PHILIP DALTON: THE LOST NAVIGATOR

The Naval Aviator whose techniques and inventions made aerial navigation practical and safe for hundreds of thousands of aviators over three generations, but who has been lost to history.

by Keith Smith

In an age where aerial navigation consists of being able to key your destination into the airplane's GPS (and one in which that acronym needs no explanation), it is understandable that there is little appreciation for the problems faced by the lone aviator flying the trackless skies of the 1930's, or for those who by persistence and hard work evolved solutions to the problems faced by the aerial navigator. However, it was a tough time and flying then was still a "by the seat of the pants" occupation. Airplane pilots were incapable of reliable, safe cross-country flight unless they were able to see the ground for a significant part of the flight.

This was the world of aviation as seen by Philip Dalton as he graduated from Naval Aviation School at Pensacola, Florida in June, 1931. Ensign Philip Dalton was like a small meteorite streaking toward the earth; his life was destined to be short, flame brightly for the moment and thereafter to be forgotten!

In the 1930's the big names in aerial navigation were Lt. Commander Weems, US Navy and Harold Gatty, the navigator for Wiley Post in his first round the world record flight of June 1931.

Philip Dalton, born in 1903, was the fourth of five sons in a family living in Schenectady, New York. Father, William, was employed by General Electric. Mother, Ida, in keeping with the times, raised the boys. Both had been educated at Cornell University. They were a supportive family and their frequent correspondence provides a basis for knowing more about Philip and his interest in aviation.

While in junior high school, Phil became fascinated with physics. During The World War, his eldest brother Bill was an Army aviator, so it was natural that when he enrolled at Cornell in 1920 to study physics that he joined the Field Artillery unit of the Reserve Officers Training Corps. His study of physics and the problems of artillery ballistics formed an interlocking interest that stimulated the practical side of his mind. He confessed in a letter home:[1] "I didn't know exactly what to do about a thesis because most of my interests are more or less practical and not very theoretical." He soon became engrossed in developing calculators to aid the artilleryman in laying his guns. In a letter to his father from military camp in 1923, he was very enthusiastic about the French 75 mm cannon and his ability to aim it much more accurately than the other cadets. He received a Reserve Army commission in the Field Artillery upon graduation and continued his artillery interests while attending Princeton where he earned a Master's Degree in Physics in 1925.

Ensign Philip Dalton 1931

In 1926, he accepted a position working in the physics laboratory at Harvard and enrolled in the graduate program there intending to acquire a Ph.D. He worked at various laboratories and began experimenting on aircraft blind flying equipment through 1930 while staying active in the Army Reserve. For someone with an active mind and lots of determination, it was a poor time to be a part of the Army. The officers were of the "old school" and wanted none of the ideas this brash 2nd Lt. was pushing. After five years and a promotion to 1st Lt. in the reserves, he was very discouraged that anything would come of the "gadgets" he invented for laying artillery. He knew of the challenges that navigating airplanes presented from long discussions with brother Bill and his aeronautical work in various labs. Late in 1929, he sought an appointment to the naval flight-training program knowing that if accepted and successful, he would have to revert to being an ensign in the Navy and lose his rank in the Army. Phil's one-year assignment following graduation in 1931 was as an aviator aboard the cruiser USS *Northampton* in the Scouting Squadron.

On the *Northampton*, Phil was the lowest ranking and least experienced in the squadron. He wrote home,[2] "I certainly have my work cut out for me this year. I am the only reserve and the only ensign in my squadron so I have two years work to do in a few months if I am to catch up with the rest in radio, navigation, gunnery, etc. But it is tough because aerial navigation at sea is not something to be done 'off hand,' so to speak. And if I should make a mistake, it would be too bad because we will be leading a large formation most of the time and the poor guys behind can't do anything about it but follow. The squadron commander wants me to be his pilot and navigator while he sits in the back seat works the radio and carries out tactical missions. He told me to rig up a plotting board in the front seat and learn to fly with one hand on the stick and with a pencil in the other. It is the best job I could possibly get in the squadron."

Instead of complaining about a tough job, Phil viewed the demanding task as an excellent opportunity to shine his inventive genius on how to satisfy the job requirements. In another letter[3] he stated, "I will have plenty of opportunity to test out my navigational gadget under service conditions."

Aerial navigation at the turn of the 1930 decade mostly consisted of *pilotage* – the art of matching characteristics printed on a map with those the pilot could observe from his vantage in the cockpit. This was difficult enough during the day when the weather was good, let alone at night, given the state of aerial map-making of the time. Much of the flying was done with automobile road maps that had few recognizable terrain features and few paved roads. Of course, flying above or in the clouds at any time precluded this type of navigation.

