

Wings Over The Ocean ... Conclusion

A History of Sea-Air Aviation

By John M. Lindley

While the time after WW II was filled with its share of wars, conflicts and crises which involved sea-air aviation, usually in its role as a military vehicle of transportation, those 30 years also saw an intense effort to develop new or improved vehicles of warfare. Since 1945 jets had largely replaced propeller-driven aircraft on carriers; super carriers replaced the carriers of WW II; helicopters joined the fleet; and the vertical or short takeoff and landing aircraft (V/STOL) emerged as a potential future development in Naval Aviation.

The first jet-propelled airplane flew in Germany on August 27, 1939. Hans von Ohain designed that first jet engine. At the same time Frank Whittle was at work in England trying to develop a jet engine. Whittle's jet engine made its first flight on May 15, 1941. During WW II the Americans, Japanese and Italians, as well as the Germans and British, tried to develop jet-propelled aircraft. Although a few RAF Gloster *Meteors* and German Messerschmitt ME 262 jets did see action at the end of the war, they had no significant impact on its outcome.

Both the United States and Britain pursued jet development after the war. The jet engine had the important advantage, over the reciprocating internal combustion engine with propeller, of greater thrust for comparable weight. Thus jet engines were poten-





tially far more powerful than internal combustion types at high speeds. In addition to greater speed, the elimination of the propeller made possible a more streamlined airframe, which further improved speed. Jet engines are also more efficient than propeller-type engines at speeds above 500 miles per hour. Thus there were several sound reasons for development of jet engines.

The first jet flight by a U.S. Naval Aviator occurred on April 21, 1943, when Captain Frederick M. Trapnell flew a Bell XP-59A *Airacomet* in California. It had a speed of 375 miles per hour. LCdr. Eric M. Brown, Royal Navy, achieved the distinction of being the first pilot to land a jet on a carrier, a *Vampire I* fighter on the light carrier *Ocean* on December 3, 1945. In 1947 the U.S. Navy held carrier acceptance trials for the jets that it had ordered during the war, the McDonnell Aircraft Corporation's FD-1 (later redesignated FH-1) *Phantoms* (maximum speed 579 miles per hour). With subsequent early carrier-based fighters in the fleet by 1950, the U.S. Navy was ready to use them when the Korean War broke out.

Combat operations in Korea demonstrated the military effectiveness of the jet and also revealed a serious drawback. In contrast to propeller-driven aircraft, the new jets consumed fuel at a prodigious rate. As the size, weight and thrust of jets grew in the

1950s, the demand for more and more fuel continued. In addition to increased fuel-carrying capacity (which also increased the weight), high speed at high altitudes meant that the jets had to have more auxiliary gear. New or improved electronic, navigational and communications equipment further increased the weight. These factors combined to make the *Essex*-class carriers of WW II inadequate for jet operations. The *Essex*-class flattops lacked the fuel storage capacity for jet operations; their decks were not sufficiently strong for the weight and they lacked large enough storage areas for these new aircraft.

Faced with the growing obsolescence of part of its carrier fleet, the U.S. Navy initiated two programs to deal with this problem. It systematically began to convert some of its existing carriers so they could handle jets. It also began to build new carriers which would be large enough to handle existing and future jets. The shipyard conversion programs included strengthening the flight decks, installing more powerful steam catapults and doubling fuel storage capacity. The Department of Defense and President Truman were at first reluctant to authorize construction of a new class of carriers, largely because they felt they would duplicate the role of the Air Force's strategic bombers. But the high level of carrier air operations in the Korean War soon won support for the construction of *Forrestal*-class carriers, beginning in the early 1950s. *Forrestal* was the first carrier built specifically to operate jets and, at the time of its completion, it was the largest carrier afloat. It has an overall length of 1,039 feet and displaces 54,600 tons. With a speed of 33 knots, 4 catapults and 4 deck-edge elevators, and an air group that included more than 80 jets, *Forrestal* joined the fleet in 1955. Three more carriers of this class would follow with four more in the new *Kitty Hawk*-class which had *Terrier* surface-to-air guided missiles for close-in defense. The final carrier in this class, *John F. Kennedy*, went to sea in September 1968.

