

Submarine Aircraft

By DAVID R. WINANS

The following article on Submarine Aircraft covers the period from 1915 to 1945 and was prepared by Mr. Winans for delivery at the Second Annual Northeast Aero Historians meeting held at the Sheraton-Tenney Inn, La Guardia Airport, on October 29, 1966.

The present day Polaris missile-carrying submarines could very well be termed the United States Navy's "Sunday Punch." With constant references to the capabilities of this weapons system appearing in the daily press, they have become the symbol of our deterrent to aggression. What is not generally realized is that behind this achievement lies a half century of experiment and development. While the unmanned guided missile carrier is a comparatively recent idea, the employment of the submarine as an airborne weapon transport began during the First World War.

When the German forces invaded Belgium in 1914 a number of important seaports were captured and occupied. Among these were the Flanders towns of Ostend, Bruges, and Zeebrugge. Bruges was connected to its tidal port of Zeebrugge by a ship canal several miles in length. Located at the entrance of this canal is the famous Mole, a seaward-curving breakwater extending out into the North Sea for a mile and a half. Near the shoreward end of the Mole the Germans established a naval air station on 6 December 1914.

A new idea in naval warfare was tried on 6 January 1915. Early that morning one of the large mobile cranes at the air station lifted a seaplane from the roadway on the Mole and lowered it very carefully upon the forward deck of the submarine U-12. The aircraft, a Friedrichshafen FF 29a twin-float seaplane, Navy number 204, was secured athwartships to the deck. The purpose behind this curious operation was to attempt to transport a reconnaissance aircraft some distance out on the North Sea so that its scouting range might be increased. The pilot of this aircraft was the commander of the air station, OBLT zur See Friedrich von Arnould de la Periere. His brother, Lothar, later became the ranking U-boat ace of the Imperial German Navy.

U-12 commanded by OBLT zur See Walter Forstmann who also became another top scoring submarine commander, was to ferry her ungainly deck cargo far out on the North Sea and to launch it by trimming down forward until the seaplane floated clear. The aircraft was to take off, waves permitting, make a reconnaissance over the southeast coast of England 70 miles away, and to return to its land base. The experiment was carried out but not repeated. U-12, a small 500 ton coastal submarine, did not have the necessary room for further trials of this sort. In addition to this, her Korting kerosene engines threw up such a cloud of white smoke that she could easily be spotted by British or French patrol craft.

During 1917 a new class of larger undersea cruisers was under construction in Germany. To take advantage of the greater amount of room aboard these new boats, it was proposed to design small demountable aircraft for them. Accordingly, Dr. Ernst Heinkel, the chief designer for the Hansa-Brandenburg Aircraft Werke, created a tiny flying boat that could be dismantled and stowed aboard a U-boat. The first prototype, the H.B. W-20, Navy number 1551, first flew in 1917. With its biplane wings spanning less than 20 feet, it resembled an excited water bug upon takeoff. The wings were of cantilever construction without interplane struts. It was powered by a 7-cylinder Oberursel rotary engine of 80 hp. Its wings and tail surfaces could be removed and the entire assemblage stowed in a pressure-resistant container 20 feet by 6 feet. It could be assembled ready for flight in less than three minutes and dismantled for stowage in less than two. While flight and erection trials were successful, the Navy could not be convinced that the idea was sound. The U-Boat High Command did not wish to expose its submarines to any undue risks such as might be encountered on the surface while conducting launching or recovery operations. Two other aircraft, Navy numbers 1552 and 1553, were converted for general service by strengthening some of their components. Larger lower wings and interplane struts were added.

Late in 1918 the Luft Fahrzeug Gesellschaft (L.F.G.)



SMS U-12 with Friedrichshafen FF 29a seaplane aboard at Zeebrugge, January 1915. (Heinz J. Nowarra)



Hansa-Brandenburg W-20 prototype with hexagonal lozenge type naval camouflage of 1917. (Heinz J. Nowarra)

Werke at Stralsund, on the Baltic, was engaged in the construction of a ship-based demountable seaplane. This tiny mid-wing monoplane was built entirely of duraluminum, a new technique for that time. When disassembled it could be stowed into five steel cylinders. Although designed primarily for surface warships, it could, by substituting pressure-resistant containers, be carried aboard a submarine. This aircraft, the V.19 "Putbus", required about 15 minutes for erection, while dismantling and stowage took about a half hour. It is believed to have been completed after the Armistic, and only the prototype was constructed and flown. At this time its subsequent history is not known.

When the German Zeppelins began their raids over England in 1915 there were no aircraft available that could out-climb them at altitude to shoot them down. The ones that were destroyed were lost either through normal operational difficulties, or through the efforts of lucky anti-aircraft batteries.

One thing was noticed by the Royal Navy. This was the fact that the Zeppelins did not, as a rule, start to climb to high altitudes until they approached the British coast. The Royal Navy felt that if they could launch a ship-based aircraft before one of these huge raiders neared the coast there might be a good chance to destroy it. This plan worked out successfully toward the end of the war when fighter aircraft were launched from towed lighters and from the forward gun turrets of cruisers. In every case, however, the aircraft was forced to ditch near its mother ship.