The meticulous pilot (there were a few) could plan longer flights by drawing a line of the intended course on the map with a pencil. He could measure the angle this line made with lines of longitude on a Mercator projection map and thereby know the True Course required to fly to his destination, assuming that there were no wind. However, what he really needed to know was how the wind would affect his flight; how it would drift him off course and add to or subtract from his speed over the ground. With this knowledge, he could aim his aircraft and proceed to his destination with some degree of confidence. In addition, there were other sources of error relating to the compass which had to be considered.

This meticulous pilot could correct for all these variables by calculating the effects of wind, if it were known in advance, by a simple graphical solution and applying known corrections for the compass errors. However, the wind was frequently unknown and apt to change along the flight path. Airplanes of the day did not have room to layout a chart and figure a new course using a graphical solution. Even if the space needed for this operation were available, the planes were unstable, even in smooth air and required constant attention from the pilot, making precise navigation a strenuous, if not impossible task.

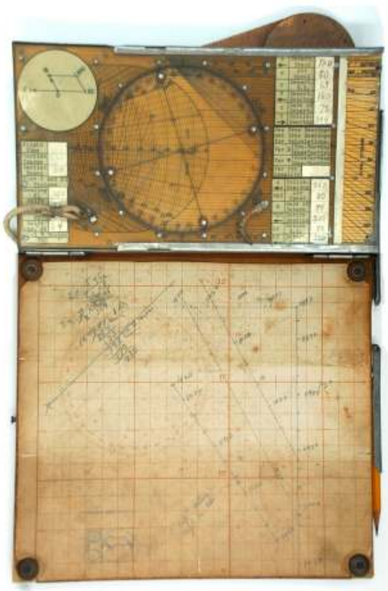
Lt. Comdr. P. V. H. Weems, sometimes called "the father of Naval Aerial Navigation," had this to say about the state of the art in 1931:[4] "Sea going… methods of navigation, while correct in principle, are too slow and cumbersome for use in the air…Only by practical work in the air can one realize how utterly impractical it is to use any but the shortest and simplest methods for air work."

Instruments to help guide the pilot and inform him of the plane's attitude were just coming into being and were not generally available, especially not to the military pilot, who was usually the last to receive the benefits of technology in this depressed economic time. Radio aids to navigation were virtually non-existent. Some well-equipped planes had radio receivers and transmitters, used principally for communications. Direction finding was possible with a radio receiver equipped with a loop type antenna. A few were so equipped and could, with some difficulty, track toward or away from a radio station that was transmitting almost constantly. Special forms of light beacons were being installed for night flying on some of the more heavily traveled airmail routes, but nothing existed elsewhere in the United States. Of course, the Navy pilots who flew over the trackless oceans had few, if any, "landmarks" to tell them where they were. Fledgling Ensign Philip Dalton faced this situation when his commander assigned him as his pilot/navigator. This is why Phil thought that his commander had just handed him the best assignment in the squadron.

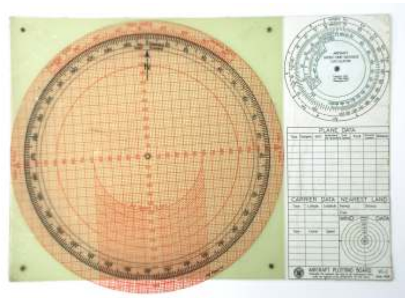
"Dead reckoning" was the navigation technique used then, and still taught today. (Most think that this is a corruption of the earlier name, "deduction reckoning" which was shortened to "ded reckoning.") This method used by early nautical navigators allowed them to "reckon" their position from knowledge of their heading, speed and time since their last known position (fix). On the surface, ocean currents would introduce measurable errors, while in flight, it was the wind, which was of main concern. Dead reckoning combined with any other navigational means, such as pilotage, celestial or radio for fixing the navigator's actual position is a very practical system, since the "reckoning" part provides an approximation of where the navigator is between the times when he knows with any certainty from the fix. Phil's goal was to provide tools that would facilitate the dead reckoning part of the aerial navigation problem.

While most of us think of flying from point A to point B as a typical aerial navigation task, this was a simple job compared to that of the naval aviator. Typically, Phil was flying from a cruiser in a floatplane catapulted from the ship. His task was generally to fly a search pattern, usually a straight course a hundred or so miles from the ship, turn parallel to the ship's course for a given distance and then return back to the ship, which had moved some distance in the interim. While the planes had radios, they were not generally used for pilots to "home" in on, since in wartime, radio silence would be maintained to prevent the enemy from knowing where the ship was located. Therefore, unless an emergency occurred, the pilot had to return using his own navigational skills. In addition, radios of this period were highly unreliable and an aviator that depended too much on them might easily wind up in the "drink!" Phil's typical flight navigation problem was similar to that of the pilots flying from the emerging carriers of the day, so that anything that he could do to improve his situation was equally beneficial to the carrier pilot.

