About Us

Since 1928, Weems & Plath has taken great pride in building each of our precision marine navigation products with the goal of providing the highest quality possible. Every step of this building process; from development to production is taken with meticulous care. Our products are meant to be enjoyed for a lifetime, and it is with confidence we offer a limited lifetime warranty on most. We also strive to provide exceptional service and we encourage you to let us know how we are doing.

Contact Us

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Click on a link below to learn more about our rich history:

Click Here to visit the Annapolis Maritime Museum

Contributions of Captain Weems

In May of 1919, eight years before Lindberg's famous solo flight, three small planes set out from Newfoundland headed for London in an attempt to make the first trans-Atlantic flight. Only one of them made it. Twenty-five hundred feet below on board a station tracking ship, a young navigator, **Lt. Cdr. Philip Van Horn Weems**, U.S. Navy, gazed up and thought there must be a safer and simpler way than using a small armada of ships as beacons for the flight.

For centuries, man had relied on the heavens, on the circling planets and the constant horizon, to guide him in his travels. A compass, a sextant, and charts were the necessary tools for plotting a course, but these required time for computations and a place to spread out and study the charts. The timeworn system of celestial navigation was ill suited to the cockpit, but the airplane was here to stay. Lt. Cdr. Weems, a brilliant, inventive, and determined young man knew as he tracked that first flight that navigation was his destiny and he went on to revolutionize the field with his ideas, writings, and inventions.

Capt. Phillip Van Horn Weems

- History of Navigation
- The Genius of Captain Weems
- 1889-1912 Farm Boy to Midshipman
- 1919-1928 Early Naval Career
- Weems System of Navigation
- Author & Inventor
- A Family Company
- The Adventurers
- Undersea to Space 1957-1979
- Grand Old Man

About Carl Plath

Carl Plath

C-Plath was named for the owner (Carl Plath) of a well-known German instrument manufacturer in Hamburg, Germany. This highly respected company manufactured the finest commercial sextants and magnetic compasses available in the late 1800's and throughout the 1900's. C-Plath developed the first gyrocompass installed on a commercial vessel in 1913. Weems school for navigation had become the purveyor of Weems' instruments. It was a natural development for Weems' company to become the North American source for C. Plath's fine instruments also. Hence the alliance of two distinguished names - Weems and Plath.

Today Weems & Plath is still located in the Chesapeake Bay town of Annapolis where it began so many years ago. It is committed to supplying the world with the finest nautical products available while maintaining the high standards of service that have distinguished Weems & Plath from its inception.

Learn more about Carl Plath

History of Navigation

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Modern navigation stands on the shoulders of those who came before us. Ancient astronomers passed down their knowledge of the celestial bodies. Artists and cartographers produced charts of the oceans and new lands. Mathematicians and scientists invented tools and techniques so that mariners might find their way. Adventurers bravely took this knowledge to sea discovering and charting new worlds. And as navigation advanced, so did civilization.
Early mariners were coastal pilots, hugging the coastline in order to find their way. They used charts and known landmarks as navigational aids. They used the lead line or fathometer to obtain depth readings called soundings. And they had a few simple tools to measure distance and bearing to safely navigate through inland and near shore waters.

By the 16th century, the "Age of Exploration," advances in celestial navigation enabled mariners to measure the angle of the sun and stars to determine their latitude (their location on the Earth north to south) but not their longitude (their position west to east). These early explorers could never truly know their precise position at sea.

Dead reckoning, often used as a last resort today, was one of the few navigation techniques available for ancient mariners. This method requires the navigator to factor in the compass direction, speed, currents, and other information to track and determine the vessel's location. It also requires meticulous observations and careful record keeping on a chart. Errors in a log could often result in a prolonged voyage at best - and at worst... disaster.

New technological developments such as the marine sextant and the sea-going clock in the 18th century made ocean passages routine. The advent of airplanes in the early 20th century sparked a new interest and energy in the field of navigation. Calculations now had to be made not for the speed of ships, but for the speed of airplanes.

Captain Philip Van Horn Weems was instrumental in revolutionizing modern navigation and was an active participant in navigational

advances from the time of his sailing cruise aboard the USS Hartford in 1909 to his patent in 1961 of the space navigation sphere.

The advent of computers, satellites, the Global Positioning System, and electronic navigation has revolutionized the ways in which navigators ply the oceans, fly the skies, and explore space in the 21st century. Navigators at sea today are more likely to remain below deck at a computerized navigation station than on deck observing the stars.

Everyone who travels on land, sea, or in the air and in space should appreciate understand, and perhaps even practice the "art" of navigation using the methods of old to gain an appreciation of the work of those who came before us.

The Genius of Captain Weems

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BEFORE THERE WAS GPS
The Navigation Genius of Captain Philip Van Horn Weems
1889 – 1979

In the 21st century we take knowing exactly where we are and where we are going (navigation) for granted. An inexpensive little black box gives us our latitude and longitude in a matter of seconds. But before the invention of the satellite Global Positioning System, and the GPS receiver, navigation was both an art and a science, and quite complex.

Captain Philip Van Horn Weems, the "Grand Old Man of Navigation," is renowned as a pioneer in the field. He modernized navigation by simplifying techniques; invented and adapted new, time saving methods; and most significantly, shared this knowledge through the tireless teaching of his discoveries and insights. His pupils were naval officers and adventurers. His advancements, which began during his career as a naval officer, now stretch across all types of navigation - from maritime to aeronautic, from underwater to outer space.