In the early Spring of 1916 the Royal Navy drydocked one of its submarines in order to have some special fittings installed. The boat chosen was HMS E-22, one of a class of highly successful 660 ton submarines built during the war. Two parallel ramps were fitted, extending from just behind the conning tower to the end of her upper deck casing. After undocking E-22 was brought to Harwich Harbor in order to receive a novel deck cargo. Two Sopwith Schneider twin-float fighter seaplanes were borrowed from nearby N.A.S. Felixstowe and hauled aboard. During April of that year E-22 made two runs out on the North Sea with her pick-a-back aircraft aboard. The destination was Heligoland Bight where Britain-bound Zeppelins might be encountered. The Schneiders had one fault, though. They could not be launched in any kind of rough water. Their fragile float construction caused them to come to grief as soon as rough water takeoffs were attempted. E-22 did, however, manage to launch her unpopular freight without undue incident so that they could return to Felixstowe. No Zeppelins were encountered or engaged at this time.

In 1918 the steam turbine submarine, HMS K-5, was fitted out experimentally to tow an SS ZERO type blimp. This was another trial for the purpose of extending the cruising radius of a blimp in order to protect convoys from U-boat attacks. An Admiralty source mentioned the fact that several British "C" class submarines towed kite balloons with an observer on board to spot for submerged German U-boats.

1919 to 1939

It was not until after the Armistic in 1918 that serious consideration was given to the idea of combining the aircraft with the submarine. During the early post war period the major navies of the world tried this experiment with varying degrees of success. Until the perfection of radar during WW II a scouting seaplane was the only means of extending the effective reconnaissance range of a fleet-type submarine at sea.

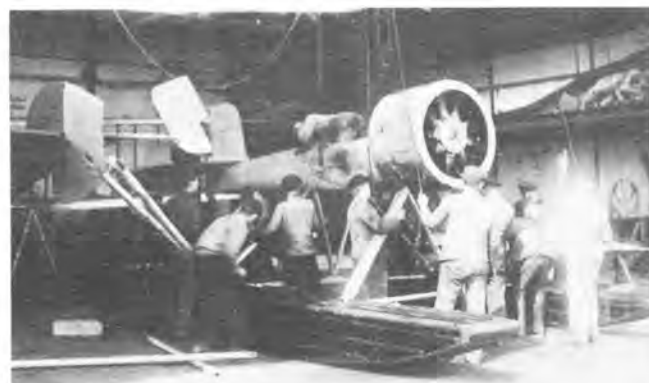
One of the first post war ventures was another design by Ernest Heinkel, the Heinkel-Caspar U-1. As military aircraft construction in Germany was forbidden by the Allied Air Control Commission, any such endeavors had to be conducted in secrecy. Dr. Heinkel's new design was an all-plywood biplane that could be dismantled and stowed into a small cylinder. One of its unique



Modified Hansa-Brandenburg W-20. (Heinz J. Nowarra)



German L.F.G. V.19 "Putbus" of 1918. (Peter Grosz)



L.F.G. V.19 being assembled in hangar. (Peter Grosz)



Two Sopwith Schneiders on HMS E-22, 1916. (Admiralty)

features was the means employed to unlock the cantilever wings. Under the tail section a small door disclosed a lever which, when pushed forward, caused the wings to unlock from special fittings. The fuselage during this stage was supported by a small crane. This also allowed the twin floats to be removed for placement upon a small dolly. The main sections, including wings, were then lowered upon a larger dolly and the whole assemblage of components rolled into a cylinder 24 feet by 6 feet in size. Manufacture of the U-1 commenced during 1921 at the works of Carl Caspar, a former naval flier, located at Travemunde. Two aircraft were ordered by the U. S. Navy, and two more by the Imperial Japanese Navy. Deliveries were completed by 1923.

The two Heinkel-Caspar type U-1 submarine aircraft, A 6434 and A 6435, were received at N.A.S. Anacostia toward the end of 1922. LCDR Zachary Lansdowne had previously inspected them in July before delivery. Flight tests began during the late fall of 1922. In 1923 one of the machines was damaged during an exhibition flight and was used for spares for the other. Flight tests with the remaining aircraft were completed by December 1923. Although this machine did not operate from a submarine, it did furnish useful design data for future types.

During 1923-24 the Navy accepted delivery of 12 submarine-based aircraft by two different manufacturers. The designs were the same, but the materials used were different. The six machines built by the Cox-Klemin Aircraft Corporation, Baldwin, Long Island, N. Y., were of conventional wood and fabric construction. These XS-1s were assigned Bureau numbers from A 6515 to A 6520. The other six machines, A 6521 to A 6526, were built by the Glenn Martin Aircraft Corporation of Baltimore, Maryland, as type MS-1. These aircraft, largely of all metal construction, enabled the Navy to compare the new techniques of using metal in airframes against older practices at a relatively low cost.

Tests with the Martin MS-1 (A 6525) were conducted aboard the USS S-1 during October and November of 1923 at Hampton Roads, Virginia. At this time S-1, commanded by Lt P. M. Rhea, had a crew of aircraft specialists from the USS Langley (CV-1) assigned to her. The crew, under the command of LCDR V. C. Griffin, had the duty of erecting and dismantling the aircraft and stowing it into the pressure-resistant tank fitted abaft of S-1's conning tower. At this time no flight trials were made. It was found during the preliminary trials that almost four hours were required for aircraft erection. As this was unacceptable, it became very obvious that modifications would have to be made in order to reduce assembly time. Accordingly, the Naval Aircraft Factory at Philadelphia took over Cox-Klemin A 6519 to make the required alterations. Though the machine reached the N.A.F. during late 1923, it was nearly two years later before the necessary changes were completed.

