The Birth of Guided Missiles

By Rear Admiral Delmar S. Fahrney,
U. S. Navy (Retired)

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These were the pioneers. Led by Lieutenant Commander Fahrney (in the middle of the row and inset), a small group of naval officers enlisted men, and civilians demonstrated that radio-controlled, pilotless airplanes could attack moving targets at sea. The drones weren't called guided missiles then, but—argues the author—that's where guided missiles got their start.

It is not generally known that the world's first guided missile was designated, fabricated, and tested in the United States more than two years before such a development occurred in Germany. Few people are aware that the Navy's Bureau of Aeronautics developed the first guided missile in each of the four categories that define the use of this weapon:

- *Air to Surface*—on 14 September 1938, an N2C-2 (Curtiss training plane) drone, using radio control and visual guidance dove on the radio-controlled target ship *Utah* (AG-16).
- *Surface to Surface*—on 9 April 1942, a TG-2 torpedo plane drone, using radio control and television guidance, made a torpedo attack on a maneuvering destroyer.
- *Surface to Air*—on 13 June 1950, a Convair Lark missile, using a Raytheon radar seeker, intercepted an F6F fighter plane target drone.
- *Air to Air*—on 3 December 1952, a Douglas Sparrow missile, using a Sperry radar beam rider, intercepted an F6F target drone.

The earliest successful missile test by the Germans did not occur until 17 December 1940, 27 months after the *Utah* test. Dr. Herbert Wagner designed and developed a glide bomb, called the HS 293, which had no power plant but was equipped with gyro stabilization and radio control equipment. The glider was launched from an airplane, then guided visually by the bombardier in the control plane until it intercepted a ground target.

Since little factual information on the pioneering effort by the Bureau of Aeronautics in the development of guided missiles is in the public domain (mainly because of the secret or confidential classification of the projects before, during, and for a number of years after World War II), it is well to retrace our steps to the beginning of the program that gave birth to the guided missile era. Space limitations preclude discussion of all four missile types listed above, so I will concentrate on the first two, air to surface and surface to surface.

I was ordered to duty as officer in charge of radio-controlled aircraft on 20 July 1936. I had instructions to review all previous efforts at controlling ve-

hicles (water, land, and air) by radio and to recommend a program that would supply realistic aerial targets for the fleet's antiaircraft gunners within a period of three to five years. The Naval Aircraft Factory at Philadelphia was selected as the base for the project. Two Stearman Hammond JH-1 planes were purchased, special radio equipment (modulators and selectors) was developed at the Naval Research Laboratory in Anacostia, D.C., and five planes were modified at Philadelphia to accept the radio control signals (to move the throttle and control surfaces). The cost of the project was less than $90,000 and would have been even lower if the planes had been delivered on time.

The project proceeded so well that by early November 1937, flight testing at the aircraft factory was concluded, and the planes and personnel were shifted to the Coast Guard Air Station at Cape May, New Jersey. In our tests, one of the drones was placed on the runway abreast a field control cart. A radio transmitter enabled the control pilot seated at the console on the field cart to operate stick, rudder, and throttle controls similar to those in an airplane. The same type of equipment was installed in the control plane (a TG-2) for the radio control pilot's use to maneuver the drone when airborne. The pilot on the field cart would control the drone during takeoff and fly it to an altitude of 200 feet. At that point, the control pilot in the TG-2 took over. The sequence was reversed when bringing the drone in for a landing after aerial maneuvers.

The first test flight of an N2C-2 drone without a safety pilot on board was made on 15 November 1937. The takeoff, air maneuvers, and landing approach were perfect. The flight was marred by a hard landing on the front wheel of the tricycle gear which carried away, folding the other wheels and damaging the propeller. Fortunately, the damage to the plane was slight, and it was soon back in service. An entirely successful flight was made on 23 December, just one year and three months after the Chief of Naval Operations had authorized the drone program. This significant achievement, using a JH-1 as the drone, was the first completely successful flight in this country of a full-scale airplane under radio control without a human pilot on board.

