

## **TDR-1**

***First Operational US Navy Drone...  
...Successful in Combat in 1944!***

***~ Foreword ~***

In recent months, the US Navy has successfully conducted at-sea launchings and recoveries of an unmanned combat aerial vehicle from NIMITZ-class carriers. Touted as the first completely unmanned aircraft...or drone...capable of being operated from an aircraft carrier, certification of the X-47B for carrier service will take until 2019. That's assuming funding continues to be provided and naval aviators accept the reality of such a device augmenting or perhaps even totally replacing them in time.



As impressive as this sophisticated machine is, it will not be the first drone to be suitable for 'combat ready' deployment onboard a carrier. That honor properly goes to the Navy's TDR-1. Although capable of being launched from American aircraft carriers seventy years ago, operation of a number of the fledgling, remotely controlled TDR-1 aircraft was restricted to Pacific island bases during World War II. Nevertheless, they did fly a number of successful combat missions.

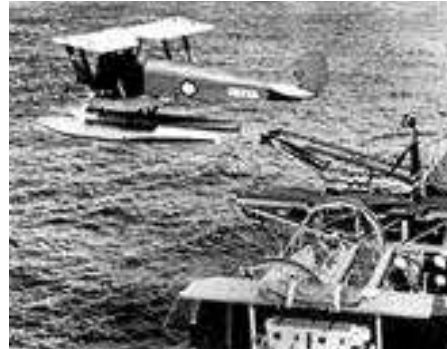
Just goes to show...that ain't much new in this-here world...

*Bill Lee*  
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## ~ Derivation of 'Drone' and Early American Development ~

Experiments involving unmanned flight date back to World War I. But the development of remote control systems was not technologically advanced enough to permit development of a practical Unmanned Aerial Vehicle (UAV). In the mid-1930's, the Royal Navy created remote-controlled aircraft, using obsolete biplanes for use as targets for shipboard anti-aircraft weapons.

One of these radio-controlled aircraft, nicknamed the 'Queen Bee', is shown to the right, being catapulted from a British cruiser. The Bee proved its worth by exposing deficiencies in the anti-aircraft defenses of the Royal Navy. Once, a Bee buzzed the British Mediterranean Fleet for over an hour. Flying straight and level at less than 100 mph, it was not hit despite the expenditure of considerable ordinance by the fleet's frustrated gunners.



In 1936, Admiral Standley, the American Chief of Naval Operations witnessed a Queen Bee in action during a live fire exercise. Impressed, he decided the US Navy should develop a similar training tool. Lt. Commander **Delmar S. Fahrney**, US Naval Academy, Class of 1920 was selected as the leader for such an effort.

Fahrney was a veteran aviator and had a masters degree in mechanical engineering. In time, he would be regarded as a visionary and often is called the 'Father of the Guided Missile'. Working with the Naval Aircraft Factory in Philadelphia, he helped modify four discarded aircraft in 1937 to serve as 'drones'. Reportedly, the now-familiar appellation...drone...was a product of his fertile imagination, and was a sign of respect to the motivational Queen Bee.

The next year, Fahrney envisioned creating a bomb-carrying 'assault drone'. Adding radio controls to an old and slow biplane, he attempted a simulated attack on an American battleship. But a lucky hit by the ship's gunners destroyed his assault drone. "*Operation successful,*" he wrote, "*but the patient died.*"

But the implications were clear; a drone could make such an attack without putting a pilot at risk. Soon thereafter, Fahrney learned of a newfangled invention...television. One of television's inventors at RCA, Dr. Vladimir Zworykin, had been promoting the idea of a television-guided drone, but no one in the military paid any attention to him. Until Delmar Fahrney learned of the RCA inventor's interest. Then, together, they developed the world's first television guided drone; demonstrating it in 1940. But that didn't raise much interest either amongst high level military figures ...until the attack on Pearl Harbor.

## ~ *Creating and Testing the TDN-1* ~

America's entry into World War II immediately created a huge interest in anything that might contribute to winning the war. In February of 1942, a secret program code-named Project Option was created to develop a practical combat assault drone. Fahrney and Zworykin were logically assigned to the project.