In the summer of 1926, S-1 was assigned the duty of carrying out the complete cycle of assembly, launching, recovery and stowage of a scouting seaplane. Her new aircraft, the modified Cox-Klemin XS-1, now designated XS-2 with a new engine, was first flown from its new base on 28 July. The pilot, Lt D. C. Allen, had reported that same day to the U. S. Navy Submarine Base, New London, for submarine-aircraft flying duty. He remained with S-1 until the end of November. Operations out of New London were under the direction of the commander of S-1, Lt C. B. "Swede" Momsen. By the end of October the launching crew had become so proficient with the modified aircraft that the submarine could surface and have her machine launched and afloat with engine ticking over in 12 minutes. It could recover, dismantle and stow away in but 13 minutes. Assembly now required nine minutes as against the four hours originally. The XS-2 had an effective scouting radius of 130 miles.

A number of other tiny aircraft were built with the hopes of interesting the Navy in their possibilities for submarine service. During 1931 the Navy purchased



German Heinkel-Caspar U-1 about 1922. (Heinz Nowarra)



U-1 as U. S. Navy's first submarine plane. (Nowarra)



Martin MS-1 aboard USS S-1 in 1923. (Glenn Martin Co.)



Cox-Klemin XS-2 aboard S-1, July 1925. (U. S. Navy)

a Loening XSL-1 amphibian for submarine trials. A number of necessary alterations were needed to make it suitable for this type of operation, and it was converted into the XSL-2 by an engine change, to obtain better performance, and removal of its wheel gear to make it into a flying-boat. Although tested aboard S-1 in 1932, it was not accepted for submarine service. There was a rumor that naval aviators did not relish the dual hazardous duty aboard an old S-boat. After 1933 there was no further interest shown by the U. S. Navy in experiments of this nature. Emphasis had shifted to small scouting aircraft to be carried aboard the Navy's new rigid airships, the USS Akron and Macon.

The only other venture into the field, after the E-22/Schneider trials, by the Royal Navy was the conversion of HMS M-2 into an aircraft carrier. M-2 was originally one of a class of three "Monitor", or big gun, submarines with a length of 296 feet and a surface displacement of 1650 tons. These boats carried a short barreled 12 inch naval gun, mounted in a water-tight turret, for use in surprise bombardments of German coastal installations. In 1927, M-2 had her gun removed and an aircraft hangar fitted in its place. A compressed air catapult and an aircraft-retrieving crane were also built. The weight of these new installations were such that the diving characteristics of M-2 were not appreciably changed, and M-2 thus became the first true undersea aircraft carrier.

Before M-2's new aircraft became available, her crew became familiar with launching and recovery procedures by using a Fairey fleet-spotter plane. This machine was too large and too heavy to be catapulted, however.

Two Parnall Peto prototypes appeared in 1929, the first aircraft designed specifically for the Royal Navy's experiments with undersea carriers. They were small, two-seater biplanes with folding wings and had tail surfaces covered with thin stainless steel as protection against corrosion by sea water. The first, N181, had a 135 hp Armstrong-Siddeley Mongoose engine, while the second, N182, had a Bristol Lucifer of 135 hp. Flying performance was similar with either engine. Maximum speeds were but 113 mph with a relatively low rate of climb. Such unredeeming features can best be illustrated by one incident.

One day M-2 launched her aircraft offshore from a famous British seaside resort. Her flight crew had as one of its members one of the heaviest men in the Fleet Air Arm. This circumstance did nothing to improve the situation that followed. After the Peto was airborne and headed inland over the resort area, the pilot suddenly realized that he was steadily losing altitude. With his little engine wide open he found himself headed straight for some bathhouses on the beach. He barely managed to miss all but the last one in the row, hitting its roof with the Peto's float and demolishing it. Unfortunately for the pilot this bathhouse was occupied by a very prominent citizen of the area. His dignity had suffered considerably as he stood there amidst the ruins clad in nothing but a towel. Needless to say, the Royal Navy heard about the affair.

M-2 could surface, assemble and launch her aircraft, and dive within the space of five minutes after her crew had become proficient. She was lost in 1932, presumably through accidental flooding of her hangar space while preparing to surface in order to launch her aircraft. She was too heavy to salvage using conventional methods of that time. In all, eight Peto aircraft had been constructed, and after M-2's loss one of the remaining aircraft was sold to the Imperial Japanese Navy. It is ironic that the Japanese thus became the ones to derive the benefits from these experiments.

France, as did Britain, only conducted one experiment with an aircraft-carrying submarine between the World Wars. The pride of the French submarine service was Surcouf, which had been launched in 1929. She was



Loening XSL-1, submarine scout. (Merle Olmsted Coll.)



BuNo 8696 modified to XSL-2. (Grover Loening Coll.)



Parnall Peto with 135 hp Mongoose engine. (IWM)



British Parnall Peto with Lucifer engine. (IWM)



French Navy Marcel-Besson MB-35 shipboard aircraft as it appeared in 1926. (Manufacturer)

the second largest submarine in the world at the time of her launching (2880 tons to Britain's HMS X-1 of 3050 tons). With her twin turret-mounted eight inch guns, and her considerable torpedo armament, she was considered a match for any cruiser afloat. Too large and too slow at diving, she would have been at her best as a convoy escort with her seaplane scouting ahead for enemy submarines or surface warships.