Most tools developed by Weems were developed in an era before computers as we know them today. The tools developed by Weems simplified and automated the problems of navigation so that anyone with a high school education could master basic celestial navigation.

Delve into navigating the old-fashioned way and explore for yourself how mariners of the past paved the way for navigation today.

Captain Weems lived in Annapolis as a Naval Academy midshipman in the early 1900s and again from the 1930s to his death in 1979. The company he founded lives on today as Weems & Plath , located at 38°58.16' N 076°28.68' W, that is, 214 Eastern Avenue, in the Eastport neighborhood of Annapolis, just blocks from the Annapolis Maritime Museum.

In 2003, Captain Weems was inducted posthumously into the Maritime Hall of Fame in Annapolis. Through his accomplishments and inventions, we invite you to explore his contributions to the history of navigation.

1889-1912 Farm Boy to Midshipman back to top

An Orphaned Farm Boy from Tennessee Is Appointed to the United States Naval Academy
Philip Van Horn Weems was born in 1889 in Montgomery County, Tennessee, and orphaned at only 14. Instilled with a strong will to achieve by his supportive family, Weems always had the dream to attend West Point. Though he graduated at only an eighth grade level from the one-room Walnut Grove School, Weems obtained an appointment to the United States Naval Academy in Annapolis and entered with the class of 1908.

Weems soon became a standout athlete, playing football and earning his first "N" in wrestling in the fall of 1909.

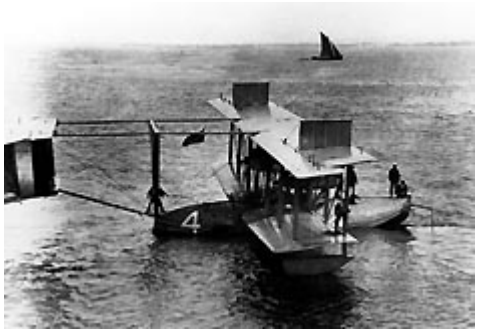
Weems excelled academically, impressed his instructors, and worked hard to score high marks. One course he excelled in as a plebe - or a first year student at the Academy - was seamanship. When Weems entered the Academy, the Navy was shifting from sail to steam, a transition that brought a new way of thinking about going to sea. Steam vessels were faster and not reliant upon the wind, thus navigation began an early evolution. Weems' class was the last that would take its summer cruise aboard a sailing vessel, the *Hartford*, in 1909.

The young midshipman acquired the nickname "Mammy" in his plebe year at the academy, allegedly due to his propensity to use a drawn out "Ma'am" when addressing ladies.

Classmate Captain R. A. Lavendar noted in a 1974 letter that "{t}he nickname Mammy was so out of place that it could be accepted only by Mammy himself. It was fitting because his athletic prowess and his strength of character. Van was aggressive, a fighter and was not afraid of the devil himself. Van accepted his nickname because he knew that he was not a mamby-pamby and everyone else know it to {sic}."

1919-1928 Early Naval Career back to top

Varied tours of duty at sea from 1912 to 1920 - combat assignments, supply ship duty, and hydrographic survey voyages - brought many pieces of the navigation puzzle to light for Weems and played an important role in his development as a navigator.



The newly promoted Lieutenant Commander Weems, on his first assignment as chief navigator, was responsible for the precise location of his ship, the destroyer USS O'Brien, on a historic deployment. The O'Brien was one of many picket ships strung across the Atlantic to guide the first airplanes to complete this first trans-Atlantic flight. The world stood on tip toe waiting for news. Two of the three aircraft had already dropped out by the time they had reached the Azores.

The last remaining NC-4 Curtiss Flying Boat was delayed due to bad weather, leaving Weems much time to contemplate the importance of his duty and to consider the problems of air and sea navigation.
"Suddenly the plane came up over us," Weems said, "It was a great thrill." From that moment Weems caught the vision that would change his career

-- Louise Davis, The Nashville Tennessean, May 29, 1966

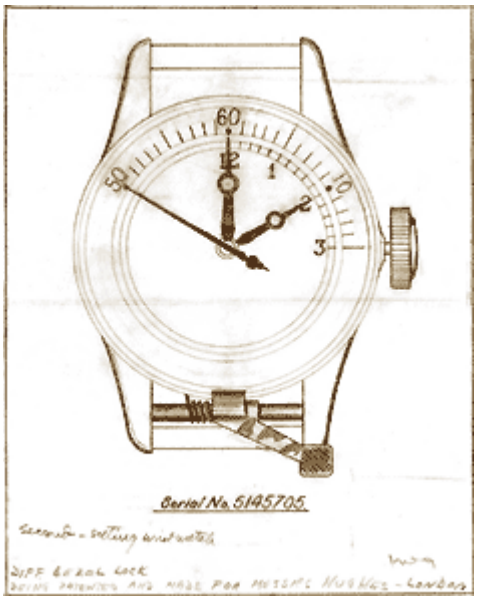
Weems went on to an assignment in the Navy's Department of Navigation and served at the U.S. Naval Academy from 1924 to 1927.

Weems System of Navigation back to top

The complicated tables and timely calculations required for celestial navigation were effective at sea. However, the speed of airplanes presented new problems and inspired Weems' tireless pursuit to simplify navigational techniques.

The Weems System required two shots of the sun with a modified sextant, an accurate time reading from the second setting watch, and referencing of the tables in the Line of Positions book - a revolutionary method for navigation at the speed of flight.

Weems invented the Second Setting Watch - a watch that would help navigators find Greenwich Mean Time - a critical step. The final design allowed a navigator to read an accurate time directly from the watch face.