Departing from the past practice of using obsolete biplanes, they elected to develop a smaller and faster...and thus harder to hit...aircraft. The scarcity of materials normally used in aircraft manufacture forced Project Option to exercise an option of its own; resulting in the new aircraft being built almost entirely of plywood. Nevertheless, it had a 2,000 pound payload capability.

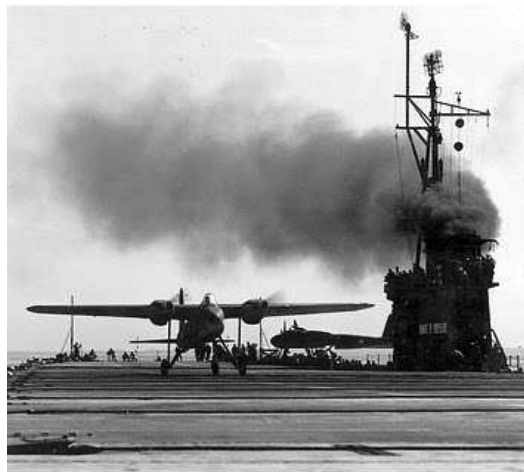


The TDN-1 had a wingspan of 48 feet. Two-220 HP Lycoming piston engines provided a maximum speed of 145 MPH. Ungainly, it had a tricycle landing gear to facilitate carrying a bomb or torpedo beneath its belly. It also had a removable cockpit so that it could be flown from the factory to operational air bases.

The new design was given the alpha-numerical designation of TDN-1. 'T' stood for torpedo; 'D' for drone and 'N' was one of several letters assigned to aircraft manufacturers. In this case, 'N' identified the Naval Aircraft Factory in Philadelphia, Pennsylvania. The number '1' represented the first model.

Ultimately, 114 aircraft of the TDN-1 design were created. Most of them were built at the Naval Aircraft Factory. The last thirty, however, were built under a license granted by the Navy to the Brunswick Company...better known for such peacetime commercial products as bowling balls and billiard tables.

TDN-1 flight testing commenced in late 1942 and quickly raised questions about its capabilities. Plus, it was expensive and not suitable for mass production. As a result, none of them ever made it into combat. Instead they were used for target practice. But in August of 1943, a pair of them did demonstrate their ability to fly off the flight deck of the USS SABLE. The SABLE was a coal-burning Great Lakes paddle wheeler that had been converted for use as a training carrier.



## *~ The Combat-Capable Interstate TDR-1 ~*

Fahrney had anticipated trouble with the TDN design early on, and wisely implemented a back-up plan before the first of that aircraft model ever flew. When his instincts were validated, the Navy contracted with the Los Angeles-based Interstate Aircraft and Engineering Company to design and build a more capable drone. Interstate Aircraft was a small but experienced manufacturer of civilian air planes, including a rival of the famed Piper Cub.

Dubbed TDR-1, following the Navy's assignment of the manufacturers' code letter 'R' to Interstate, an improved drone design was fairly quickly formulated under Fahrney's leadership. Like its predecessor, it featured twin Lycoming 220-HP piston engines, tricycle landing gear and a removable cockpit.

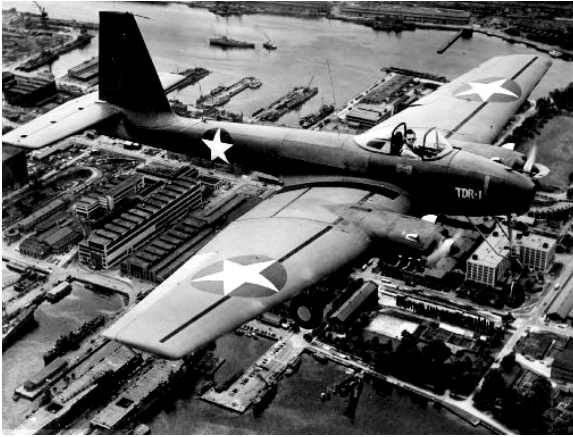
The easy-to-build airframe was constructed of light-weight tubular steel...the manufacture of which was subcontracted to a famous bicycle firm...Schwinn. The wings, fuselage and other surfaces were sheathed with preformed plywood. Another sub-contactor, the Wurlitzer Music Company lent their piano, organ and jukebox woodworking expertise to this aspect of the production process.

