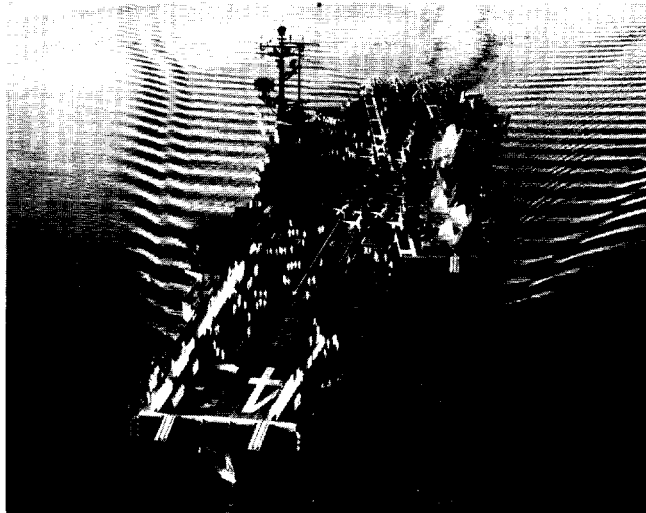


ESSEX joined the Oriskany class after Project 27A. She is shown after Ship Improvement No. 1. CV-9 got her angled deck in Project 125.



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 propeller-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

By Scot MacDonald

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.

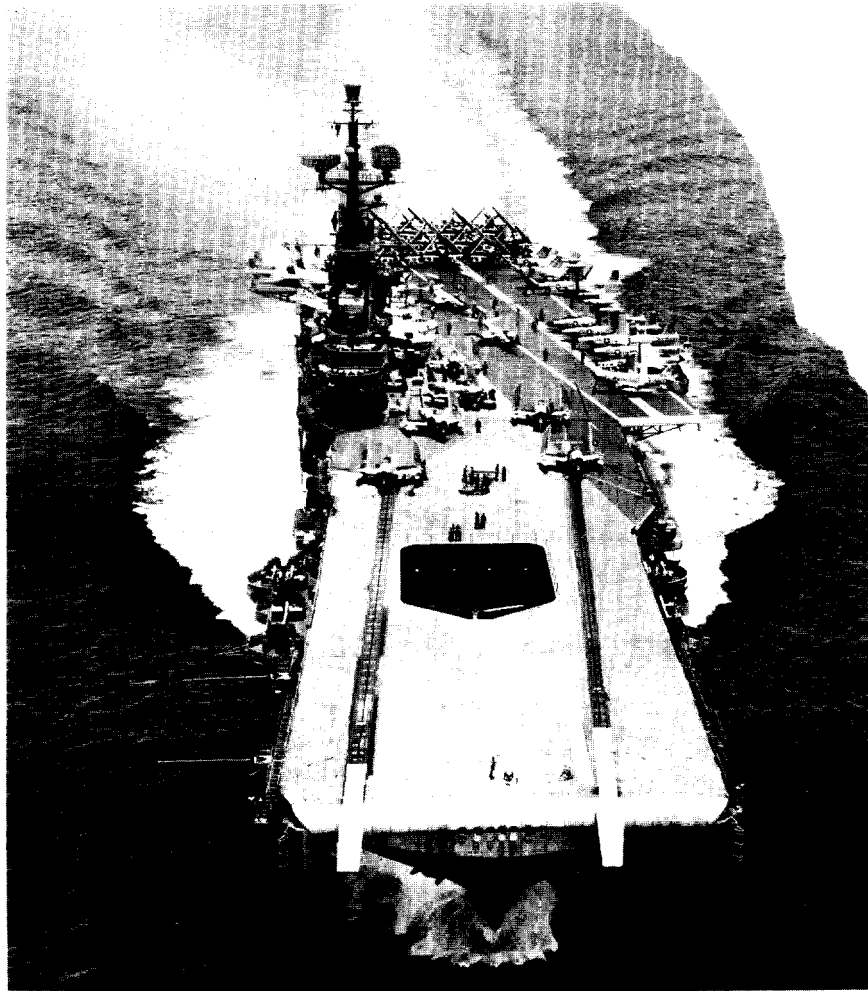
It was inevitable, then, that the Navy would introduce all-jet squadrons to carrier operations. On May 5, 1948, Fighter Squadron 17-A, equipped with 16 FH-1 *Phantoms*, became the first carrier-qualified jet squadron in the U.S. Navy. It took three days of operations to do it, but all squadron pilots, 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.

