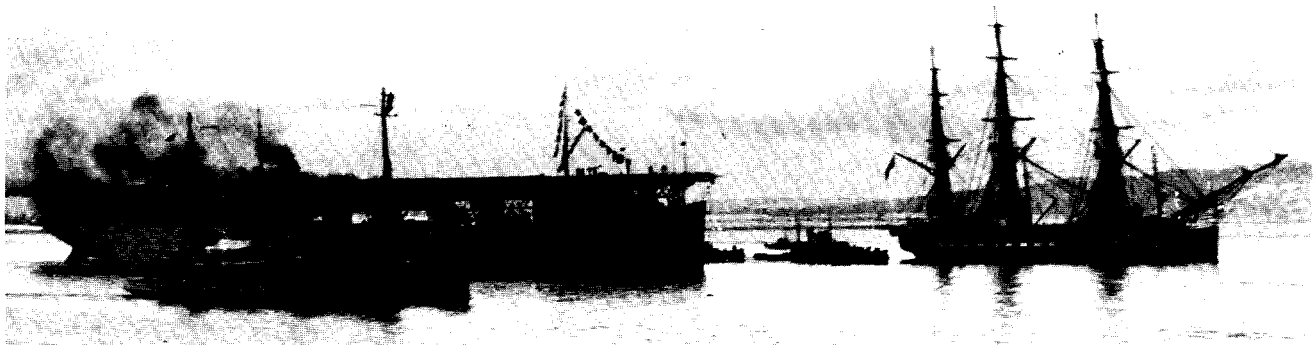


ANCHORED IN SAN DIEGO *harbor January 1933, U.S. Navy's first aircraft carrier, USS Langley, provides a startlinq contrast against the recent past. At right is USS Constitution. "Old Ironsides" was then on her last major voyage, a tour of important U.S. seaports.*

Evolution of Aircraft Carriers

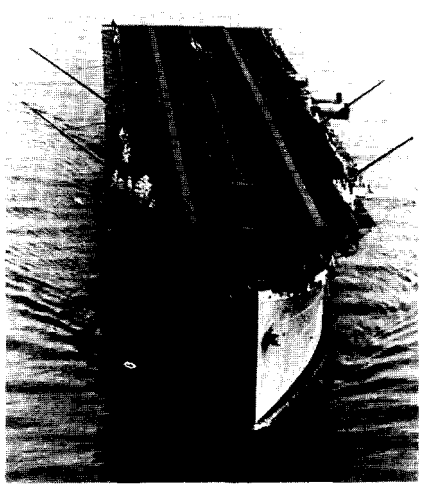
LANGLEY, LEX AND SARA

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 Proccedings*

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."

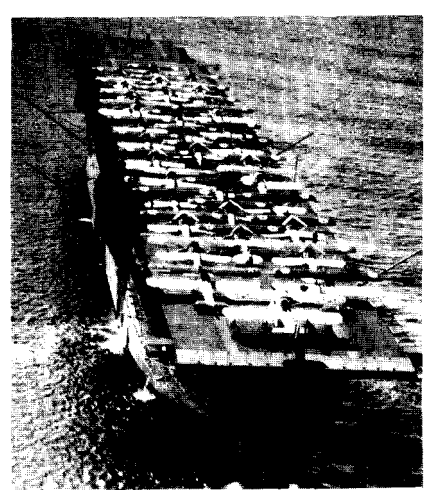


EXPERIMENTAL *autogiro takes off from Langley in September 1931 during tests underway.*

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-



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 advantages outweighed her disadvantages."

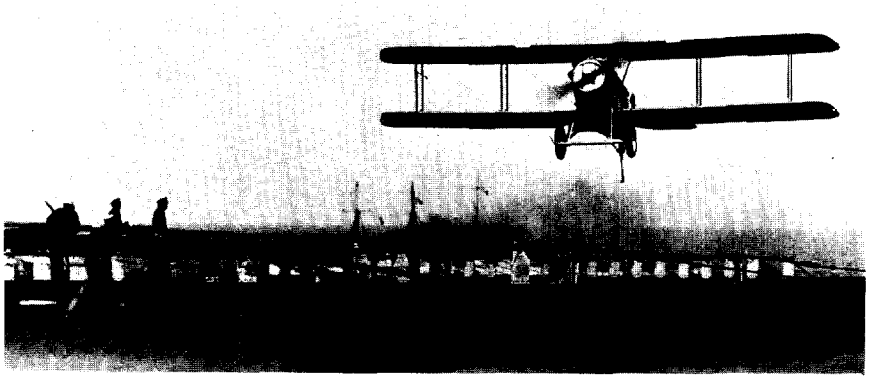
CAPT. THOMAS T. CRAVEN, *Director of Naval Aviation, pressed hard in Congressional hearings for conversion of the collier Jupiter.*