The TDR-1, shown below in a pre-production artist's impression that features early World War II insignia, had a wingspan of 48 feet and weighed 5,900 pounds, not counting its payload of up to 2,000 additional pounds of explosive devices. After being placed in service, its tricycle landing gear design was modified to allow it to be remotely jettisoned after take-off, providing the unmanned assault drone the capability of making a one-way trip to a target as far from its take-off point as 425 miles.



But its most innovative feature was an improved guidance system. Mounted in its nose was a Cyclops-like 'eye'...part of RCA's 'Block-1' TV system. The Block-1 was a marvel of miniaturization for the 1940's...long before transistors replaced vacuum tubes. Zworykin managed to fit a TV camera and transmitter in a box (or block) that measured only 8x8x26 inches. The system, including a battery power supply weighed only 97 pounds. Coupled with an onboard radar altimeter, the TDR-1's guidance system could be controlled remotely from some distance.

## Testing the TDR-1 ~



Initial flights were conducted in the latter half of 1943. Before the guidance system was tried, several of the aircraft were put through their paces by test pilots perched in TDR-1 temporary cockpits that had minimal controls and instruments. Nevertheless, one test pilot enthusiastically noted: *"It was exceptionally stable. You could do maneuvers in it that would stall out most conventional airplanes."*

But the TDR-1 had some drawbacks. For example, the drone's landing gear had no brakes. When being readied for takeoff, the plane's tail skid had to be secured to a stationary object; usually the bumper of a truck parked on a runway. After the engines were run up, a ground crew member had to cut the line to enable the drone to start down the runway.



Once the manned test flights were completed, the more complicated tasks of figuring out how to remotely control the drones for combat missions were initiated. Operation of a TDR-1's guidance system was accomplished either from a ground station or from a companion aircraft (or 'mother ship'). Typically, a skilled operator in an airstrip's control tower would remotely control a drone during take-offs and landings. Once airborne, control of the drone would be 'handed off' to the crew of its mother ship.



Several of the Navy's Avenger torpedo-bombers were modified for this purpose and redesignated TBM-ICs. Radio controls for the drone were provided for the Avengers' pilots. Duplicate controls, plus a TV screen and a radar altimeter were installed in the rear of the crew compartment of the mother ships, and a retractable dome was fitted below the fuselage to house the necessary transmitters and receivers.

## ~ Special Task Air Group One (STAG-1) ~

In early 1944, roughly a thousand Naval personnel were assigned to a secret unit that consisted of an unrecorded number of TDR-1 drones and TBM-1C mother ships. Designated as Special Task Air Group One (STAG-1), extended training took place in isolated locations; first in rural Oklahoma and later on the shores of Lake Michigan.

Once the crews of the mother ships were sufficiently skilled in the difficult task of remotely flying the drones and aiming them, using the television apparatus, a series of simulated attacks were conducted against a Great Lakes lighthouse, using 500 pound dummy bombs. Their base of operations was in Traverse City, Michigan, some 65 miles from the lighthouse location.



Once airborne and given control of the drone, a TBM-1C pilot would guide a TDR-1 to the vicinity of the tall, slender structure. Control of the drone was then handed off to another pilot, seated in the rear of the mother ship. Under a black cloth hood, he would peer at a six-diameter TV screen, shown below on the right side of his rudimentary control panel when zeroing in on a target.



Because of the low priority given to Project Option, the designers of those controls had to improvise. Clearly visible on the panel in the center of the photo on the left is a joy stick...and an old-fashioned telephone rotary dial.

The joy stick was used to control the attitude of the drone being controlled. The telephone dial was pre-programmed to set altitude. "Dial 1 for 50 feet above sea level, 2 for 100 feet, etc." Dialing other numbers would arm a bomb or drop a torpedo.

Crude, but workable. Most of the time. However, the remote controls triggered responses from a series of gyros installed in a drone, which sometimes malfunctioned. On such occasions, a drone would bank or whip around violently. Pretty exciting if the drone was carrying live ordinance!