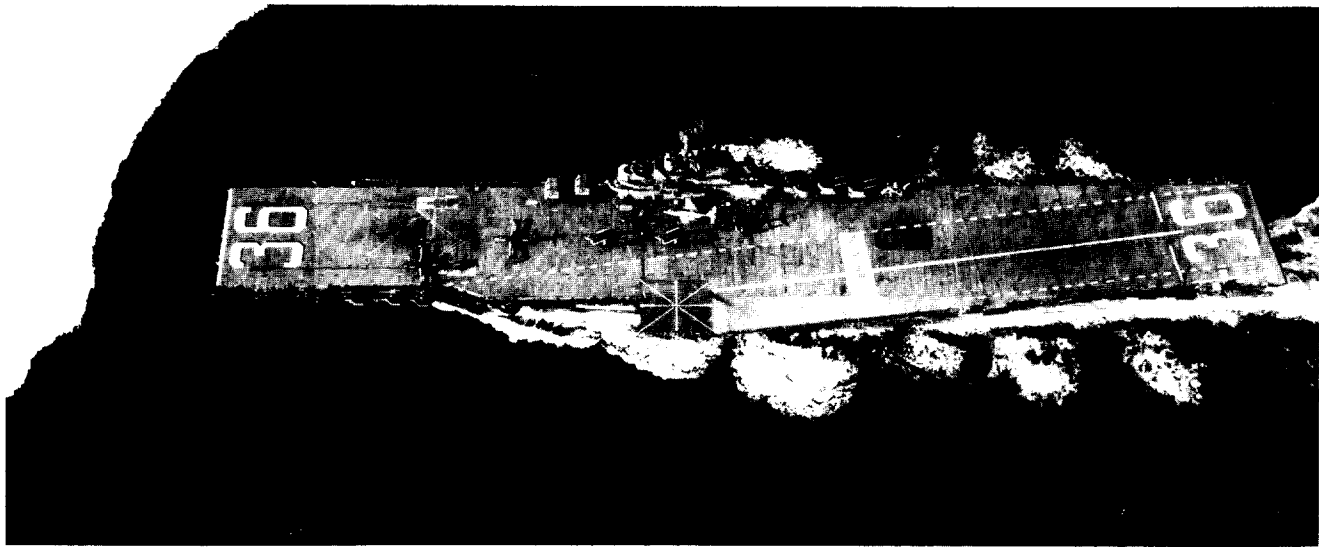
"While the amount of steam required for sustained operation is large, tests have shown that the boilers can meet the demand without interfering with the ship operations."

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."

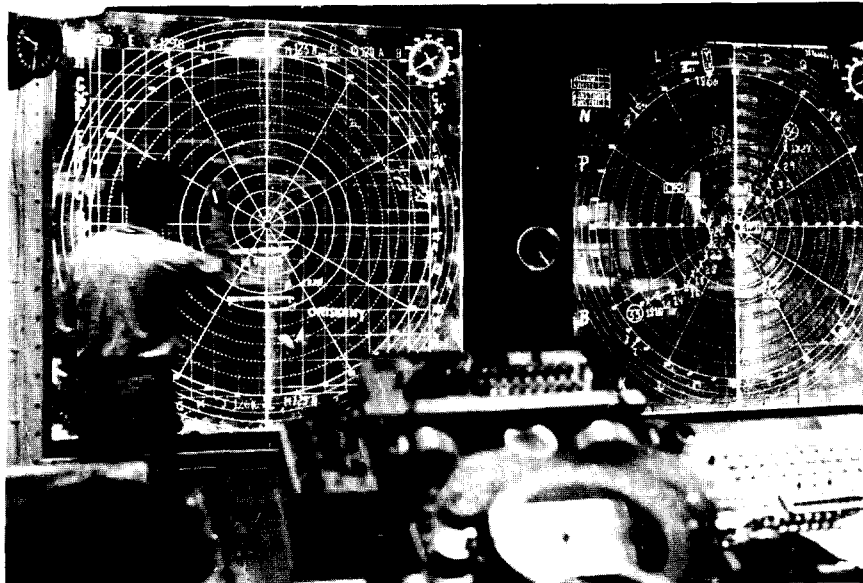
Project 27C (angled deck), which resulted from the *Antietam* tests and modified the original 27A, significantly changed the silhouette of the aircraft carriers. The canted or angled deck was installed and the hurricane bow of the original *Saratoga* and *Lexington* carriers reintroduced. The project 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.