The JH-1 had no automatic pilot or gyro instrument to keep it on course or to keep the wings level. The radio control pilot had to fly the drone at all times as if he were seated in it. There was a problem for the field control pilot when he took over control of the drone for the final phase of the landing, because his orientation with respect to the approaching plane was reversed. The right wing of the incoming drone was to his left—exactly the opposite of the situation he would experience if he were in the drone's cockpit. Consequently, the field control pilots had to condition themselves to "reverse control" the ailerons of the approaching drone, and this led to the development of a wing-levelling instrument which could be thrown in, when signalled, to perform that task.

The initial drone firing tests with the U. S. Fleet were conducted in the San Diego area. The Naval Aircraft Factory experimental unit with personnel and planes was transferred in June and July 1938 to a spot called Otay Mesa south of San Diego near the Mexican border. This location was remote from any populated areas and clear of the aviation flight operations around San Diego. An individual who joined the project there and stayed for a number of years was Lieutenant (junior grade) Robert F. Jones. While on duty in the instrument laboratory at the Naval Aircraft Factory, he had assisted in the modification of instruments for us. When he was ordered to flying duty with the utility wing's squadron VJ-1 at San Diego, I was able to get him assigned to my unit. It was easily arranged, because VJ-1 was scheduled to take over the project after the scheduled tests with the fleet were completed.

By early August 1938, the unit had progressed so well with the flight testing that I reported to the Commander in Chief U. S. Fleet that firing tests on a target plane could be scheduled. He selected the aircraft carrier *Ranger* (CV-4) to conduct the first firing test, which was designed to simulate the firing of a screening vessel at a bomber that had passed over the ship and was headed toward the center of the fleet. Two firing runs were made for the *Ranger* on 24 August, using a JH-1 drone. One TG-2 served as primary control plane, and the other flew nearby as a backup. The firing commenced when the slant range was 4,000 yards and ended when the range reached 6,000 yards. No bursts were near enough to hit the drone, and the *Ranger*'s report lamented that a better performance could have been made "had the drone been able to maintain steady course and speed." That was the sort of comment to be expected after years of firing on towed sleeves which gave artificial and unrealistic procedures and erroneous assumptions of an antiaircraft battery's capability.

In preparation for the dive-bombing tests on the target ship *Utah*, the radio control unit conducted tests in which the drone was placed in a dive at 10,000 feet by the control pilot in the accompanying control plane and visually guided to a near-collision with a ground target before the safety pilot pulled it out of the dive. Shallow dives were made so as not to

over-stress the drone. These tests confirmed the strong conviction that a vehicle under remote control could be developed into an effective weapon affording a significant degree of safety for the controller.

World's First Guided Missile: On 14 September 1938, an N2C-2 drone, starting from an altitude of 8,000 feet, was placed in a guided dive of 45° toward the ship by the control plane. The newly installed 1.1-inch/75 caliber guns of the *Utah* fired two bursts. The second burst hit the drone, and it crashed into the sea. (It appears that this first test was not indicative of the true effectiveness of the 1.1-inch battery. In March 1939, at Guantanamo Bay, Cuba, the *Utah*'s battery expended 1,500 rounds of service ammunition and got no hits against an N2C-2 drone.) The dive tests at Otay Mesa and off San Diego were of special significance to the small band of pioneers conducting them. They proved conclusively that a new and revolutionary weapon had been developed and successfully demonstrated.

