The Sargasso Sea

Author(s): John H. Ryther
Source: *Scientific American*, Vol. 194, No. 1 (January 1956), pp. 98-108
Published by: Scientific American, a division of Nature America, Inc.
Stable URL: https://www.jstor.org/stable/10.2307/24943833

The Sargasso Sea

It is commonly supposed that this area of the Atlantic is so thick with seaweed that ships cannot penetrate it. Although it is indeed strewn with floating Sargassum, it is actually a biological desert

by John H. Ryther

For more than four centuries the Sargasso Sea has been wrapped in a legend which has frightened mariners and still fascinates armchair travelers. The seaweed to which the sea owes its name has always given it an aura of uniqueness and mystery. Early voyagers in it pictured the sea as a vast, impenetrable mass of floating vegetation in which hapless ships might become imprisoned with no hope of ever escaping. The legend still lives. As recently as 1952 Alain Bombard, the French physician who crossed the Atlantic alone in a life raft, carefully plotted his course to avoid the Sargasso Sea, because, as he said: "The whole area has always been a major navigational hazard, a terrible trap, where plant filaments and seaweed grip vessels in an unbreakable net."

Ship captains who regularly cruise to Bermuda, which lies in the middle of this sea, must smile at such accounts. Yet the Sargasso Sea remains an intensely interesting body of water, in many ways more interesting than the romantic but mistaken legends about it. Generations of scientists have sailed forth to study it, and the Sea has rewarded them with many unexpected discoveries. Most unexpected of all is the paradox that the Sargasso's masses of seaweed hide a biological wasteland. Contrary to what the floating vegetation might suggest, the Sargasso Sea is not a jungle teeming with life but one of the great oceanic deserts of the earth.

Christopher Columbus noticed the unusual plant life of these western waters on his first voyage across the Atlantic in 1492. He began to encounter floating seaweed not far west of the Azores, and by the time he reached mid-ocean there was "such an abundance of weeds that the ocean seemed to be covered with them." When the ship was becalmed for three days, his men grew alarmed, for they feared that the masses of vegetation covered coastal waters with submerged rocks and reefs—little realizing that the ocean bottom lay nearly three miles below them.

Columbus described the weeds in some detail in his log, and later explorers brought back further tales of these strange waters. Portuguese sailors gave the sea its name: air bladders on the floating seaweed reminded them of small grapes at home which they knew as "salgazo." Through the centuries the legend grew, as ship captains traveling between the Old World and the New reported encounters with the greatest accumulations of weeds they had ever seen. The legend became so firmly established that in 1897 the Sargasso Sea was described by the *Chambers' Journal for Popular Literature, Science and Arts* in these terms: "It seems doubtful whether a sailing vessel would be able to cut her way into the thick network of weeds even with a strong wind behind her. With regard to a steamer, no prudent skipper is ever likely to make the attempt, for it certainly will not be long before the tangling weeds would altogether choke up his screw and render it useless."

When William Beebe sailed on the much-heralded expedition of the *Arcturus* in 1925, the reading public was keyed up by lurid predictions of sea monsters that would be found in the great weed beds of the Sargasso. The expedition was an unbelievable disappointment. Not only was there a total absence of sea monsters, but in all the area of the Sargasso Sea over which he voyaged Beebe could find no patches of seaweed larger than a man's head!

Beebe was unlucky. The Sargasso Sea is rarely as barren as he found it along his route. Nonetheless scientists have known for a century that its reputation is greatly exaggerated. It is doubtful that the Sargasso's weed masses are ever dense enough to impede the progress of even the smallest vessel. And indeed the floating *Sargassum*, though intriguing enough in its own right, is no more than a surface outcrop of a great oceanic phenomenon.

What exactly is the Sargasso Sea? The scientific study of this huge sea without shores began with attempts to define its borders by charting the extent of the seaweed. In 1881 the German scientist O. Krümmel analyzed the reports of German sea captains, who for many years had been required to record their observations of drifting weeds in the Atlantic. He concluded that the Sargasso Sea covered an area of some 1,720,000 square miles—an area elliptical in shape and extending from the mid-Atlantic to near the North American coast.

In 1923 a Danish botanist, O. Winge, made a second attempt at the same problem. He had the advantage of information on regular collections of seaweed made with net tows by Danish ships plying the Atlantic, which gave more systematic data than the estimates of the German sea captains. Winge decided that the Sargasso Sea was considerably bigger than Krümmel had pictured it. He placed its eastern boundary near the Azores (at exactly the point where Columbus had located the first weed masses) and its southern boundary somewhere near the West Indies. The western and northern borders of the weed area, he found, shifted considerably from season to season; this he attributed to changing weather conditions.