When you set a watch, you can adjust the hour and minute hands, but the second hand sweeps on irrevocably. To the layman it is not important if his watch is twenty seconds off. To the navigator, it can be a matter of life or death. So navigators, when they synchronized their watches with observatory time, used to make note of how many seconds their sweep hand was off. This factor, plus or minus, had to be figured for every calculation they made on a voyage. Weems mounted a movable rim on his watch, marked the sixty seconds on it and, since he was unable to adjust the second hand to the watch face, he simply adjusted the face to the hand.

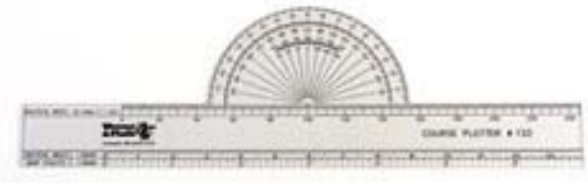
The Line of Position Book offered the navigator extensive charts of pre-calculated positions. The air navigator could simply and quickly look up the positions, instead of doing extensive complicated calculations.

Weems modified a sextant to operate independent of the horizon to facilitate navigation in the air, where the horizon is not visible. This innovation provided the foundation for the invention, more than a decade later, of the Link Bubble sextant.

Though predating modern computers, the key to the Weems System of Navigation was automation of information. Weems developed quick reference tables to eliminate the complex mathematical computations required when a navigator takes a fix on a celestial body.

Author & Inventor back to top

Spanning Four Decades: A Few Key Instruments Invented by Weems



Several tools developed by Weems, more than half of a century ago, continue to be in demand from Weems & Plath today. The most widely used is the Mark II Plotter, now identified as the Weems Course Plotter.

It is a simple tool that allows quick plotting and projection of one's position. This one tool replaced the need for a navigator to carry a separate protractor, straight edged parallel rules with indices at statute and nautical miles, and a set of dividers. The tool is successful due to its simplicity.

Books by Captain Weems

- **1928 Line of Position Book** - A short accurate method using Ogura's altitude tables and Rust's modified azimuth diagram.
- **1928 (1938) (1940) (1950) Star Altitude Curves** - A method for obtaining a fix, given only the Greenwich sidereal time and the observed altitudes of two stars. The use of the dead reckoning position, declination, right ascension, hour angle and azimuth is eliminated.
- **1931 Air Navigation**
- **1940 Instrument Flying** (With Charles Zweng)
- **1940 Simplified Celestial Navigation** (with Edwin Link)
- **1940 Marine Navigation**
- **1943 Learning to Navigate**

1962 Pilot Class in Space Navigation; final report, 1 July 1961 to 1 July 1962.

The Weems Rolling Plotter (ca 1930s) was developed by Captain Weems early in his navigation career. The revolutionary rolling mechanism and design allows a navigator to transfer parallel lines, determine headings, and measure distances with great speed and accuracy. This tool remains the single most popular Weems and Plath plotter used by navigators today.

Proportional Dividers (1953), a highly accurate speed-time-distance computer, long used by chart makers. This tool allows the navigator to quickly solve for either time, speed, or distance when two of the variables are known. This tool remains a popular item for aviation navigation today.

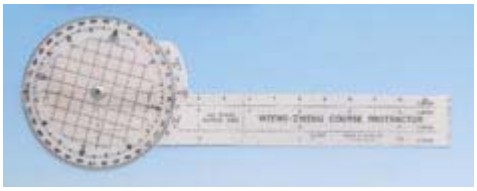
The Weems Parallel Plotter, the Nautical Slide Rule, and Dividers are the core navigation tools issued to every midshipman at the United States Naval Academy.

The **Nautical Slide Rule** quickly solves and speed-time-distance calculation and is a staple item for marine navigators today. By aligning the disks to any two known factors of an equation, the tool displays the unknown factor. Many of Captain Weems inventions were based upon this "computer" concept, such as is seen in this nautical adaptation of a slide rule - a tool common to all engineers prior to modern computers.

Weems collaborated with fellow navigator, friend, and business partner Edwin Link to develop the **A-12 Link Bubble Sextant**. Link and Weems created this pre-World War II sextant that was used by the military and airlines through the 1940s. This was the last of a line of sextants developed specifically for use in open cockpit planes. Celestial altitudes are measured by reference to an artificial bubble horizon.

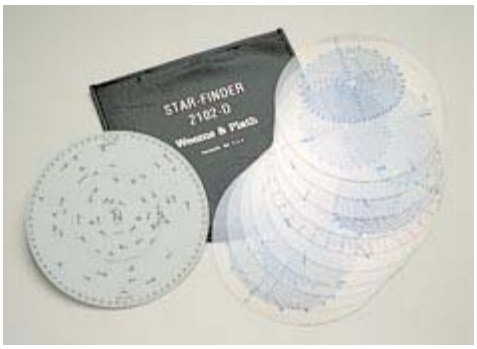
The **Weems-Zweng Course Protractor** (1957) is used to determine headings and bearings, and their reciprocal. The tool also allows for rapid measurement of distances in several common scales.