## ***~ Project Option Runs Almost Completely Out of Options ~***

In the spring of 1944, following a prolonged training period, STAG-1 received orders to move to Monterey, California. Fahrney had long assumed that when his team was ready, they would be embarked in an aircraft carrier to do battle.

But the fortunes of war had changed by that time, and conventional weaponry was considered sufficient to bring the Japanese Empire to its knees. High-ranking naval personnel, including Admiral Nimitz, were cool to the idea of casting an experimental, radical and unproven weapons system into battle.

Undaunted, supporters of the TDR-1 concept lobbied endlessly for a chance to put STAG-1 in harm's way. Finally, they were given a chance. Well, half a chance. STAG-1 was ordered to a base in the Russell Islands, which by late 1944 was in the war's backwaters. Enemy targets of significance would be rare.

On May 18, 1944, some of the STAG-1 personnel and the unit's TBM-1C aircraft embarked in an escort carrier, bound for the South Pacific. The remaining men followed close behind in a Navy transport, as did a cargo vessel in whose holds were stored dozens of crated drones.

Three weeks after their June 5<sup>th</sup> arrival in the Russell Islands, STAG-1 commenced flying...yet another round of training missions. The group's commanding officer had the foresight to arrange for color photography. But that soon proved a bit embarrassing, when a TDR-1's landing gear collapsed and the aircraft nosed over during a remotely controlled take-off.



Not knowing that the 2,000-pound bomb slung beneath the drone had not yet been armed, people standing alongside the runway scattered frantically. Other than a smashed nose wheel assembly and two broken propellers, the only other damage was to the unit's pride.

Finally, on July 30<sup>th</sup>, 1944, they were given permission to attack a grounded and abandoned Japanese freighter. Because bombing by drones had previously proven to be inaccurate, it was decided to fly bomb-laden drones on a one-way mission and deliberately crash them into the vessel...and any future targets.

In essence, Fahrney's unmanned assault drone concept had become a more dependable...but expendable...guided missile.

*~ First Success for the Interstate TDR-1 ~*



The photo on the left, probably posed, shows ground crews preparing a TDR-1 for action. Their scant attire indicates the high heat and humidity conditions which they faced. Clearly visible is the aircraft's single bomb load. The drone's nose cone, not yet attached, allows for an excellent view of the Block-1 TV system.

Four drones were loaded with 2,000-pound bombs and sent aloft. Two TBM-1C's followed; each was assigned control of a pair of drones. When they reached a point seven miles from their intended target, pilots in the rear of the TBM-1C's took control of the drones and guided them to the derelict ship. The TV receiver images had low contrast and resolution, as this photo of a receiver's 'green screen' indicates.



Navy motion picture crews were dispatched to record the attack's results from a nearby beach. Two of the four TDR-1's made direct hits, literally lifting the vessel out of the water. The other two crash-landed close alongside the freighter. One exploded in the nearby jungle; the other failed to explode. While the results were not perfect, two direct hits out of four tries was a much better average than experienced by conventional bombing sorties during World War II.

When the commanding officer of STAG-1 went to Pearl Harbor to report the results of the attack, he carried along the film taken of the event. The following sequence of stills were a part of that motion picture. Convinced that the performance captured on film would lead to permission to expand operations, he was shocked to learn that orders had been cut to recall STAG-1.





## ~ A Thirty Day Reprieve ~

Proponents of Project Option, incensed that the multi-million dollar program was going to be scrapped at the very pinnacle of its success, swung into action. Against all odds, they somehow won a thirty-day extension of operations for STAG-1 to attack targets of opportunity throughout the Solomon Islands.

STAG-1 broke into two combat squadrons; VK-11 and VK-12. One moved to Treasury Island; the other went to Green Island. Between September 27 and October 26, 1944, they engaged the enemy repeatedly. Over the course of one month, they expended 46 of their drones. Thirty-seven of these reached their assigned target areas and at least twenty-one made successful attacks.

The men of Squadron VK-12 created a unique insignia for themselves, showing a stork (wearing a sailor hat) delivering a dog. The use of a dog's image was an inside joke, for the radio code name assigned to the TDR-1's was 'Dog'. Alternatively, the initials 'BWB' were also utilized as a code name or call sign, which the unit's irrepressible Navy men jokingly declared stood for 'Big Wooden Bastard'!