Before Surcouf was launched there was already in existence in France an aircraft that could be taken to sea aboard a submarine, the Marcel-Besson MB-35 "Passe-Partout" ("Go Anywhere") that had first been shown at the 1926 Paris Air Show. Considerable interest was shown in this little plane and the manner in which it could be dismantled and stowed into a small cylinder. It was, even then, looked upon as being an ideal machine for a submarine. The French Navy purchased several for service aboard light cruisers, and one of the first ships to carry an MB-35 was the Jeanne D'Arc, a training cruiser.

In August 1932 a new design was ordered from Marcel Besson et Cie. This was the successor to the MB-35, the MB-410. The first prototype was flown in 1933 but was destroyed in a crash later that same year. In the meantime, the Marcel Besson firm went out of business. It was not until two years later, in June 1935, that the successor firm, Ateliers du Nord de la France et des Mureaux (ANF), could complete the second prototype, now termed the MB-411, the "Petrel."

The new MB-411 completed its tests and was delivered to Surcouf during late 1935. Originally built as a single-seater, it was returned to the factory at Mureaux to be converted into a two-seater. In this new form it was again returned to Surcouf for service tests in 1936. A third machine was ordered by the Navy and was completed in July 1937.

Surcouf had its aircraft hangar built as an integral part of the conning tower structure. Twin stacks extended from the interior of this housing out to the quarterdeck to enable her dolly-mounted aircraft to be trundled in and out for flight operations. Erection time for the "Petrel" required but five minutes. Launching was accomplished by lowering the aircraft by crane into the water after the submarine had stopped her engines.

Surcouf was lost in a nighttime collision off Panama when she was rammed and sunk by the American freighter S.S. Thompson Lykes on 19 February 1942 while en route to the Panama Canal. There were no survivors and no aircraft aboard at the time. A curious story concerns the subsequent history of her seaplane.

During the early part of 1942 a quasi-Q ship, HMS Fidelity, was fitted out in the harbor of Plymouth, England. Part of the plans made for this ship's operations concerned her carrying a scouting aircraft at sea. As Surcouf's MB-411 had been left ashore it happened to be



The MB-411 "Petrel" scouting seaplane on the quarterdeck of the Surcouf. (Musée de la Marine)

available for tests. It was found, however, that rough seas effectively prevented takeoffs, and as the plans called for operation on the open seas, the "Petrel" was considered unsuitable for this duty. Shortly after it was put ashore in Plymouth, a German air raid damaged it beyond repair. The fate of the second MB-411 is unknown. It was last known to be in France when the German forces occupied the coastal ports.

GERMAN REICHSMARINE

The U-boats of the German Navy in the Second World War were not designed for accommodation of scouting aircraft. The small 800 ton Type VII U-boats and their variants formed the backbone of the U-Waffe in the Battle of the Atlantic.

There were, however, some experiments conducted with the design of a suitable submarine-borne aircraft. In 1940 the Arado Flugzeug Werke was awarded a contract for six "U-Bootsaugen", or "submarine eyes." Their design, the Ar 231, was a high wing single-place monoplane powered by an air-cooled six-cylinder inverted Hirth HM 501 160 hp engine. The outer wings were attached to a cranked up center section so that they could be folded, one over the other, atop the fuselage. The entire airplane could be fitted into a cylinder a little over six feet in diameter. During evaluation tests it was found that the Ar 231 could not become airborne if the surface wind exceeded 20 knots, thus rough water would prevent operations from a submarine at sea. As it was not contemplated to fit U-boats with catapult gear, it meant that launching operations would again be too risky, as they were in 1917. No more aircraft of this type were ordered by the Navy.

During 1943 the long range Type IXD2 "Monsun" U-boats began to enter service. These 1760 ton U-boats were designed for service far from home waters, and in 1943 several were ordered to proceed to the Indian Ocean where they were ultimately to join forces with the submarines of the Imperial Japanese Navy. In order to extend the visible range of the lookouts of these big boats while at sea, an interesting device was furnished. This was a manned helicopter kite, the Focke-Achgelis FA 330 "Bachstelze" (water-wagtail). The kite, after being withdrawn from a water-tight compartment behind the periscopes of the IXD2 boat, was rapidly assembled for flight. A crewman seated himself while the submarine worked up to full surface speed. As the kite required a wind speed of at least 20 knots to become airborne, some time was available to allow for the testing of the telephone with the bridge. A telephone wire was embedded in the attaching cable to allow the airborne lookout to contact the deck in the event a ship was sighted. A tiny platform that covered the top of the stowage canister was the takeoff point for the kite. The seated pilot could raise his vehicle to a height of



German Arado Ar 231 submarine aircraft. (Heinz Nowarra)



FA 330 with landing gear for training. (Heinz Nowarra)



Rocket fired from submerged U-511. (Deutsches Museum)



Rocket launching racks on the U-511. (Deutsches Museum)

330 feet at the end of a 1000 foot tow cable. If enemy aircraft was sighted, and the mother U-boat had to dive in a hurry, the pilot could, by pulling a lever attached to the rotor mast behind his head, descend rapidly by parachute after the rotor blades were jettisoned by this action. These devices were not very popular with U-boat crewmen, however, and were seldom used. U-861 used her kite in the Indian Ocean while off Madagascar. One U-boat commander traded his kite to the Japanese at Penang for a small twin float seaplane. He felt that he had the better of the deal.