Admiral Claude C. Bloch, the Commander in Chief U. S. Fleet (CINCUS), recommended to CNO that I be ordered to report to the CINCUS staff for duty and to remain with the target unit until the tests with the fleet at Guantanamo Bay were completed during the winter of 1939. This was largely a consultant assignment, because the operations had been transferred to Lieutenant Jones of squadron VJ-1. The Radio Control Target Unit was now given the name "Project Dog." The antiaircraft gunners achieved no hits at all in about half of the practices. Several drones were returned to base with hits in fuselages and wings, but only two drones were lost to gunfire. This precipitated an agonizing reappraisal of the effectiveness of fleet antiaircraft defenses and resulted in redesign of both fire control and artillery systems. Fortunately, these target drone tests were responsible for major changes in the defenses against bombing aircraft before war began in December 1941. Admiral Bloch stated that ". . . it is the well considered opinion of the undersigned that the exercises with, and the firing upon, the radio controlled target airplanes have resulted in the greatest interest and advance in antiaircraft gunnery since its inception in the Fleet. It is considered most fortunate that this condition should have been discovered in target practice and not in an actual campaign."

It should be noted that two U. S. Army Air Corps Officers, Captain George Holloman and Lieutenant Rudolph Fink, were sent from Wright Field, Dayton, Ohio, to witness and report on the firing tests at Guantanamo. The two officers witnessed the ground control operations for the practice by the USS *Idaho* (BB-42) on 16 March 1939 and made flights in the control planes for the USS *Patterson* (DD-392) practice on 17 March. A report by the two officers recommended that the Air Corps initiate programs for development of radio controlled targets and weapons. Major General Henry H. Arnold, Chief of the Air Corps, requested that the Navy supply a TG-2 control plane, an N2C-2 drone, and a field control cart. During the summer of 1939, the planes and equipment were delivered to the Air Corps.

Back at the Naval Aircraft Factory in April 1939, as officer in charge of "Project Fox," I began planning, design, and development work on a guided missile that could be successfully controlled beyond visual range. This duty was in addition to continuing the development and testing of radio-controlled target drones, using obsolete naval planes and commercial aircraft. Since television showed some promise as a guidance aid, a contract was negotiated with RCA to develop a small TV transmitter to be carried on a missile and a small TV receiver to be carried in a control plane. By 17 February 1941, flight tests of the TV sets were carried out satisfactorily, and it was decided to proceed with the development of equipment for the "assault drone" program which had been formally approved by the Chief of the Bureau of Aeronautics in March 1940. As first visualized, a torpedo plane drone would fly at a set height above the water, under control of a radio altimeter, and be directed visually to the torpedo release point by radio. However, when the television method of guidance proved to be satisfactory, it was embraced enthusiastically.

First Surface-to-Surface Guided Missile: By early 1942, the guided missile unit was ready to carry out a torpedo attack on a destroyer in Narragansett Bay. The USS *Aaron Ward* (DD-483) was the maneuvering target. The torpedo was programmed to run at a depth of 38 feet in order to pass under the destroyer. On 9 April, the TG-2 with its torpedo was flown from Quonset Point, Rhode Island, on a "nolo" flight (no pilot) under radio control. The TV receiver in the control plane picked up a usable picture when the drone was 8 miles from the target and the control plane was 20 miles away. The control pilot then guided the drone on an interception course. When the drone reached a point estimated to be 300 yards from the target, the torpedo was released, and it passed directly under the full length of the destroyer. The control pilot in the TG-2 control plane who performed this remarkable control feat was Lieutenant M. B. Taylor.

Ten days later, another test of noteworthy impor-

tance was carried out with great success by the Project Fox personnel. Our purpose was to determine the practicability of crashing a drone into a target. A battle target raft towed at a speed of eight knots in the Chesapeake Bay was used as the target and a BG-1 bombing plane drone was the guided missile. At a range of 4 miles, the drone TV transmitter picked up and relayed a good picture of the target to the control operator, who was again Lieutenant Taylor. The control plane was more than 30 miles away when the drone crashed through the upper forward center of the battle raft target.

Assault Drone Program: In mid-February 1942, Captain Oscar Smith had been assigned to duty as Director of Plans Division in the office of the CNO. This assignment resulted from his early interest in the possibilities of using target drone techniques in the development of missiles. Before coming to Washington, Captain Smith was in command of the Atlantic Fleet School at Norfolk, and while there he addressed a letter to the CNO, suggesting ways in which radio-controlled aircraft could be used as weapons. Smith wrote:

> ". . . my request for supervision over the development [guided missiles] should not be rejected because I am not an aviator. I can bring more experience and as much common sense to the subject as any aviator, and an equal or greater enthusiasm. There are few aviators who flew before my first flight in 1912, and none has a greater interest in the adaptation of aviation to naval warfare."