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

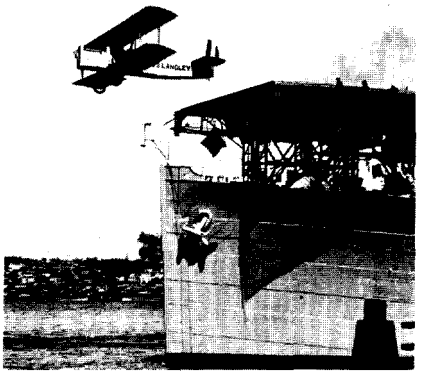
The ship was slow and might prove a drogue to a fast-moving fleet. But she did have the necessary length to permit planes to fly off from a specially prepared deck. Her hold spaces were very large, "with high head room in them, a difficult thing to find in any ship. She had larger hatches leading to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

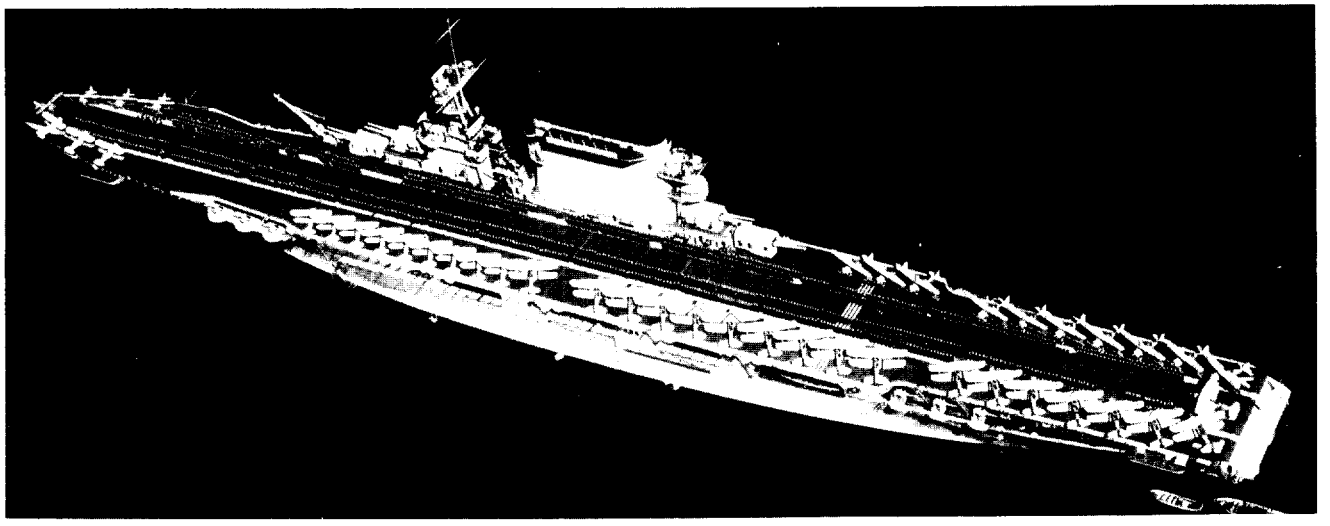
When *Langley* eventually went to sea in September 1922, she had an arresting gear installed.

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 accommadtions 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 grapnels, 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."

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.*

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 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.