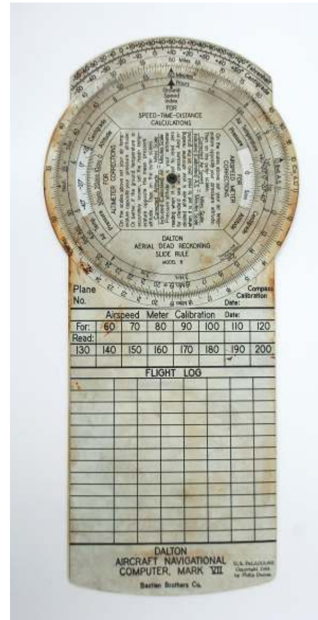
An early version of Phil's experimental plotting board (shown below) was 11.25 x 16.25 inches overall, with a plotting surface of 11.25 x 10 inches. It had provisions to hold a piece of aircraft plotting paper. The graph paper on this model covered slightly over three degrees in latitude, or over 180 nautical miles vertically and over 200 nautical miles laterally



Dalton's prototype plotting board



Dalton Aircraft Plotting Board VC-2



Dalton Aerial Dead Reckoning Slide Rule Model B, which also carried the designation "Dalton Aircraft Navigational Computer Mark VII" showing altimeter correction scale on the slide rule calculator, patent number and a copyright for 1934.

(the actual width would depend on the latitude of the flight contemplated). This was quite sufficient for a scouting plane of the day. The upper portion of the board had labeled boxes to note the various parameters of the flight. In two years of practical application and testing, Phil was able to reduce this crude plotting board to that shown as Aircraft Plotting Board VC-2, which was released by the Navy Hydrographic Office in June 1933 and made standard for all Navy planes at the time. With this board and a good watch, the naval aviator, now had a much better method of finding his way over the ocean.

The VC-2 plotting board also incorporated a circular slide rule on its upper right hand corner capable of performing distance, time and speed computations and calculating the rate of fuel usage and estimated endurance with fuel remaining. In addition, it had a special scale for correcting errors in the aircraft's speed indicator resulting from air temperature and altitude effects. (Later versions of this calculator would include corrections for altimeter errors resulting from non-standard temperatures at altitude.) This new board had an area (lower right hand corner) where the pilot could note various items relating to the aircraft, carrier and nearest land formations. All entries were made in lead pencil and were easily erased so that the plotting board could be used over and over, indefinitely. This type of plotting board became ubiquitous in the Navy. By 1934 the Navy was pretty well sold on Phil's gadget. He wrote to his brother, Johnny,[5] "Letters from the fleet state that for the first time in the history of naval aviation single seater fighters have been able to do accurate navigation at sea using my plotting boards. And the aircraft manufacturers are designing all new models to take the plotters." It was about this time that Phil became personally associated with Lt. Comdr. Weems.

Prior to Phil's work, the problems associated with dead reckoning were tackled by using the "Aviator's Dead-reckoning Tables." In his second edition of *Air Navigation.*[6] Weems updates the preface with, "Some other important changes are: …*b*. Development of mechanical computers, such as the Mark VII computer, which have largely replaced the dead-reckoning tables formerly in use." This edition contains detailed instructions for the use of the Dalton Mark VII Computer. Weems not only encouraged Phil in his development efforts, but he also offered him a partnership in his navigation business, which he conducted *sub rosa* while on active duty and which flourished once he left the Navy. Phil declined this offer feeling he would be doing nothing but running a mail order business while Weems was on active duty and that would interfere with his development work. However, he continued his professional association with Weems who subsequently marketed Phil's inventions.

After a year on active duty on the USS *Northampton*, Phil returned to civilian life, but continued to fly with the Navy as a reserve aviator. During this time, he pursued the development of his "gadgets" and their acceptance by the Navy brass. His letters contain many references to the frustrations he experienced in dealing with the Navy bureaucracy. By now, he had approached the Army as a likely customer for the inventions, for which he had received patents. "I am happy to report," he stated in a letter[7] to his father, "that…the Army has given me two contracts that will net me $1500 in the first quarter of 1936. And what is more encouraging, Keuffel and Esser Co. are giving me cooperation in the development of a new device that I am sure will be a very fine thing financially as well as otherwise." A later letter reveals,[8] "…Incidentally, every one of my navigation gadgets that have been put on the market here has now been adopted by the British Air Ministry." By this time, Phil had devised a smaller version of the plotting board into a handheld calculator, the Mark VII. This was what had interested the Army. They signed a contract to produce the computer that would eventually be known as the "E-6B" and issued to virtually all Army pilots navigators and bombardiers.