Some 32 boats of this class were completed by the War's end. While it is not known if all of them were equipped with these kites, it is known that at least 200 kites were built by Weser Flugzeugwerke at Delmenhorst. Submariners were trained to fly the kite at the French Aeronautical Experimental Establishment at Chalais-Meudon, outside of Paris. Preliminary instruction was given on tethered machines inside a large wind tunnel at Chalais-Meudon, while advanced training was carried out by towing wheel-equipped kites behind trucks along airfield runways. It was later proposed to install small engines to convert these kites into true helicopters.

Fortunately for the Allies the most significant experiment that was performed with an airborne submarine weapon during WW II was largely ignored by the German Reichsmarine during 1942. This was the first underwater launching of rockets from a submerged U-boat. Earlier that year KPLT Fritz Steinhoff, the brother of the rocket scientist, Dr. Ernst Steinhoff, brought his submarine, the U-511, into Swinemunde, near the experimental missile base of Peenemunde on the Baltic Sea. KPLT Steinhoff had, with his brother's help and influence, been permitted to try an experiment with launching rockets from a U-boat while submerged. A launching rack holding six conventional Army-type "Granatwerfer" 42cm (16") infantry rockets were fitted to the port side of U-511 aft of her conning tower. The exhaust vents of the missiles were sealed with wax while waterproofed electrical wires led from them to the inside of the conning tower where firing contacts were installed. Tests were conducted out in the Baltic off the Island of Usedom. Several firing trials were made at increasing depths down to 75 feet. In every case the rockets ignited and made successful firing runs after they broke surface. Due to probable inter-service rivalry, however, these experiments were not followed up. Thus, what might have become a terror weapon against the east coast of the United States, died in the experimental stage.

The only other recorded incident in which rockets were launched from a submarine occurred during July and August of 1945 when USS Barb (SS-220) raided the Japanese coast. Her missiles were fired while she was surfaced however. (The writer was present when she returned to Midway with a huge red ribbon tied around her 5 inch rocket launcher.)

The Polaris Missile could trace its immediate ancestry back to 1943 when the Germans proposed to launch V-2 rockets from huge containers towed by U-boats. The plan was to fit out huge floats with rocket fuel tanks and launching gear. When the towed float reached its destination offshore, ballast tanks were to be flooded so it would stand vertically in the water with the watertight door exposed, allowing technicians to refuel the rocket and prepare it for firing. Actual firing was to be done from the U-boat after the launching crew had left the float. Work on this project continued into the fall of 1944, but it was delayed by development difficulties with the V-2 itself. Peenemunde had to be abandoned shortly thereafter, thus halting any further progress.

IMPERIAL JAPANESE NAVY

Soon after the end of the First World War the Imperial Japanese Navy embarked upon a program of extensive warship construction. Their modern submarine force had

its beginnings with the acquisition of seven war prize U-boats from the German Navy. The features of these boats were adopted by the Japanese in their own new construction. The net result was that, by 1930, Japan had a formidable submarine force either built or building.

The Japanese had been much interested in the possibilities of submarine-borne scouting aircraft. Their first submarine aircraft were the two Heinkel-Caspar U-1 airplanes purchased in Germany in 1921. The first operational trial aboard a submarine did not take place until 1927 when I-21 was assigned this duty. By that time the Japanese Navy had its own design available, the Yokosuka Naval Arsenal-built Yokosho-1, largely a copy of the U-1 but with several modifications, including a more powerful Le-Rhone rotary engine. It was designed in 1925, and was test flown in 1927. It operated from I-21 (later re-numbered I-121) for about 18 months. During this time, I-21 was fitted with the aircraft hangar on her quarter deck, as with USS S-1, and launching operations were conducted by trimming down by the stern as with S-1.

These early trials were conducted at the urgent request of the Navy Department in order to develop fleet-type submarines capable of operations against U. S. battleships in the Pacific Ocean.

As I-21 was too small and too slow for this service, a larger fleet-type boat was selected. In 1930, the 1400-ton I-51 had a compressed air catapult fitted to her after deck and two aircraft hangars installed to accommodate the components of her new type of aircraft. The new airplane was the 6-Shi E6Y1 Type 91 Small Reconnaissance Seaplane. This tiny single-seater biplane was almost a small copy of the British Parnall "Peto", and used the same engine as the "Peto", the Mitsubishi Mongoose, built under license. The first two models were built at the Yokosuka Naval Arsenal under the designation, Yokosho-2, and the prototype was first flown during 1929. Eight more production models were constructed by 1932 and were built by Kawanishi as the E6Y1-N. A number of modifications were incorporated in the latter airplanes to make them more suitable for submarine service. After testing airplanes aboard for three years, I-51's catapult was removed and she was re-assigned to general service.