Bigger than the three battle carriers or *Midway*-class flattops of WW II

(*Midway*, *FDR* and *Coral Sea*), *Forrestal* and *Kitty Hawk*-class carriers incorporated three British innovations in carrier design; the angled flight deck, steam catapults and the mirror landing system. The British had begun experimenting with the angled deck (canted to port between five and ten degrees) in 1950 with the new *Ark Royal*. The U.S. Navy first tried this innovation on the carrier *Antietam* in 1962. The advantage of the angled deck is that it provides a landing and takeoff area which is separate from the forward part of the straight deck where other aircraft are parked or taking off. Steam catapults replaced the compressed air or powder catapults because they were able to launch heavier jet aircraft, which could not become airborne in a deck run of 800 to 1,000 feet.

In 1951 a Royal Navy officer designed a new steam catapult which proved successful on HMS *Perseus*. The U.S. Navy subsequently adopted this British breakthrough which gave jets flying speed after a brief deck run. The steam catapults on *Forrestal*-class carriers have a capacity of 42 million foot-pounds of force. Later catapults had an even greater capacity so that they could hurl a jet weighing over 50,000 pounds from 0 to 180 miles per hour in just 310 feet.

The third British contribution to carrier flight operations in the 1950s was the mirror landing system. Prior to the adoption of the mirror landing system, the pilot responded only to the signals of the landing signal officer (LSO) during his approach. Sometimes this system was slow and inaccurate or the LSO was hard to see. With the mirror landing system the pilot has a visual image of the relationship of his jet to the required approach path; thus he can adjust his speed and angle of approach more rapidly and accurately than if only the LSO were signalling these adjustments.

The culmination of the development of the super carrier in the post-WW II era has been, of course, the nuclear carriers *Enterprise* and her successors. Begun in 1957, *Enterprise* was commissioned on November 25, 1961. The new *Big E* has an overall

length of 1,123 feet, displaces 85,350 tons fully loaded, has a crew of over 5,000, and a top speed of at least 35 knots. Her four nuclear reactors allow her to steam at maximum speed for years, if necessary, without refueling. Instead of the usual funnels, *Enterprise* has an island which is a box-like shape filled with fixed radar antennas and electronics gear. She cost \$445 million, a reasonable figure when compared to the projected costs of the nuclear carriers *Nimitz*, *Eisenhower* and *Carl Vinson*.

The three *Nimitz*-class carriers will be similar to *Enterprise* in design but larger (91,400 tons fully loaded) and will have only two reactors. All four nuclear carriers will carry about 100 aircraft and will have *Sea Sparrow* surface-to-air missiles for close-in defense. The air group on the *Nimitz*-class carriers will probably consist of 24 F-14A *Tomcat* fighters; 24 A-7 *Corsair* attack planes; 12 A-6 *Intruder* attack jets; 4 KA-6 *Intruder* tankers; 3 RA-5 *Vigilante* reconnaissance jets; 4 E-2 *Hawkeye* airborne early warning planes; 10 S-3A *Viking* antisubmarine warfare aircraft and 8 SH-3 *Sea King* helicopters.

Of these latest carrier aircraft, the F-14A *Tomcat* is most noteworthy. Designed as the successor to the F-4B *Phantom II*, the *Tomcat* is an all-weather carrier-based fighter than can counter multiple aircraft or missile attacks. Its variable-sweep wings automatically adjust as the plane maneu-



vers, assuring the most efficient wing angle at all times. The *Tomcat* has Mach 2 speed and carries *Phoenix* air-to-air missiles. Its weapons system can fire up to six missiles at six different targets up to 50 miles away.

The presence of *Sea Kings* on the *Nimitz*-class carriers indicates the changing role of the super carrier in the Navy's plans. Until the mid-1960s, attack carriers had a primary role as nuclear deterrent forces. With the growing availability of *Polaris* missile submarines and the eventual presence in the fleet of the *Trident* submarine with its *Poseidon* ballistic missiles, the carriers in the fleet have had their nuclear deterrent role taken over by the ballistic missile subs. The attack carriers retain a nuclear deterrent role, but it is distinctly secondary to that of being dual purpose forces employed for the projection of sea power overseas and for sea control missions, such as antisubmarine warfare. The presence of *Sea Kings* and *Vikings* on the *Nimitz*-class carrier provides this sea control capability. The *Sea King*, a large, twin-engine antisubmarine helo, carries a crew of four. These helos and the *Viking*, in combination with the *Tomcat* and the other attack aircraft, should be most effective in helping project sea power where and when needed.

Although experiments with helicopters or, at least, rotary-wing aircraft date back to the mid-fifteenth century, the first practical helicopter

was the machine built by the German Focke-Achgelis in 1939. In 1939 Igor Sikorsky, an immigrant to the United States from Russia, first flew his VS-300 which had only one main rotor. Two years later, Sikorsky's single-rotor helicopter remained in the air for 92 minutes establishing a world record for time aloft and the true practicality of his design. The U.S. Navy began to buy Sikorsky helicopters during WW II, the first model being the R-4B (later designated HNS-1). Both the Navy and the Coast Guard used these first helos, but the Coast Guard had primary responsibility for the sea-going development of helicopters.