Early in May, motion pictures of our recent tests were shown to the Commander in Chief U. S. Fleet (COMINCH) Admiral Ernest J. King and chiefs of interested bureaus. Captain Smith and I presented oral descriptions. Admiral King assigned Captain Smith as officer in charge of Project Option with basic directives to develop a service weapon from the experimental guided missiles and to ready the weapon for combat employment in quantity at the earliest practicable date. Smith was directed to function under the head of COMINCH's Readiness Division, Rear Admiral Willis A. Lee, Jr. Cognizance over the weapon's development and procurement was to remain with the Chief of the Bureau of Aeronautics (BuAer), Rear Admiral John Towers.

Friction soon developed between Smith and Towers because of the magnitude of the programs which Smith and his staff were projecting for BuAer to carry out. The demands being made on BuAer for training of aviation personnel and supplying urgently needed planes and engines by the commanders in the combat areas were taxing the bureau to the limit,

JH-1 Stearman Hammond

TG-2, the world's first assault drone

Above and below, two views of the N2C-2 target drone, the world's first guided missile.

and now came the vast requirements of Project Option. The initial request was to organize 18 drone squadrons and provide 162 control planes, 500 assault drones (with another 500 in reserve), all the necessary control equipment, and the necessary support facilities. Not only did Towers object strenuously to the size and complexity of the Project Option program, he also opposed the appointment of an officer who was not an aviator to head an aviation project. Further, he objected to the mass production of a weapon that had not been given a limited test in a combat area to prove its superiority, if any, over conventional weapons.

By then, I was head of the Special Design Branch of the Engineering Division of BuAer. My plan was to get a wartime feasibility test as soon as Project Fox had completed the TG-2 torpedo drone and the BG-1 bomber drone tests described above. There had been a request from our naval forces in Europe for a weapon which could be flown into the submarine pens on the coast of France and a request from the South Pacific for a weapon that could be used against the Japanese defenses at Rabaul. These plans were discussed with the assistant head of the Engineering Division, Captain L. C. Stevens, and approved by Admiral Towers. The plans for the combat tests were being formulated when COMINCH directed that all guided missile employment be the special responsibility of Project Option under Captain Smith.

On 10 November 1943, a conference was held at the headquarters of the Commander in Chief Pacific Fleet, Admiral Chester W. Nimitz, in Hawaii. Among those present were Towers, by then a vice admiral and Commander Air Force, Pacific Fleet, and Commodore Oscar Smith. Admiral Towers stated that because of the heavy demands on every air facility in the Pacific to supply conventional weapons for the war, there was no time or space for experimentation. He said there were no carrier or airfield facilities available for unproven weapons like the drones. This conference effectively closed the door on the employment of the assault drones in a combat area. Smith had been sent by Admiral King to test the climate of interest at Admiral Nimitz's headquarters because two squadrons, designated STAG (Special Task Air Group) I and STAG II, would be ready for movement to the Pacific in a few months. Smith found that Towers held the key position to advise Admiral Nimitz on all air operations. Towers had not changed the views he held while chief of BuAer regarding the essential requirement that a new weapon get a limited exposure in a combat zone to prove its merit before it was employed on a broader scale. His views conflicted with those held by Smith and his staff, as well as those of Admiral King, that the weapon should be introduced into combat on a massive first strike with sufficient reserves to keep the operations repetitive. The Germans introduced the V-1 buzz bomb into combat in a heavy first attack.