During the early 1930s Japan was building a number of giant submarines patterned after the huge German U-142 of late 1918. Although U-142 was not completed in time for service with the Kaiserliche Marine, her plans and specifications did survive to create the Imperial Japanese Navy's new force of undersea monsters. While two, the I-5 and I-6 (2130 short tons) were still on the ways, construction was halted in order to convert them into aircraft carriers. I-5 had twin hangars, a compressed air catapult mounted on her after deck, and an aircraft retrieving crane fitted. Work was completed in 1933 at the naval base at Kure. After successful operations with aircraft, I-6 was completed in the same manner by 1935. Subsequent large fleet-type boats built under the 1937 program had larger single hangars and catapults mounted on their forward decks so that aircraft could be launched without the mother submarine having to stop its engines.

The first really successful submarine-aircraft was designed in 1935 as the 9-Shi Type 96 Small Reconnaissance Seaplane. The Watanabe Aircraft Company placed this model into production as E9W1 Type 96, Model 11. Four prototypes were followed by 32 production aircraft which were completed by 1936. Evaluation tests with the E9W1 "Slim" were carried out aboard I-5 during 1935.

The E9W1 was a small two-place biplane with folding wings and removable floats. It was powered with a 300 hp (later 340 hp) Hitachi Gk2 Temput radial engine. It had a maximum speed of 144 mph, and a cruising endurance of almost five hours. The observer was provided with a flexible 7.7 mm machine gun and radio equipment for contacting the mother sub.

As Japan was still at war with China during this

period, these aircraft operated mainly from submarines stationed in the China Sea as a deterrent against Chinese blockade runners. There were still more than a dozen of these aircraft in service in the middle of 1942. They were relegated to training duties after their successors, the E14Y1 "Glens", came into service in quantity.

Following the initial success of the E9W1, a replacement had been considered necessary. Accordingly, in 1937, the Yokosuka Naval Arsenal put its aircraft design staff to work on a machine under the 12-Shi requirement for a new reconnaissance seaplane with greater range and speed. With the advent of newer and larger submarines, more space was to be available aboard them for scouting aircraft. The result of these efforts was the E14Y1 Type Zero "Glen", the Japanese Navy's first operational submarine-borne monoplane. Production was given over to the Kyushu (formerly Watanabe) Aircraft Company. In all, 126 of these aircraft were built from 1940 to 1943. They became the eyes of the Japanese Navy's submarine fleet when it set out to challenge the United States Navy in December of 1941.

The Kyushu "Glen" was a departure from previous aircraft designed for this service. It was a low-wing two-place monoplane powered by a 340 hp Hitachi radial engine. A combination of metal and fabric was used on fuselage and wings for covering. Wooden wing ribs with metal spars combined lightness with strength in the detachable wings. The two crew members were housed under a sliding canopy and the observer was provided with a 7.7 mm flexible machine gun. Top speed was now increased to over 150 mph, while scouting range at 104 mph was 570 miles.

Considerable reconnaissance flying was done over the Pacific both before and after the attack on Pearl Harbor. On 17 December 1941 I-7 launched its "Glen" for a dawn reconnaissance over the harbor in order to assess the damage done there by the carrier bombers. I-25 cruised to the South Pacific and scouted the harbors of Sydney and Melbourne in Australia, and that of Hobart, Tasmania. She was later ordered to the U. S. west coast where she equipped her "Glen" with small incendiary bombs to attack the timber forests of Oregon. Warrant Officer Fujita, IJN, was the pilot on the two attacks made from I-25 during September 1942. Due to the weight of the bombs and fuel load, no observer could be carried on either of these flights. Although the aircraft was seen by a number of people, it was not identified as being Japanese. On several occasions "Glens" were launched on long one-way missions from which they could not return. I-36 launched her aircraft during October 1943 from 300 miles off the Hawaiian Islands for a reconnaissance of Pearl Harbor. Although her pilot was able to radio back his report of shipping, he did not have enough fuel to return to the mother submarine. Presumably he went down at sea and was lost. Radar spelled the end of this method of warfare.

In December 1941 the Imperial Japanese Navy had 11 submarines that were equipped to carry scouting aircraft. By 1945 a total of 27 more were placed in service. In addition to the carrier-submarines that roamed the Pacific, there was also a large aircraft-tender boat. This was I-351, a 2880 ton undersea aviation gas tanker. She was the survivor of a class of two boats built that were to service as many as three large flying boats simultaneously at remote atolls. Her aviation gasoline tanks were fitted outside of her pressure hull so that there was no possibility of explosive fumes penetrating the inner hull. She could also act as an aircrew transport and had the ability to provide supplies to isolated bases. Even the aircraft-carrier boats often had to act as gasoline transports by loading fuel drums into their large coffin-type deck hangars.

Until the middle of 1944 Japanese submarines had used their aircraft only for scouting enemy shipping and coastal installations. The two pin-prick bombing raids on the U. S. west coast went largely unnoticed

at the time. This was hardly conducive to maintaining a force of tiny submarine-based gnat-bombers off the shores of the U. S.

In the meantime, unknown to the outside world, Japan had been forging her secret naval weapon. This was something that the United States Navy did not become aware of until almost two weeks after the surrender of Japan in August 1945. The weapon was a giant undersea aircraft carrier, the I-400, one of the largest submarines ever built up to that time. It dwarfed the USN destroyer that was sent out to bring it into Tokyo bay after hostilities had ceased.