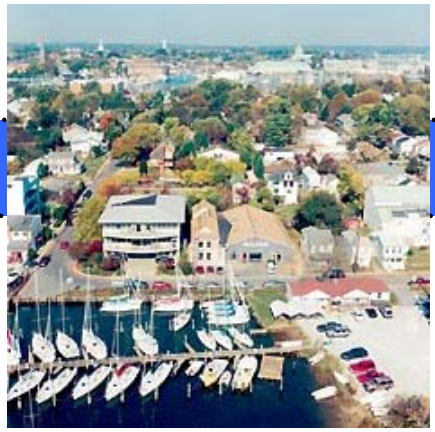
The **Star-Finder** is designed to locate and identify, by altitude and azimuth, the 57 stars listed in the Air and



Nautical almanac. The complete unit includes one star base and ten templates set for different latitudes. This item is regularly used today by the US Navy.

Link Star Globe - This portable instrument is a device that teaches the basic principles of celestial navigation and star recognition. Weems and Link collaborated to develop this instrument so that many principles of celestial navigation that are otherwise difficult to conceive are easily grasped.





A Family Company back to top

1928
Weems and his wife, Margaret, established Weems System of Navigation in 1928 in Coronado, California.

During the early years, the company sold its popular correspondence course. The firm grew with the sale of the navigation tools Weems invented.

1930's
The Weems family, along with the company headquarters, moved into the Randall House in the heart of downtown Annapolis in 1939. From there, Weems taught the latest navigation skills to some of the most famous adventurers of this day. Weems mentored and collaborated with Charles Lindbergh, Fred Noonan, former Naval Academy classmate Admiral Richard E. Byrd, and flight pioneer Douglas "Wrong-way" Corrigan.

1940's
Though Weems retired from the Navy in 1933, he was recalled to active duty in 1942 for three years to serve in World War II. The company thrived as a family business and Weems brought several colleagues into the fold including early air navigator Harold Gatty. G. Dale Dunlap joined Weems after the war and played an important role in the long-term success of the company and its offshoots.

1950's - 1980's
Weems System of Navigation was unincorporated until 1952 when Weems (with Dunlap's assistance) started Aeronautical Services Incorporated (ASI) and Weems and Plath, Inc. ASI focused on air navigation markets while Weems & Plath focused on marine navigation. The businesses operated at various locations in Annapolis, including 9 Southgate, 229 Prince George Street, Randall House, 222 Severn Avenue, and in Washington D.C. and Baltimore, MD.

1990's
Weems System of Navigation lives on today as Weems & Plath, Inc., manufacturer and distributor of marine

navigation tools, 75 years from its founding. The company now operates from its new offices in the Eastport neighborhood of Annapolis - just blocks from the Annapolis Maritime Museum.

The Adventurers back to top

Charles Lindbergh
In May 21, 1927, Charles A. Lindbergh completed the first solo non-stop transatlantic flight in history on the "Spirit of St Louis." The 3,610-mile journey between New York and Paris took a mere 33 hours and 30 minutes. This historic event not only propelled Lindbergh to the status of a world hero, but also established to the world that air travel was safe and efficient. Aircraft industry stocks, along with general interest in aviation skyrocketed.
In 1926, Weems encountered Colonel Charles Lindbergh on an airfield in California. Weems walked up to the plane and said "Colonel Lindbergh, I would like to show you my sextant and watch." Lindbergh took the sextant and looked through the eyepiece, and replied "Commander, I am very much interested in this; I would like to get together with you on it."

The conversation lasted only a few minutes and Weems thought he would not hear from Colonel Lindbergh again. But, within a year, President Calvin Coolidge's office sent Weems new orders to report to Washington immediately to work with Colonel Lindbergh for a series of instruction on navigation. Weems began training "Lindy." And they developed a mutual respect that led to Lindbergh endorsing the Weems System of Navigation.

Frederick J. Noonan
Fred Noonan was hired as a Chief Navigator for Pan Am in 1925 and developed his skills at the Weems School of Navigation. From 1925 until 1936, Noonan surveyed and charted courses for the Pan Am fleet of Flying Clipper Ships. Noonan, using the Weems System, played an important role in permanently changing the world's concept of time and space and opening up international air travel for the public.

"Wrong-Way" Corrigan
In 1938, early aviator Douglas Corrigan requested permission to emulate Lindbergh's historic trans-Atlantic flight in his own plane, but authorities denied his request claiming the plane was overweight for take-off. After secret preparations, Corrigan took off from New York claiming he was headed back to California. Twenty-three hours and 13 minutes later, Corrigan landed in Dublin. Ireland. Tongue-in-cheek, Corrigan proclaimed "I flew the wrong way. My compass got stuck."
This navigation mistake gained him the nickname "Wrong-way Corrigan,' and rewarded him with fame - from a ticker tape parade down Broadway, to a book and a movie deal.
Throughout his life, Corrigan maintained that his Atlantic flight was the result of faulty navigational techniques. But he clearly knew what he was doing. Weems had developed a navigationally responsible flight plan for Corrigan when he began his quest for flying the Atlantic in 1936.

Undersea to Space 1957-1979 back to top

SPACE NAVIGATION

Between the expected activities of a retiree, such as traveling and spending time with family, Weems continued to lead an extraordinary life. When Russia launched the Sputnik into orbit in October of 1957, Captain Weems, at the age of 68, turned his mind to the problems of navigation in outer space. It was during the orbit of the Sputnik that NASA scientists first fathomed the use of a global positioning system - a system that would revolutionize navigation in the late 20th century.

Weems patented a "Method for Space Navigation." This invention was a lightweight transparent sphere with which the space navigator would look through the sphere at earth and observe the planet as a backdrop of navigation stars.

Weems new invention was noted by the U.S. Navy and, at the age of 71, he was called back into active duty for six months on January 23, 1961 to conduct a class on Space Navigation. He was the oldest U.S. Naval Officer ever called to active duty.