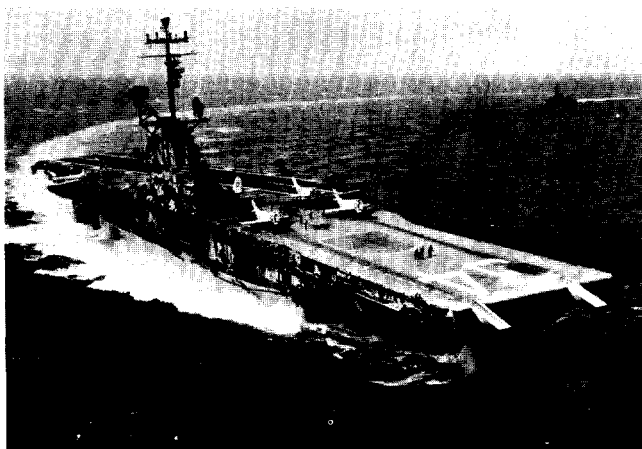
ing August 8, five CVA's were redesignated CVS's, ASW support carriers.

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.

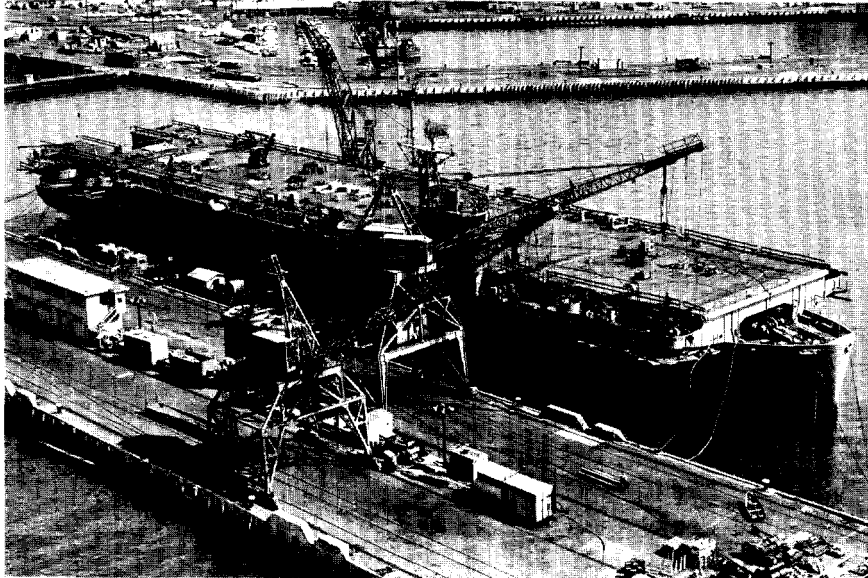


MIRROR LANDING SYSTEM, developed by British, was tested in Bennington by Cdr. R. G. Dosè, C.O., VX-3, Bennington's C.O. congratulates.

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.

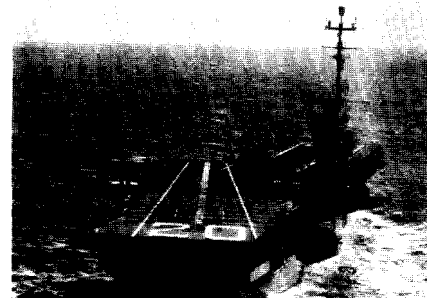
Modular CIC, a clock-like layout of communications, radar, and other CIC elements, had been tested in the *Oriskany* and proved successful. It was installed in *Coral Sea*, which became the second aircraft carrier to have such an arrangement.

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.