On September 27<sup>th</sup>, VK-12 attacked a grounded freighter that had been turned into an anti-aircraft emplacement. Just a few days before the attack, Japanese gunners had shot down a US Army Air Corps transport, killing everyone onboard.

Years later, the pilot directing one of the drones shared his memories: *"I distinctly remember the excitement, watching the grainy and sometimes static-filled green TV screen as the drone I was guiding approached the grounded ship.*

*"When an unfamiliar pattern of small dots began to appear, I thought the receiver was malfunctioning. Suddenly I realized; they were flak bursts! But I kept the drone on target, concentrating on holding its bouncing nose squarely on target.*

*"I crabbed it a bit to correct for wind and to avoid the worst of the flak. At the last second I had a close-up view of the ship's deck. Then...just static. I had hit the ship squarely amidships and probably killed everyone onboard."*

The combat diary of STAG-1 lists similar successes, day after day. Not realizing that the drones had no pilots, the Japanese referred to the TDR-1's as 'American Kamikazes'. On October 26<sup>th</sup>, for its final combat mission, a lighthouse on one of the Solomon Islands that was in Japanese occupied territory was attacked by three drones, completely demolishing it.

**~ Disbanded, Disillusioned and Disappointed ~**

In spite of their successes, at the end of their thirty-day operational extension, Project Option was cancelled and STAG-1 disbanded. Squadron personnel were reassigned to other, more conventional combat units in the US Navy. To a man, they felt that their hard-won talents and future potential had been squandered.

Many of their TDR-1 drones and accompanying TBM-1C mother ships were unceremoniously dumped at sea. By the end of 1944, STAG-1 was history.

Drones that had been completed but not yet shipped overseas were later used for target practice or were sold, post-war, for civilian use as sports planes. The latter included their cockpits and their controls...minus their TV guidance systems. None of them are known to still exist.



Today, a sole example of the 189 Interstate TDR-1 drones that were completed remains. Meticulously restored, it is on permanent display at the National Museum of Naval Aviation in Pensacola, Florida.



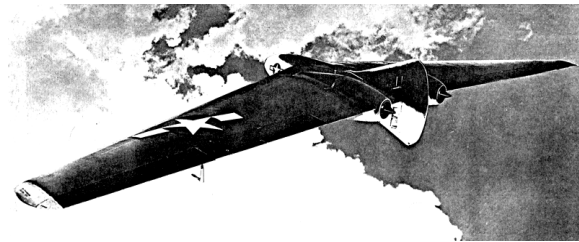
Years after World War II ended, Delmar Fahrney wrote in an unpublished history of Project Option that: *"The great broom of victory swept all new projects into the ashcan of forgotten dreams."*

~ *Postscript* ~



To his credit, Fahrney continued to pursue the development of unmanned assault aircraft. His efforts included plans for an improved version of the TDR-1. It had more powerful radial engines and a much-improved Block-3 TV system. Four prototypes were built and flown, but by that time the war had ended and the Navy abandoned that effort, as well.

Interstate Aircraft, with Fahrney's help came up with a drone design that was to be jet powered and have a then-radical flying wing design. Designated XBDR-1, a scale model was tested in a wind tunnel at Langley Field, Virginia in 1944. But it never got off the ground...literally or figuratively.



Fahrney next turned his attention to helping to develop the nuclear-capable Regulus missile. Ironically, it did not have a TV guidance system. Military strategists felt they didn't need a true precision weapon, since in the 'next war' whole cities would be decimated by nuclear warheads.

Fahrney eventually attained the rank of Rear Admiral, and for a few years was the US Navy's Chief of Guided Missile Research. He retired in 1950, following thirty-two years of active service.



Later, he became interested in the possibility that UFO's were extraterrestrial. In 1957, this comment he made became widely publicized: *"Reliable reports indicate there are objects coming into our atmosphere at very high speeds and controlled by thinking intelligences"*.

Delmar Fahrney, the man largely responsible for the profusion of drones in use today, passed away in 1984 at the age of 86. Appropriately, in June of 2000, at the Naval Air Missile Test Center, Point Mugu, California, a new headquarters building was named in his honor during that structure's dedication ceremonies.