Weems conducted a seminar with four "at or near genius" ensigns which resulted in the publication of Pilot Class in Space Navigation: Final Report.

SUNKEN CITY OF PORT ROYAL

Weems' map of the sunken city of Port Royal, Jamaica, was published in the February 1960 edition of National Geographic. This map was drawn by the same man who was once a young midshipman who struggled with mechanical drawing. In 1960, National Geographic presented Weems with a lifetime membership and the prestigious gold John Oliver la Gorce Medal.

He began a new adventure as a pioneer in early underwater archaeology when he joined friend and business partner, Edwin A Link, as a diver and assistant navigator on the expedition to locate Columbus's route to the New World. In 1959, he joined with the Link, National Geographic, and the Smithsonian to explore the sunken city of Port Royal Jamaica - a colonial city that sank in 1692 during a catastrophic earthquake. Though today underwater archaeology is an accepted field of historical study, Weems was on the cutting edge of historic underwater exploration.

Grand Ol Man back to top

THE GRAND OLD MAN OF NAVIGATION by ***N. W. Emmot***

If the captain of the ships in which Saint Paul was wrecked on Malta had come back to earth in 1730 he would have felt very much at home. Navigation methods would have scarcely changed in 1650 years. Had he come back half a century later, however, the art and science of navigation would have changed out of all recognition. The marine sextant, unchanged in its essentials today, was demonstrated in 1731. Just two centuries ago the Nautical Almanac was first published, giving sea captains the means, together with their sextants, of doing serious celestial navigation. By 1770 the Harrison chronometer was in use. In the first third of the 19th century the Sumner method of plotting celestial position lines was introduced. Except for minor details, marine navigation, and to a very large extent air navigation as well, remained the same from then until the Nineteen-Thirties.

The Thirties began a period of revolutionary changes in navigation. Foremost among those responsible for these improvements are Captain Philip Van Horn Weems, U.S. Navy (Retired). Weems, born in 1889 and orphaned as a child, grew up on a Tennessee farm, with his six brothers and one sister worked themselves after their widowed mother died. In 1908, after a year at a prep school, he entered the U.S. Naval Academy, where he sailed on the last cruise of the Navy's square-rigged sailing ship *Hartford*. During his student days he began his love affair with the stars which lasted the rest of his life. After he graduated in 1912, he specialized in navigation, especially celestial navigation, practicing it at sea and instructing midshipmen in Annapolis classrooms.

When Weems first used his "hambone" sextant aboard the ships of the pre-World-War-I fleet, he used the American Nautical Almanac, which still contained tables for the solution of longitude by means of lunar distances. First published in 1757, these tables allowed navigators to calculate their longitude even without an accurate chronometer, but the observations were so difficult, and the method of reducing the observations so complicated and lengthy, that Weems had never met a navigator who knew a navigator who ever made practical use of the technique.

The Nautical Almanac still tabulated the positions of the heavenly bodies using hours and minutes of Right Ascension. Celestial observations were still worked out by most navigators by solving the celestial spherical triangle by means of logarithms, the biggest improvement here during the previous century being the adoption of the Marcq St. Hilaire azimuth intercept method, coupled with improved haversine tables devised by Percy L.H. Davis. (The big advantage of haversines is that they are always positive, and obviate blunders from giving quantities the wrong signs). Solving a celestial sight, however, was a long process that required a lot of arithmetic, although with eight-knot ships nobody was in much of a hurry.

By the time Weems had been in the navigation business for ten years, however, he had begun to do a very un-expert-like thing -- he was trying to simplify matters. Ordinarily, people who become experts have a vested interest in keeping things complicated, since this makes their expertise more valuable. Weems, however, had begun to interest himself in aviation, and particularly air navigation, where the ten-fold increase in speed meant that the navigator wais always in a hurry. The old ways, hallowed by centuries of use aboard ships, were no longer fast enough for those who had to cope with the winds aloft.

By 1928 Weems was well enough known in navigation circles to take a month's leave to teach celestial navigation to Charles A. Lindbergh, who was well known as being the 105th man to fly the Atlantic, as well as the third man to fly it non-stop, and the first to fly it solo. While taking sun-sights for practice, Major Tom Lanphier, U.S. Army Air Corps, at Selfridge Field, Michigan, pointed out the weaknesses in transferring a sun-line ahead for an hour to get a running fix, as had been done for decades aboard ship. This set Weems to thinking that a fix obtained from sights on the sun and also the moon would provide an accurate fix, the difficulty being that reducing the moon observation was fearsomely complicated.

Weems turned the matter over in his mind, until one morning at 4:00 AM a partial solution occurred to him, which he forthwith suggested to the Naval Observatory superintendent. Solving sights involved adding or subtracting longitude, which is recorded in degrees, from right ascension, which was then recorded in hours (at fifteen degrees per hour). After receiving suggestions from several other navigators, Weems in 1929 came up with his "Lunar Ephemeris for Aviators," which tabulated the moon's Greenwich Hour Angle in degrees of arc against ten minute intervals of Greenwich mean time. This was an enormous simplification from the practice followed by the Nautical Almanac, and is essentially the same as that used today by the Air Almanac, and also the Nautical Almanac (though here the periods are hourly), The idea was so good that Weems extended it to stars, planets, and the sun, coming up with his "Air Almanac" in 1933.