The helicopter proved its value for the Coast Guard's rescue work on January 3, 1944, when Commander Frank A. Erickson, USCG, made an emergency flight to deliver 40 units of blood plasma from the Battery, New York City, to a hospital in Sandy Hook, N.J., for the aid of survivors of an explosion on the destroyer USS *Turner*. Erickson's dramatic landing at the hospital, in an area that was too small for a conventional airplane, was even more spectacular than most life-saving missions because he had made the flight through snow squalls and sleet which had grounded all other aircraft.

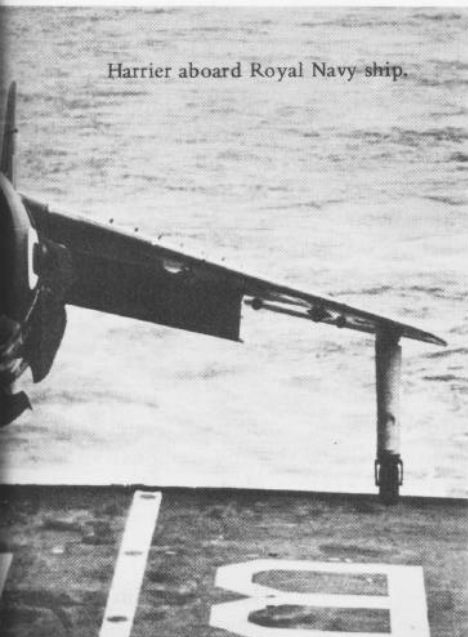
After WW II, the U.S. Navy began serious evaluation of helicopters for antisubmarine warfare. It found that a sonar transducer could be lowered into the sea (dipped) to detect the presence of a nearby submarine. At the same time that these tests were being conducted, the Marines began their development of the tactics and doctrine of vertical envelopment. By the time of the Korean War, helicopters had joined the fleet air program in antisubmarine warfare, rescue work, plane guard, medical evacuations, and other utility tasks. By 1955 U.S. Navy HSS-1 helos carried dipping sonar, homing torpedoes and a four-man crew for their submarine hunting operations. These helicopters operated from aircraft carriers specifically designated as antisubmarine support carriers (CVSs).

When the U.S. Navy dropped the distinction between attack carriers

(CVAs) and antisubmarine carriers (CVSs) in the late 1960s, all fleet carriers were given the capability for handling both attack and antisubmarine operations. Thus helicopters became a permanent part of carrier aviation. Today helicopters go to sea not only on carriers of various types, but also on many Service Force ships for use in vertical replenishment, on hospital ships (as in the Vietnam War), and on some of the new patrol frigates, destroyer escorts and destroyers. The Navy expects to use these patrol ships and destroyers for escorting amphibious forces, merchant ships, and service forces, and in antisubmarine warfare operations as part of the sea control mission. Another Navy project which will put helicopters on some destroyers and escort ships is LAMPS (light airborne multi-purpose system), an indication of the Navy's future surface warfare plans which will integrate air and surface forces more fully than ever before.

In its antisubmarine warfare forces the U.S. Navy has land-based aircraft as well as sea-based helicopters and fixed-wing patrol planes, such as the S-3A *Viking*. For many years the land-based *Neptunes* were the mainstay for long-range air patrols. Today the P-3 *Orion* has succeeded the *Neptune*. The *Orion*, a four-engine turbo-prop, has a crew of 10 who fly 12 to 15-hour patrols searching for submarines. It is filled with sophisticated radar and electronic gear that can detect submarines in a variety of ways. In contrast to its predecessors, the *Orion* has the advantages of speed, fast response to changing tactical information and the capability for immediate attack against enemy submarines — with torpedoes, depth bombs, mines, rockets, or even nuclear weapons.

Although not specifically used for antisubmarine warfare patrols, another long-range patrol aircraft is the Coast Guard's HC-130B *Hercules*. The Coast Guard uses these four-engine planes to fly six to eight-hour ice patrols in the area of Newfoundland's Grand Banks. Aerial reconnaissance of icebergs provides information concerning ice conditions which is extremely helpful to North Atlantic surface ships.



Harrier aboard Royal Navy ship.