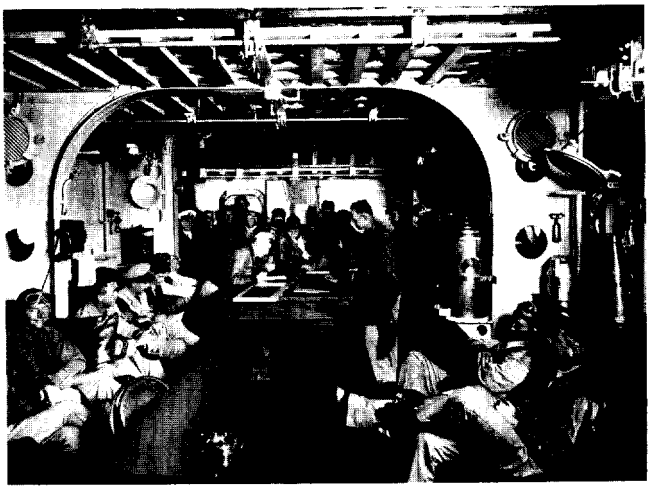
Principal purpose of the *Langley* was to teach Naval Aviators about carrier operations, but the early days were certainly tough on pilots, according to *Our Flying Navy,* a book published in 1944. "'Instrument face' was the distinguishing mark of the *Langley's* pilots, who loosened teeth and flattened 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.

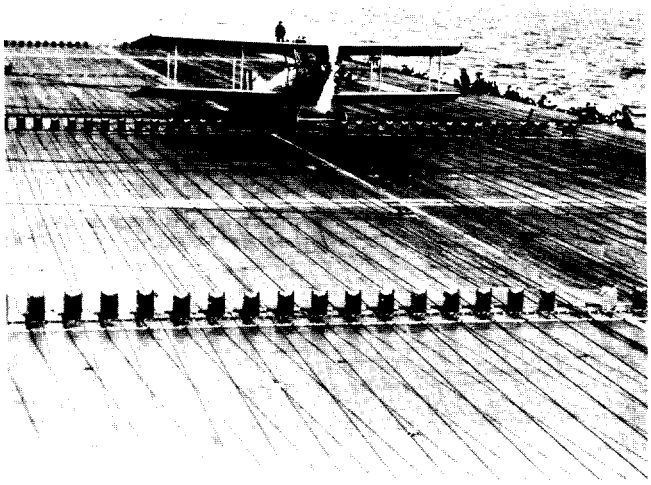
There was an urgency related to these tests. Already in the ways were the keels of two battle cruisers destined for the scrap heap as a result of the Washington Naval Treaty of 1922. A clause within this treaty permitted their conversion to aircraft carriers. Tests aboard the *Langley* were to influence 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 /or 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 12½ 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.

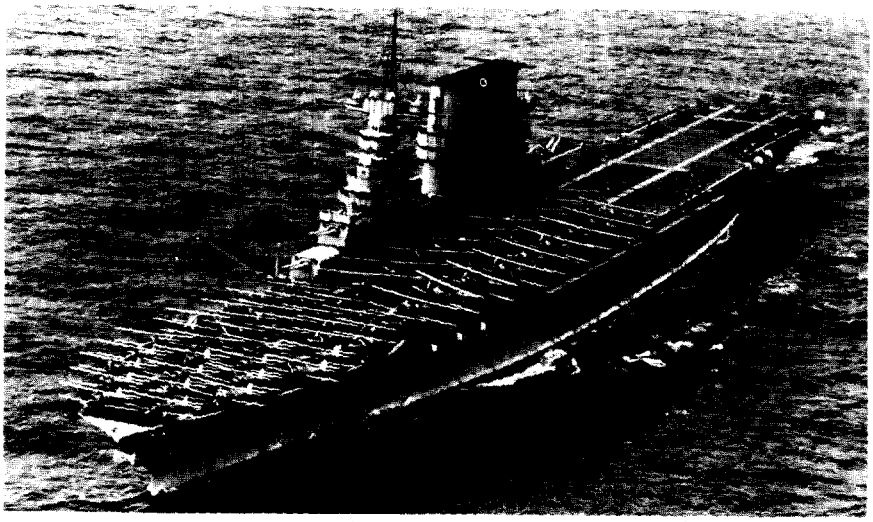
"The preliminary mission of the carrier is to get planes in the air quickly, both torpedo planes and combat [fighter] planes. Due to lack of operating experience, it is impossible to tell at this time whether this can be accomplished without the use of catapults and, if not, how many catapults will be 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 *Lexington* 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. Saraatoga was commissioned November 16, 1927, Lexington on Dec. 14, 1927.*