A prophet, however, has no honor in his own country, and the Air Almanac was discontinued in 1934. In 1936 the idea was suggested to the British, who grasped it enthusiastically, and have published it every year since 1937 in a book whose cover bears a design of an Elizabethan seaman shooting the sun with a cross-staff, together with the slogan "Man Is Not Lost."

The United States began publishing the American version of the Air Almanac in 1941, and then shortly after the war the United Kingdom and the United States began publishing it jointly. Her Majesty's Stationery

Office, as a mark of respect to Capt. Weems, provided him with advance copies free of charge; the United States provides him with as many copies as he wishes to pay for. The Nautical Almanac was also re-designed to bring it into line with the streamlined methods which had worked out well in the air.

Meanwhile Weems was progressing further in his endeavor to simplify celestial navigation in the air. Working out celestial sights by logarithms was still popular at sea, but "short" methods were gaining favor. "Short" tables (which air navigators paradoxically thought were long ones) short-circuited the logarithm route by tabulating certain values (which were, indeed, often logarithms themselves) which, when added and subtracted according to a set of rules, arrived at a star azimuth to plot (i.e., the direction to look to see the star) and also a tabulated height (i.e., the altitude at which the star would appear if the navigation were actually located at the navigator's assumed position). Almost always these tables relied on the principle that splitting any spherical triangle into two right-angle triangles by dropping a perpendicular from the apex to one side would make the solution easier. The calculations and table-searches for "short" tables were easier than they were when using logarithms, but they were still rather lengthy and vulnerable to error, especially when the navigator was in a hurry, which he usually was aboard an aircraft. There were a myriad of short methods, including Ageton's, Ogura's, Dreisonstok's, Smart and Shearme, and Comrie's tables, to name only a few.

The big advantage of short methods was that they were usually contained in a small book. Their chief competitor was the pre-computed table, which did all the computational work beforehand and then tabulated the actual altitude and azimuth for any combination of even degrees of latitude and hour-angle, combined with the declination of the body being observed. Examples of these tables were the British Air Navigation Tables and HO 218, first used during the Second World War, HO 214 widely used for surface navigation, and HO 249, the simplified and improved version published since the early 50's. These tables were convenient and faster than the short methods, but they required a large number of books.

Weems pondered the matter at length and came up with a method which depended on the fact that circles of equal altitude (really the position-circles which the navigator wishes to plot) ring the sub-stellar point of each star (the point on the earth's surface immediately beneath the star) like the circular ripples around a stone dropped in the water. This family of circles travels around the world at the same speed as the rotation of the earth. The longitude of any portion of this set of concentric circles depends on the hour-angle of the star (i.e., the difference in longitude between the sub-stellar point of the star and the aircraft). Weems, with immense labor, selected a number of pairs of stars whose families of circles intersected at convenient angles (i.e., gave a good "cut") and plotted them for given bands of latitude and hour-angle. The navigator had only to pick the right page for his latitude and longitude, observe the two stars plus Polaris for a latitude-line, change his Greenwich Mean Time to hour-angle, and enter the star-altitude tables like a graph to obtain his fix.

Weems, who had retired in 1933 with the rank of Commander, published the famous Star-Altitude Curves, sinking most of his personal funds into the enterprise. The Navy, however, was not too interested. The U.S. Army Corps on the other hand was, and gave him a small contract for his tables. Before the war was over he had received, as the President of Weems System of Navigation, a contract for a million dollar's worth -- for which he gave a discount of 80%.

Weems' interest in Star Altitude Curves did not stop him from retaining a concern for the more traditional methods. While he was an instructor at the U.S. Naval Academy, he was explaining the use of tables to determine the azimuth of a heavenly body to a class of students. One of the students, a Lieutenant Ageton, contended that if a set of tables could be used to compute azimuth, which it did by solving the celestial triangle, it could be used to solve for altitude as well. Nobody had thought of this before. Weems encouraged the young officer, and before long Ageton's tables (HO 211) were in use as possibly the most compact set of "short" tables in existence. Getting the new concept into print, however, was a harrowing experience; from several authorities, Weems and Ageton received nothing but obstruction, on the ground that the old ways were perfectly good enough.

Weems was recalled after the outbreak of the war, as a Convoy Commodore (the senior naval officer with a convoy, one of whose main tasks is to keep the merchant ships from bumping into each other). In the interim, however, he had not been idle. He had published his epoch making book, *Air Navigation* and came up with the device which is associated most closely with his name -- the Weems Plotter. This combination protractor, straightedge and parallel rule has appeared in dozens of sizes, guises and modifications, and was the standard plotter for the U.S. Air Force.

Another of Weems' inventions was the second-setting watch. At sea, celestial sights had to be taken with the aid of a hack watch which was set to the ship's chronometer. It was difficult, however, to set the watch exactly, which meant that it differed slightly from the chronometer, which in turn differed from Greenwich Mean Time. Weems reasoned that the difficulty in setting the watch came from the fact that at the time it was almost impossible to set the second hand exactly. However, if the second hand could not be set to match the dial perfectly, it might be possible to make the dial movable, so that the dial and the second hand were synchronized at the right time. The fact that Weems' father-in-law was a patent attorney helped him considerably in getting the idea patented, but patent it he did and he had dozens of claims based on the second -setting watch patent.

Weems was also the author of the *Line of Position Book* which was originally published by the United States Naval Institute, plus some fifteen other books on the various aspects of navigation. He, and his company, pioneered and developed a variety of devices, including a complete celestial navigation system, a sunset-sunrise computer, the celestial coordinator invented by Wyatt, and a method of using altitudes between two stars, without a visible horizon, developed by an Australian named Burton, and Precomp Navigation, which was a super short tabular method.