The helicopter, which has been so useful for rescue work, amphibious operations and antisubmarine patrols, is a form of vertical takeoff and short landing aircraft. Major navies of the world are now experimenting with other types of vertical takeoff and short landing planes. The first jet-propelled V/STOL combat plane design to enter service was the British Hawker Siddeley *Harrier*, based on the P.1127 *Kestrel*, initially tested in 1960. The goal of V/STOL designers is a land-based aircraft also suitable for shipboard operations or for landings and takeoffs from inaccessible places. Early V/STOL trials showed that this type of aircraft was feasible for carrier use, but it lacked the lifting capacity of either conventional jets launched from catapults or heavily armed helicopters. Currently, the navies of the United States, Great Britain and the Soviet Union are all engaged in exploring the use of V/STOL aircraft. The U.S. Marines, for example, are employing the AV-8 *Harrier* V/STOL for support of ground combat troops.

Long-range U.S. Navy planning may put V/STOL jets and conventional helicopters aboard combatant and support ships. As part of its experimentation with possible future ship types, the U.S. Navy has tested USS *Guam*, an amphibious assault ship, in these various roles with V/STOL aircraft. The Navy has another amphibious assault ship (LHA) on the drawing boards. It would also carry helicopters and V/STOL jets for operation with the Marine Corps.

Since 1945 many of the smaller navies around the globe have acquired aircraft carriers and carrier-based aircraft. By 1969 Canada, Australia, The Netherlands, Argentina, Brazil, India and Spain had all joined the carrier navies of WW II — the United States, Japan, Great Britain and France — in operating flattops. All carriers of the newcomers are the light carrier class (11-16 thousand tons), except for France which has two attack carriers, *Foch* and *Clemenceau*, which displace 22,000 tons. Great Britain has supplied all the new carrier navies, except Spain — which the United States provided. France holds the distinction of having built her own attack carriers

and a supersonic carrier-based jet. All aircraft flown from these carriers are either British, French or American-built. Although none of the carrier forces of any of these nations can match the 12-14 carriers which the U.S. Navy will be operating in the last quarter of the twentieth century, their presence does provide smaller navies with an antisubmarine warfare and amphibious assault capability.

The Soviet Navy joined the carrier navies with the completion of two helicopter carriers, *Moskva* and *Leningrad*, in 1967 and 1968, respectively. Displacing 18,000 tons fully loaded, these ships are 673 feet long and have a maximum speed of 30 knots. They carry 15-20 helicopters of the Kamov-25K type. Unlike other helicopter carrier designs, the *Moskva*-class ships are missile cruisers forward, helicopter carriers aft. On the forward portion of these ships there are antiaircraft and antisubmarine missile launchers as well as rocket launchers and antiaircraft guns. Although Imperial Russia had been among the pioneering nations in aviation, the Soviets did not try to develop ships capable of handling aircraft until very recently. Instead of taking their naval aviation to sea, as had been the practice in the United States, Japan and Great Britain, the Soviets had concentrated on the development of land-based naval air forces which could fly reconnaissance and attack missions. The Soviet naval air force is presently quite large and has modern jet aircraft.

Prior to the introduction of the *Moskva*-class helicopter carriers, the Soviets had built a substantial submarine force made up of both conventional and nuclear-powered attack and ballistic missile boats. *Moskva* and *Leningrad* are now used in antisubmarine operations and to show the Soviet flag around the world. Their helicopters could also be used for amphibious operations if necessary. The Soviets are presently experimenting with jet V/STOL aircraft which they presumably plan to operate from their carriers. Since the Soviet Navy has no jets suitable for carrier operations and it would take them at least 10-15 years to build and develop an attack carrier and operational carrier-

based jets, they hope to leapfrog technologically the U.S. Navy's lead in carriers and jets with the development of their own jet V/STOL.

Recently the Soviets completed building a new and larger carrier, *Kiev*, and are building another ship of this class, *Minsk*. The *Kiev*-class carriers are estimated to have an overall length of 925 feet, displace 40-45 thousand tons and have a maximum speed in excess of 30 knots. Naval analysts conjecture that these ships will carry about 25 helicopters and 25 V/STOL aircraft, and be armed with both missiles and guns. Although *Kiev* has a 550-600-foot angled deck, there is no sign that it will have steam catapults, arresting gear or a mirror landing system, all of which are associated with attack carrier design.