Short and Sweet

R. H. Jackson

Commodore Oscar Smith, who played a large role in the combat drone program, got his administrative training years earlier. Here is his own description, written after his retirement:

"When I was flag secretary to Rear Admiral R. H. Jackson, I was trained to make all communications short and to the point. The first important letter I prepared for his signature he looked over carefully and then leaned back in his chair and remarked, 'Smith, this is a very good letter, but it should be condensed so that it will all be on one page. The commander in chief will never read but one page of a letter, and I want him to read this.' So, I wrote it over and presented the one-page letter. It was better. I spent the entire weekend on it. So, early Monday morning, again I presented it to him. As he read, he reached for his pen to sign it, then hesitated and replaced his pen. 'Smith,' he said, 'this is much better, but you have made it in three paragraphs. Don't you think you could put it even more clearly in one paragraph?' I could have killed him, but, of course, back I went with the letter and the next day handed him his one-paragraph epistle. This one really was not as good, but he signed it, saying, 'Smith, this is better, but you know it would be better still if you could put it into one sentence and even better if you could say it in a word.'"

U. S. NAVY (NRM)

COURTESY OF NAVAL ACADEMY ALUMNI ASSOCIATION

It was Towers's contention that the limited test in a combat zone should have been carried out when the war in Europe and the Pacific were stationary so that the results could have been assessed and decisions made relative to types of planes and equipment needed for future operations. He pointed out that the war was no longer stationary but had become a war of fast movement—an "island-hopping" operation—in which conventional weapons required no assist from experimental and untried prototypes.

In this climate of disinterest and skepticism by ComAirPac and his staff and eroding support by BuAer, Smith was again ordered by COMINCH in January 1944, to report to Admiral Nimitz, and arrange for combat trials of STAG-1 and TDR drones and TBM control planes. On arrival at Pearl Harbor, Smith found that Towers was opposed to the employment of the new weapon in any operation whatever. Admiral Raymond A. Spruance, Commander Fifth Fleet, was at Pearl Harbor planning the attack against the Marshall Islands and he was quite willing to give the guided missile a trial in the campaign. After the consolidation of the Marshalls, STAG 1 would be moved to one of the Gilbert Island airfields, stage forward to Majuro, and assist in the attack on Eniwetok scheduled for late May 1944. His recommendation was approved by Admiral Nimitz and Admiral King. Unfortunately for the guided missile, the Marshall Islands campaign was so successful that the date for the attack on Eniwetok was advanced. This earlier date made it impracticable to transfer STAG 1 overseas in time to join in the campaign, so a combat opportunity of prime importance was lost.

Commodore Smith finally got orders to move STAG 1 to the Russell Islands. On 30 July, with Commander Air Force South Pacific, Rear Admiral E. L. Gunther, as a witness, four TDR-1 drones made attacks on a beached Japanese merchant ship, obtaining two direct hits and two near-misses. Commodore Smith turned over command of STAG 1 to Commander Robert F. Jones, his chief staff officer, and

COURTESY OF AUTHOR

Above are the principals in the discussions which kept the TDR-1 target drone from getting a substantial combat test in the Pacific: Admiral Chester Nimitz, Admiral Raymond Spruance, and Vice Admiral John Towers. Commodore Oscar Smith is in blues. Also shown in whites is Captain T. C. Anderson.

returned to Washington via Pearl Harbor. At ComAirPac headquarters, Smith made a report, including motion pictures, of the success of the operation against the Japanese ship. He was hopeful that the presentation would persuade Admiral Towers to permit assault drone operations from a "jeep" carrier in a combat area. Instead, he was told that STAG 1 would soon be returned to the United States.

When Commander Jones learned of the decision, he was able to persuade Marine Corps Brigadier General Clauss A. Larkin to appeal to Commander South Pacific for a 30-day delay in the departure in order to carry out combat tests of the drones in the Northern Solomons. The delay was granted, and by 27 October, 46 TDR drones had been expended in strikes staged from Stirling and Green Islands against selected enemy targets. Several drones did not reach their targets, but most of them were effective. These strikes, however, had little effect on the South Pacific campaign, because the major conflict had moved far to the north, and pockets of resistance in the south were left to "dry up on the vine."