Weems continued working on sea and air navigation, but space navigation had not escaped his attention. In 1961, at the age of 72, he was recalled to service to work with four clever ensigns to develop a system of space navigation. This indeed they did, using Weems' constant companion of half a century, a sextant. During this effort, Weems and his colleagues picked up another four or five patents.

During his career Weems met most of the great and near-great of navigation and aviation. One of them was Orville Wright. In his files, also, he has a copy of an invoice for $10.00, sent to Wrong-Way Corrigan. Corrigan always insisted that he flew the Atlantic from New York to Ireland back in 1938 in a light plane strictly by mistake, since he planned to fly to Los Angeles and misread his compass. However, the invoice records that the information and charts he wanted from Weems were all about the North Atlantic. Possibly he studied the wrong area by mistake, also.

Weems flew to the North Pole, when it was far from the routine matter it is today, in 1948, and flew around the world in 1950, both times keeping detailed and accurate logs and charts and being intimately concerned with the navigation. He also navigated a light plane, flown by his son, the late Cdr. George T. Weems, USN, from London to Alice Springs in Central Australia. In the early Thirties Admiral Richard Byrd invited him to accompany him to the South Pole, and Weems was sorely tempted to go, but he was about to establish his own business, and the two years he would have had to spend in the Antarctic would have set him back seriously. Regretfully he declined.

Weems retired again at the end of the Second World War, but kept as busy as ever. One of his achievements, in his spare time, was to join with two friends of his, likewise interested in navigation, to establish the U.S. Institute of Navigation in 1945. Because of Weems' reputation and knowledge, Col. Charles Blair sought him out, as Lindbergh had done earlier, for instruction in celestial navigation when Blair planned to fly over the North Pole, from Norway to Point Barrow in his modified P-51 Mustang single-seat fighter in 1951. Weems settled on a totally pre-computed solution for Blair, which involved plotting his flight in advance, and working out the altitude of the sun for a number of points along the path. These sun-altitudes were then joined to form a graph. In flight, all Blair had to do was to take a sight and compare his observation with the predicted altitude from the graph. The difference between the two values indicated how for he was off track or off schedule. Weems and Blair carried out the computations four times, in case Blair had to delay his take-off by a day and also to allow for having to delay the hour of take-off from noon to one o'clock. Everything worked as planned, with Blair not having to lay pencil to paper after he passed Spitzbergen on the Norwegian side of the pole. He made his landfall at Point Barrow one minute ahead of his ETA.

Weems, however, overheard Blair saying, *"It was nothing"*, to an engineer when queried about his navigation. *"Don't say **that!**"* said Weems. *"That kind of navigation is still fairly complicated, and if you tell people there's nothing to it, they'll try to fly over the pole in ignorance of all the ins and outs of celestial, and kill themselves!"* Blair agreed, and toned down his navigational modesty.

Weems lived in Randall House, a historic 30 room building, built in 1717 and bought by him in 1939. Its position is 38 degrees 58.8 minutes North latitude, 76 degrees 29.4 minutes West longitude. Weems had to know this, since he was constantly trying out new techniques which involved observing the sun and the stars

from his front porch with a marine sextant or a bubble sextant. Visitors who were interested in the art were always invited to take a few sights, which Weems carefully entered into the log he kept for many years. Weems affection for his house was not diminished by the fact that it layed exactly eight-tenths of a minute of longitude West of the Maine Mast at the U.S. Naval Academy, from which he graduated 57 years ago.

Weems had several other distinctions besides his achievements in aviation. He was on the Olympic wrestling team in Antwerp in 1920, he was an All-American center with the Navy football team, he won the South Atlantic amateur light-heavyweight wrestling championship in 1925 when he was 30, he was a proficient skin-diver and in 1959 he joined an expedition to explore Port Royal in Jamaica, where the pirates of the Spanish Main had their capital two centuries ago.

In December 1968 Weems was presented with the gold John Oliver la Gorce Medal by the National Geographic Society, in token of his life's work in air, sea and space navigation, rather than in appreciation of any specific achievement. Quite a different acknowledgment of Weems' contribution to navigation was paid by Ben Carlin, the author of the book Half- Safe who says:

"Of all the professions, trades that are shrouded by their professional practitioners in an aura of self-protective bull, celestial navigation just about takes the cake.

'Well it is rather complex, old man - you wouldn't understand - y'really need forty years at sea for this sort of thing.' Thanks largely to air navigators, the Hydrographic Office of the U.S. Navy, and Commander Weems, this primeval veil has been ripped away in recent years. It's not a matter of mathematical proficiency - I can't count to twenty with my shoes on; the fantastic ease with which, given a modicum of elementary understanding, the correct time, an almanac, a book of tables, a sextant and a patch of clear sky, one can determine position within a mile or so anywhere on the earth's surface, never fails to fascinate me. Let no one interested flinch from tackling it - but on the right lines. No, I have never met Commander Weems or corresponded with him in any way."