Naval analysts in the West are unsure what the exact mission of the *Kiev*-class carriers will be, but expect that they will have considerable military and political impact. In the past the Soviets have chosen to develop ballistic and cruise missiles as well as missile-carrying submarines, rather than to try to build carrier forces to match those of the U.S. and Great Britain. The construction of the *Kiev*-class and the probable embarkation of helicopters and V/STOL jets on them indicate that the Soviet Navy is moving away from this older naval strategy of coastal defense toward a strategy of naval projection on the high seas, especially for operations against the ballistic missile submarines of the U.S. Navy.

The Soviet Navy is not only challenging the U.S. Navy's superiority in aircraft carriers, it is also probably more advanced in the development of anti-ship or cruise missiles. A cruise missile is essentially a pilotless aircraft propelled by an air-breathing engine and carrying either a conventional or nuclear warhead. First developed by the Germans as the V-1 rocket in WW II, cruise missiles have become a potent threat to all surface naval forces. In the 1967 Arab-Israeli war an Egyptian patrol boat sank an Israeli destroyer, *Elath*, with four Soviet-built cruise missiles, thereby demonstrating convincingly that these weapons will have to be acknowledged in the future.

The Soviets concentrated on the development of the anti-ship missile as a means for rendering U.S. aircraft carriers less potent. The U.S. Navy, in contrast, experimented with cruise missiles, such as *Regulus* in the 1950s, but decided to concentrate on the development of submarine-launched ballistic missiles, such as *Polaris* and *Poseidon*, air-to-air, surface-to-air and air-to-surface missiles. The Navy is now working on adapting its *Harpoon* air-to-surface missile for use as a ship-launched anti-ship missile.

At the present time the United States, Soviet Union, Great Britain, France and the People's Republic of China all have strategic ballistic missiles of one sort or another. These nations have also developed, or are in the process of developing, various kinds of tactical guided missiles for use with their aircraft and naval fleets. These latest advances in missile weaponry seem to mean that the proliferation of aircraft carriers, aircraft and missiles of the past 30 years is very likely to continue at a growing pace.

The second consequence of the post-World War II emphasis on military research and development, especially in aircraft and missiles, has been the space programs of the United States and the Soviet Union. Even before the Soviets launched *Sputnik* in 1957, both nations had seriously undertaken the military development of intercontinental ballistic missiles as part of their strategic arms defense. The space programs were a logical parallel to this military emphasis on rockets and missiles. President John F. Kennedy explicitly gave the United States space program the goal of putting a man on the moon before the end of the 1950s. Unlike the military programs in strategic arms development, the space programs have tended to concentrate on peaceful purposes, scientific exploration and sheer discovery.

As a part of sea-air aviation, the space program in the United States has depended upon the sea for its recovery areas, either the Caribbean or Pacific. Nearly every space capsule in the manned flight programs, the *Mercury*, *Gemini* and *Apollo* projects, has depended upon helicopters for initial

recovery at sea and subsequent transportation to a waiting carrier. Many of America's astronauts who made these space flights were either U.S. Navy or Marine Corps test pilots.

Unquestionably the culmination of the American space program came on July 20-21, 1969, when astronauts Neil Armstrong and Edwin F. "Buzz" Aldrin walked on the moon. Although five additional pairs of *Apollo* astronauts landed in various locations on the surface of the moon between November 1969 and December 1972, and the *Skylab* project and the rendezvous between the American *Apollo* space capsule and that of the Soviet *Soyuz* program (July 17, 1975) have made significant contributions to our knowledge of the moon and space operations, they have not surpassed the first moon landing. Indeed, the moon landing by Armstrong and Aldrin fittingly brought sea-air aviation full circle. Just as Daedalus and Icarus struck out from Crete to fly over the sea to Sicily, so also in their own way the trio of *Apollo 11* astronauts set out from launch pad 39A at the John F. Kennedy Space Center at Cape Canaveral to land at the Sea of Tranquility. Unlike their mythic predecessors, these twentieth century explorers heeded the warnings of Daedalus and did not stray too close to the sun. Thus they returned safely to earth, splashing down in the Pacific where they were picked up by an HS-4 helicopter and taken aboard the carrier *Hornet*.

After the *Apollo 11* crew returned to the United States, the three astronauts addressed a joint session of Congress. As a member of this historic first flight to the moon, Michael Collins expressed the feelings which Daedalus may have had after he first discovered that his wings of feathers and wax could help him to fly when he told his listeners: "Man has always gone where he has been able to go. It's that simple. He will continue pushing back his frontier, no matter how far it may carry him from his homeland."

In making this observation, Astronaut Collins had indirectly provided an explanation of why the Wright brothers built their first airplane and, indeed, why there is a space program.