As originally conceived the plans were to build a fleet of 18 boats of the I-400 class, each capable of carrying two scout or torpedo bombers. These huge submarines were projected originally to attack the east coast of the United States. As such they were provided with a fuel capacity to enable them to cruise 37,500 miles without refueling. They were to displace 3900 short tons on the surface, and to be 400 feet in length. As the war situation deteriorated, however, material shortages caused the Japanese to revise their plans downward. Instead of the original 18 planned, only five were actually laid down. These five were redesigned to carry three, instead of two bombing aircraft, by lengthening their huge deck hangars to 100 feet. Three were completed by 1945, one was destroyed by an air raid just before completion, while the last was dismantled while still on the ways. The completed boats were I-400, I-401 and I-402. The first two were completed as carriers, while the I-402 was relegated to supply service.

In 1943, due to the cutback of the I-400 class, the smaller 2900 ton I-13 class of four submarines were converted to carry two aircraft apiece. Two of these, the I-13 and I-14, were completed while the two others, the I-15 and I-1 (2nd), were still undergoing dockyard work when the war ended.

These four new carrier submarines had heavy duty catapults fitted on their forward decks. They were provided with 12 ton electric cranes for aircraft recovery. Their long cavernous deck hangars were offset to starboard while their conning towers were built to port overhead so as not to interfere with a straight catapult track clear to the bows. The 11' 6" hangars were closed by heavy, power-operated, bank-vault type doors. The I-400 class had an additional feature, small elevators installed just ahead of the hangar doors for storing two of the three catapult cars beneath the tracks after their aircraft had been launched. The I-13 class had a length of track curving down to the deck so that the first of their two catapult cars could be rolled out of the way of the second launching. Smaller tubular hangars were installed just below deck level for the storage of dolly-mounted floats.

While the I-400 class submarines were still under construction plans were made to have them attack the Panama Canal. For this raid a suitable aircraft would have to be provided. With this in mind the Navy approached the Aichi Aircraft Company and persuaded them to provide a design for a submarine bomber. Aichi, whose previous naval aircraft had been very successful, worked closely with the Navy on this project. As originally proposed the requirement was for a machine that could be catapult-launched without any landing gear. The savings in weight would allow for a larger fuel and bomb (or torpedo) load. Upon return to the mother ship the aircraft was to be ditched alongside and only the crew recovered. This plan was later altered to allow for the fitting of two jettisonable pontoons. Along with the seaplane version, a few models with fixed wheel landing gear were to be constructed for training ashore. The final designation of M6A1 "Seiran" was allotted to the operational aircraft, while the wheeled version was termed the M6A1-K "Nanzan."

Here was an aircraft that taxed its designers' ingenuity. It was a low-winged all-metal monoplane powered by an Atsuta 1400 hp inverted liquid-cooled engine (an



Imperial Japanese Navy's I-14 at Sagami Bay after surrender. Retractable crane on port side. (U. S. Navy)



Japanese Aichi M6A1 "Seiran" sub-based light bomber.

Aichi-built German Daimler-Benz DB 601A). The wings folded in much the same manner as the USN Grumman TBF Avenger. The horizontal stabilizer and elevators were hinged at about one-third span so that they could be folded vertically. A small section of the rudder folded down to the right to allow for hangar clearance. The pontoons were removed and stored in their separate tubes below deck level on the submarine. The fuselage, with folded wings and tail sections, was lowered almost to track level by collapsible, compressed air-activated struts on the heavy (1545 pound) catapult car. The whole assemblage could then be rolled down hill into the hangar where it was secured for sea. When the M6A1 was assembled ready for flight operations it weighed in at a little over five tons. Yet the powerful catapult could fire it off within a run of 70 feet. Upon its return (if floats were attached) the 12-ton electric crane could be raised out of its bed on deck to replace the plane on a catapult car.

The training program for the Canal raid did not progress well. The air crews were often interrupted in their practice runs on large scale models of the Canal locks by

United States Navy carrier aircraft attacks. Operational difficulties were encountered with both the large submarines and their new "Seiran" aircraft. It was not until the beginning of July 1945 that the First Submarine Flotilla, consisting of I-400, I-401, I-13 and I-14 was ready for sea. This formidable undersea task force was equipped with a total of ten M6A1 aircraft when it set out. The two smaller boats did not have the necessary fuel capacity for the round trip to Panama, and would refuel from the larger boats. Provisions for a four months' cruise were embarked. Time had run out on them, however. Plans were hastily changed for them to attack Ulithi Atoll where U. S. Navy carriers were concentrated. One boat was diverted to Truk where it was to transport aircraft. On 16 July 1945 this powerful force lost the I-13 to a carrier aircraft attack. The attack on Ulithi never came off, the other boats being still at sea when the war ended on 14 August. So, in spite of the tremendous expenditure of time and money on this operation, not one of the submarines saw action, nor did any of the 28 M6A1 aircraft built come to grips with the U. S. Navy.

There was yet another proposal for a Japanese submarine-borne weapon revealed after the war. This was to equip carrier submarines with a Model 43 Oka bomb, a small rocket-propelled "kamikaze" weapon that could be catapult-launched. It would have been a difficult task for the U. S. Navy ships to evade such an attack as the speed of these manned bombs was much higher than conventional aircraft used on suicide missions. Had the Japanese used these earlier in the war the U. S. Navy would have faced a serious problem. Each I-400 class submarine had room to carry at least six of these rocket bombs.