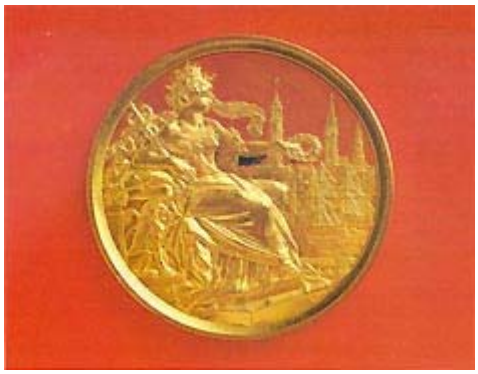
His life, however, has not to be unmarred by tragedy. Both his sons met untimely deaths, Major Philip Van Horn Jr. being killed in the Southwest Pacific in 1943, and Lt. Cmdr. George Thrackray (Weems always referred to him as "Bee") being killed at 30 in 1951 testing an aircraft. Weems and his wife Margaret had a married daughter, Margaret Dodds, who had three children.

Other people may be impressed by Weems' accomplishments, but Weems himself was not. He was at all times completely approachable, polite and pleasant. Letters to him were always answered promptly, and sometimes in his own handwriting. Those who met him always found him a thorough gentleman. Captain Weems died June 2, 1979 at the age of ninety and will always be remembered as one of the great navigators of the Twentieth Century. In memory and in honor of Weems' significant contributions to navigation, The Institute of Navigation created an award given annually to an outstanding individual "For Continuing Contributions to the Art and Science of Navigation."

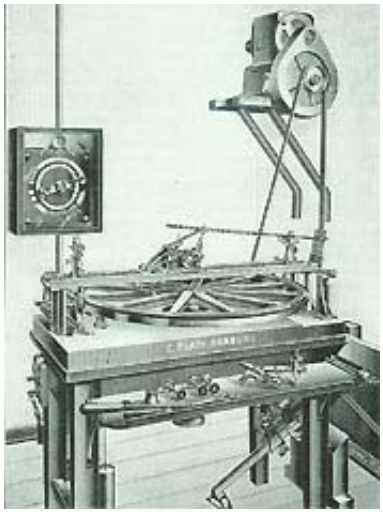
Article written by Norman Emmott and Joseph Portney from the "Litton Avionics Newsletter," Volume One, Number Two, © January 1970 as reprinted at www.navworld.com.

Learn More about Carl Plath back to top

In 1862 Carl Christian Plath purchased a small established German navigation instrument store founded by David Filby, a professional precision instrument maker, 25 years earlier. This company checked and certified sextants, barometers and compasses aboard ships in North Germany and also hand-built these instruments one by one. Plath broadened the base of the former Filby business. In 1865 Plath purchased a circular dividing machine for engraving the graduations on the arcs of the sextants he was producing. Soon Plath was manufacturing a broad line of nautical instruments, including compasses of all sorts, his newly patented lightweight compass card, patent logs, sextants and octants. In 1889, at the Hamburg Crafts and Industry Exhibition, Plath received high praise and a Gold Medal for excellent precision work and the best made instruments in Hamburg.



In 1899, Carl Plath's son, Theodor, became a partner in the family business. At this time, it was no longer efficient to produce sextants with the old circular dividing machine which Carl had purchased in 1865. Theodor was instrumental in developing a new electrically operated dividing machine which saved hours of manual labor and improved the accuracy of the sextants that were produced. The world renowned C-Plath sextants were manufactured on this machine until World War II.



Together, Carl and Theodor, showed and demonstrated their precision instruments at the Paris World Exhibition in the German Shipping Pavilion in 1900. The exhibition jury presented C-Plath a silver medal, conferring upon them, "the highest distinction for nautical instruments in commercial shipping." This achievement cemented the exceptional reputation of C-Plath products throughout the world.

The early 1900's was a period of experimentation in aviation, and C-Plath was approached by pioneers in this field to develop a compass with a rotatable ring marked in degrees from 1 to 360 that would determine drift and the necessary correction angle . This new easy-to-read compass was the forerunner of the grid compass C-Plath manufactures today.

In 1930, Theodor's son in law, Johannes Boysen, began an apprenticeship to take over the leadership role of C-Plath. Boysen took the company from a specialty craft house to a full-fledged industry, taking the company from 34 employees to 400.

The company, miraculously survived World War I, the World Economic Crisis (the Great Depression in the USA), and even WWII at which time C-Plath provided state-of-the art gyrocompasses and navigation instruments to the III Reich. At the end of WWII, the company almost disappeared when the Allied Forces dismantled the factory due to the prohibition of shipbuilding in Germany. Also, Boysen, the company president, was required to serve a two year prison sentence because he provided equipment to the German military during the war. At this time, the factory was relegated to manufacturing typewriters, spray guns and the works for station clocks of the Hamburg rapid transit system. But with the relaxing of the shipbuilding prohibition in 1949, C-Plath gradually returned to its roots and began manufacturing marine instruments again. By 1953, Boysen had worked out a relationship with Captain Weems to sell C-Plath sextants and compasses in the USA, hence the name Weems & Plath.

C-Plath was operated as a family business for three generations. In 1961, the 100 year reign of a German family-owned business ended when Boysen sold the business to Litton Industries in California. The constant financial need for technological advances in the ever developing marine industry was too much of a strain on the family-owned operation. C-Plath continued to design and improve navigation instruments for commercial use.

In 1972, the company began to standardize module sizes and developed the new spherical Merkur and Venus compasses that Weems & Plath still distributes today. They also developed a more up-to-date sextant, the Navistar Professional, which had fewer than half of the 150 parts of the Classic sextant. Weems & Plath continued to distribute C-Plath sextants until the year 2000 when the market for sextants had diminished so much that the company decided to stop production of these world-renowned instruments. Still today after more than 165 years in business, C-Plath is in Hamburg manufacturing the world's finest magnetic compasses and other marine electronic navigation instruments.