the most powerful to be installed on a floating platform, according to Capt. de Poix. Its far-reaching, three-dimensional capability is enhanced by its height above the water line. The silhouette is distinctive.

"Propulsion and control characteristics of the ship offer great tactical flexibility," said Capt. de Poix in mid-1962. "There are four rudders, one almost directly astern of each propeller. This provides excellent maneuverability at all speeds as well as tactical diameters in turns which compare with much smaller ships. . . ."

"Her ability to launch a strike on the enemy from one position, recover, and launch another 24 hours later from an unpredictable position more than 800 miles away from her previous strike position will constantly be a factor in causing the enemy to utilize protective forces that could be deployed elsewhere.

"If a show of force is required, *Enterprise* can be on distant station in a shorter period of time than any other ship in the Fleet."