The U. S. Navy had gone full circle with submarine-based airborne weapons. The original trials of 40 years ago were instituted for the purpose of extending the scouting range of a submarine at sea according to the precepts of the time. The Second World War again brought the submarine into focus as a weapon of opportunity. With the advent of the age of guided missiles and atomic power our undersea arm has become our strongest argument for peace among nations. Today we have Polaris. Tomorrow the world will have it.

APPROXIMATE NUMBER OF MANNED SUBMARINE-BORNE AIRCRAFT FROM 1915 TO 1945

U. S. Navy	15
British Royal Navy	10
(Including 2 Sopwith "Schneiders")	
Imperial Japanese Navy	203
Imperial German Navy	4
(Including Friedrichshafen FF 29a)	
German Kriegsmarine	206
(Approximately 200 "Bachsteltze" kites)	
French Navy	3
Soviet Navy (proposed)	(1)
Italian Royal Navy (proposed)	(1)
Total	441

BIBLIOGRAPHY AND REFERENCES

British Royal Navy:

Lipscomb, F. W., THE BRITISH SUBMARINE. Information on HMS E-22, M-2 and K Boats.

Shelford, W. C., SUBSUNK. Story of a/c operations aboard HMS M-2 and salvage operations after her loss. Permission to reprint Peto episode granted by the publisher, Doubleday & Company.

Thetford, Owen, BRITISH NAVAL AIRCRAFT, 1912-58.

Bruce, J. M., BRITISH AEROPLANES, 1914-18. Data on HMS E-22 and the Schneiders.

Le Fleming, H. M., WARSHIPS OF WW I, No 5, SUBMARINES.
Jackson, G. G., THE ROMANCE OF THE SUBMARINE. Data on M-2 and IJN submarines.

Imperial German Navy:

Techel, H., DER BAU VON UNTERSEEBOOTEN auf der GERMANIAWERFT. U-boat construction during WW I.

Herzog, B., DIE DEUTSCHEN U-BOOTE, 1908-1945. WW I and WW II German U-boat construction and operations.

Heinkel, E., HE-1000. Life and works of Ernst Heinkel and his submarine-borne aircraft, HB W-20 and U-1.

Nazi Kriegsmarine:

Groner, E., SHIPS OF THE KRIEGSMARINE AND LUFTWAFFE. Data on WW II U-boats and helicopter kite.

HMSO, REPORT ON ROTARY-WINGED AIRCRAFT OF WW 2. Data and drawings of FA 330 "Bachsteltze" and helicopters.

Lusar, R., WEAPONS AND SECRET WEAPONS OF WW 2. Ar 231, FA 330, rocket experiments from U-511 and proposed launching of V-2 rockets from towed capsules.

Dornberger, W., V-2. Rockets launched by U-511.

French Navy:

Report to Washington by U. S. Naval attache in Paris, 1927. Showing of MB-35 at Paris Air Show.

Julian, M., HMS FIDELITY. Describes operations of quasi-Q ship with her aircraft, MB-411.

Library of the Musee de L'Air. Data and photos.

Imperial Japanese Navy:

Fukui, S., SHIPS OF THE JAPANESE FLEET. Photos and drawings of IJN aircraft-carrying submarines.

Hori, O., THE SUBMARINE: ITS HISTORY AND PROSPECTS. Photos and drawings of aircraft-carrying subs.

Hashimoto, M., SUNK. Not very accurate. Some data on sub-aircraft operations.

Okumura, M. and Horikoshi, J., THE ZERO FIGHTER.

Nozawa, T., ENCYCLOPEDIA OF JAPANESE AIRCRAFT, 1900-1945. Sub-borne aircraft data in Vols 1, 2 and 3.

Chiba, Cdr IJN, Air Technical Intelligence Review Report No. F-IR-39-RE dated 6 August 1946 entitled: "Japanese Submarine Catapult." Data on construction and operation of catapults fitted to I-13 and I-400.

Holmes, W. J., UNDERSEA VICTORY.

U. S. Navy:

Barnes, R. H., UNITED STATES SUBMARINES, S-1 and a/c.

Larkins, W. T., U. S. NAVY AIRCRAFT, 1921-1941.

Larkins, W. T., U. S. MARINE CORPS AIRCRAFT, 1914-59.

Roscoe, T., U. S. NAVY SUBMARINE OPERATIONS, WW 2.

ACKNOWLEDGMENTS: Assistance in the form of personal correspondence came from CDR F. W. Lipscomb, B. Herzog, Peter M. Grosz, LCDR S. Fukui, the Historical Section of the French Navy, and the Bureau of Naval Weapons, U. S. Navy. A.A.H.S. Members to whom I am indebted for the loan of material are: Robert B. Casari, Richard Bueschel, Peter M. Grosz, Merle Olmsted, Mitch Mayborn, Heinz Nowarra and many others. A special note of thanks to Lee Pearson of the U. S. Navy Bureau of Naval Weapons for the receipt of historical material on S-1 and her aircraft operations.

ABOUT THE AUTHOR: David R. Winans, of 508 Outlook Ave., Colonia, N. J. 07067, served in the U. S. Navy as a Petroleum Inspector, Sp (O) 3c, attached to the Office of the Inspector of Naval Material. Part of his service was overseas at the Submarine Base, Midway Island, and gave him an intensive knowledge of submarines. This and his lifelong interest in aviation have been combined over the last six years in researching and developing this very fine study of submarine-borne aircraft.