In January of 1937, the Institute of Aeronautical Sciences elected Phil an Associate Fellow. In July of that year, Philip Dalton was married to Margaret Gardner of Alexandria, Virginia. With war a distinct possibility, the Navy recalled Phil to active duty on October 30, 1940. His assignment was to the Naval Air Station Anacostia, Maryland, across the Potomac River from Washington, D.C. He was in the process of getting reassigned to the Navy Bureau of Aeronautics where he planned to continue his research and development on air navigation instruments. In the interim, he was assigned to instruct student aviators in primary flight.

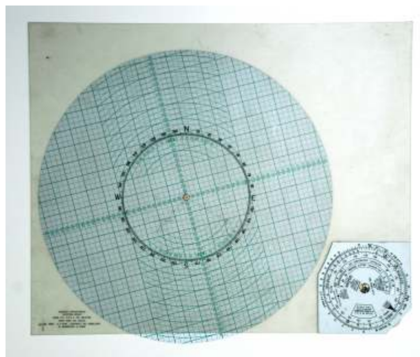
Phil's navigational gadgets not only aided the pilot in planning and conducting his flight, but by observing the wind drift on two different headings, a new value for the winds aloft could be computed on the calculator. This made subsequent dead reckoning more accurate. Phil was working on new instruments to aid the pilots and aerial navigators to more precisely detect wind drift. It was this facet of navigation that he was eager to pursue in his anticipated new assignment.

On July 24, 1941, his commanding officer wrote the following in a letter to Margaret Dalton,[9] "About 1:00 p.m., today, Phil took off in a Navy primary training plane, with Harry Lee Rogers, Jr., a student naval aviation pilot, as his passenger and student. At about 1:50 p.m., his plane crashed about five miles northwest of Hybla Valley and both Phil and his student were instantly killed…

Not only Naval Aviation but all of Aeronautics; commercial, civil and military throughout the World, have benefited by Lieutenant Dalton's genius."

By this time, Philip Dalton's gadgets were firmly entrenched in the American and British air services. They had undergone constant improvements from the initial naval plot-

Front and back sides of a modern version of the Dalton E-6B Aerial Navigation Computer



Navy Aerial Plotting Board issued during World War II

ting board, which measured 14.25 inches by 10 inches to the US Army Air Corps' E-6B, a device of approximately 11 inches by 5 inches, easily carried by any pilot or navigator in an aircraft of any size. Hundreds of thousands of Phil's gadgets were produced during World War II.

During World War II, at the Army Air Corps Navigators' Schools, as the student navigators marched to and from classes they frequently sang from their repertoire this song, "My eyes are dim, I cannot see. I have not brought my E-6B. I have not brought my E-6B with me…"

Books and magazines attest to its value and utility with stories like the one received by a manufacturer of the E-6B during World War II. A navigator wrote, "I have just returned from a mission in a badly battered B-17, and it was only with the aid of my hack watch and your E-6B Computer that we were able to reach the furthermost emergency landing spot on the coast of England. Thanks for making it."

If you watch the old Navy films from World War II, you might see all the carrier pilots in the ready room being briefed, making notes on their plotting boards and the boards clutched under their arms as they rush out to their planes.

In the post-war era, the Dalton computer continued to be useful as it was modified to conform with the needs of aircraft flying ever higher and faster. It never lost its advantage as being the most reliable, durable and ever handy means of informing a pilot or navigator what direction to fly to his desired destination and how long it will take him to get there.

Smaller, "vest pocket," versions have been produced. These measure but 3-1/2 x 7-1/2 inches, made of durable aluminum and do everything that the E-6B will do—and more. Even the advent of modern developments such as GPS, Inertial Guidance and the like have not made the E-6B computer obsolete. Every pilot knows that things electrical may some day fail and when the chips are down, plan B is, "back to basics." Therefore, even student pilots of today learn basic navigation using a derivative of the E-6B. It is still in production by various companies and fledgling aviators carry it as a heritage from the Navigator Lost to History, Philip Dalton, Lt., USNR.

References:

1. Letter to Mother, 10/14/23
2. Letter to Father, 08/11/31
3. Letter to Father, 11/31
4. *Air Navigation*, P. V. H. Weems, McGraw-Hill Book Company, Inc, 1931
5. Letter to Brother 02/17/34
6. *Air Navigation*, Second Ed. P. V. H. Weems, McGraw-Hill Book Company, Inc, 1938
7. Letter to Father ca 1935
8. Letter to Father ca 1937
9. T. U. Sisson, Lt. Comdr, USN, letter to Mrs. Philip Dalton
10. *Inventor—Aerial Navigation Computers & Equipment*, Private publication by Philip M. Smith, Westerville, Ohio, 01/29/02 contains the letters cited.

This essay is dedicated to the memory of my brother, Philip M. Smith. KRS