Contemporary Bureau of Ordnance Program: While the assault drone project was moving along, the Bureau of Ordnance developed a guided missile that enjoyed a better reception from the operating combat forces in the forward area. It was a self-seeking glide bomb called the "Bat." That project got under way in April 1942, being motivated by the need to develop a radar homing missile that could be launched from an airplane to attack German submarines operating off our East Coast at the time. Drop tests on 22 December 1944 proved the effectiveness of the weapon; large-scale production, as well as combat employment, were planned. The "Bat" missiles were tested in combat early in 1945 in operations near Japan by three PB4Y Privateer patrol squadrons. They achieved limited success under very adverse circumstances. There were hits, misses, and failures, but, on the whole, the introduction of this new and very complex missile was credible. The Bat missile was the world's first guided missile with active homing radar. The officer responsible for design, development, testing, and procurement was Commander Dundas P. Tucker.

Germany's Guided Missile Programs: In making claims concerning guided missiles, historians invariably turn to the achievements of the Germans because of the unequivocal success of their V-1 buzz bomb and V-2 rocket during World War II. However, the record shows that the first German "guided missile" was designed and developed by Dr. Herbert A. Wagner and his assistants at the Henschel Aircraft Company. This was an unpowered glide bomb with a radio control link, called the HS-293. It was first tested at Peenemunde on 17 December 1940. The glider was released and controlled visually from the parent plane at 2,000 meters altitude. It flew smoothly to the target, a barn 8 kilometers away, and passed directly over it, closely enough to be considered a hit. The first HS-293 missile equipped with solid propellent rocket engines, radio controlled and visually guided, sank English ships in the Bay of Biscay on 27 August 1943. Dr. Max Otto Kramer designed and developed the Fritz X missile, a glide bomb with a trailing wire (which was unreeled from the mother plane) through which signals were sent. The missile sank and damaged warships in the Mediterranean in September and October 1943.

The V-1 was designed and developed by Robert Lusser and built by the Fieseler Company. It was a small airplane with a pulse jet engine on its back. It had gyro stabilization, compass director, and dive and distance gear. This was a missile similar to the U. S. Navy's "aerial bomb" and the U. S. Army's "flying torpedo" of World War I. The V-1 had no guidance system and was therefore a "directed" and not a "guided" missile. It was first placed in combat on 13 June 1944. The V-2 designed by Dr. Wernher Von Braun was gyro stabilized and programmed to turn toward the target early in its flight. Thereafter, it was a ballistic missile with no guidance equipment. It was first successfully launched at Peenemunde on 3 October 1942 and first used in combat on 6 September 1944.

Conclusion: In retrospect, it is evident that the aspirations of guided missile enthusiasts in the Navy and their plans for continuing evolution of a new and revolutionary art of warfare received a severe setback when Commodore Smith's assault drone program, after a monumental expenditure of effort and funds, was denied a critical test in a combat area. It took months to recover from the shock of non-acceptance and non-support, but the basic groundwork had been laid. Today's cruise missile is an advanced version of the "assault drone" and the Regulus missile, and it is fair to say that most of today's sophisticated missiles can trace their lineage back to pioneering work at the Naval Aircraft Factory. The rudiments of remote control and guidance, so vital to the missile art today, were conceived and developed in the early guided missile programs. Solid and liquid rocket power plants and turbojet power systems were developed and used by the pioneers. Upon this base of technical research and experimentation, in which the Navy played such a stellar role, stand the nation's enormous guided missile programs of today.

Admiral Fahrney has often been described as the "father of the guided missile." He was graduated from the Naval Academy in 1919 (Class of 1920) and reported to Pensacola for flight training in 1923. He received a master of science degree in aeronautical engineering from the Massachusetts Institute of Technology in 1929 and was subsequently designated an aeronautical engineering duty officer. In addition to the activities described in the article, Admiral Fahrney was the first Commander of the Naval Air Missile Test Center, Point Mugu, California. He was serving in that billet at the time of his retirement from active duty in 1950. He now lives in La Mesa, California.