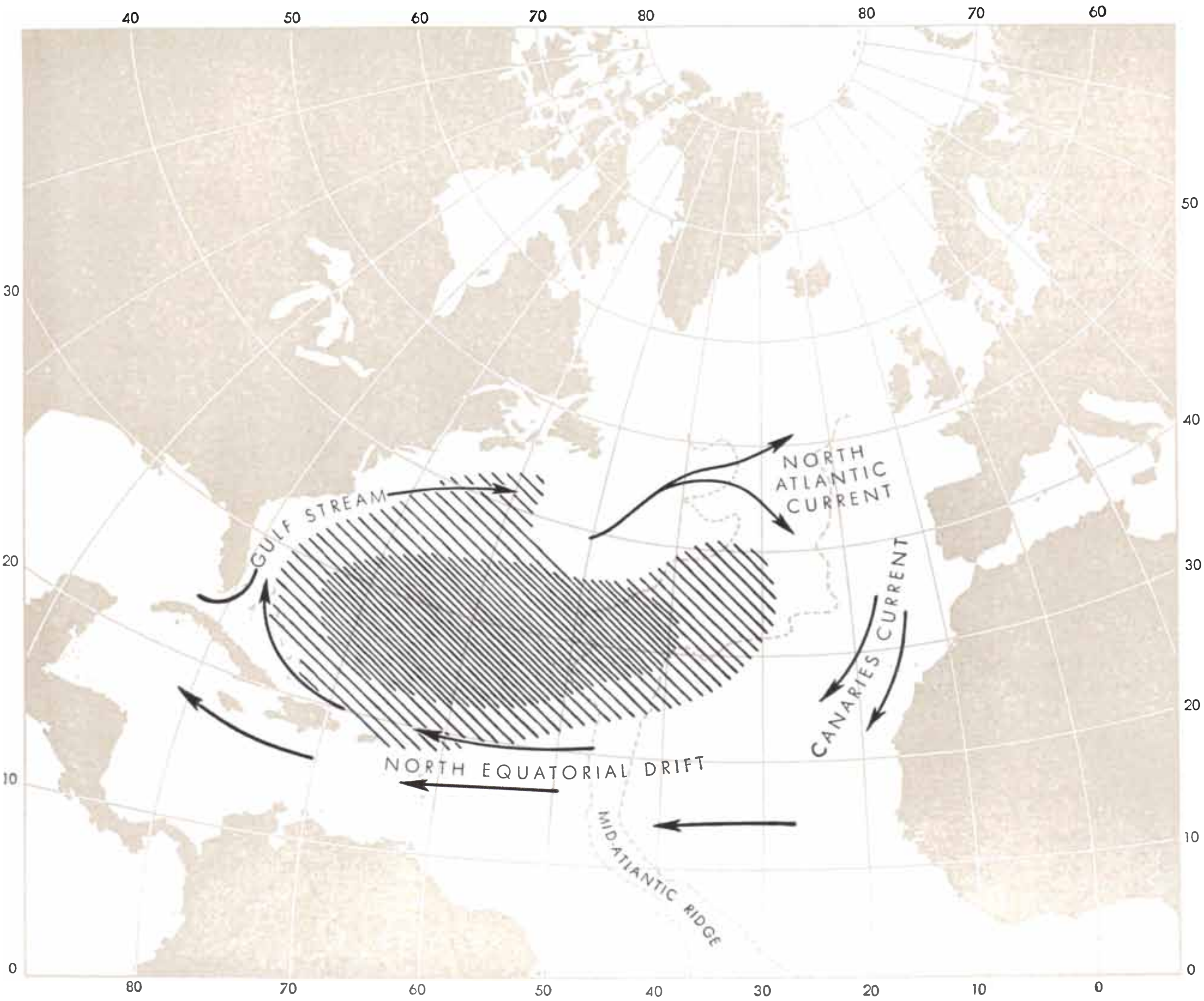
In the 1930s and 1940s oceanographers made an altogether different approach to defining the Sargasso Sea. Columbus O'Donnell Iselin, then director of the Woods Hole Oceanographic Institution, pointed out that the circular system of currents in the North Atlantic Ocean would outline the boundaries of the Sargasso Sea more definitely than drifting seaweed could. These currents are the Gulf Stream and North Atlantic Current on the western and northern sides, the Canaries Current on the eastern side, and on the south the slow movement of water parallel to the equator which is known as the North Equatorial Drift. This ring of currents encloses a great eddy, some two million square miles in area, which rotates slowly clockwise under the influence of the earth's rotation. Detailed studies have now made clear that this eddy of surface water is the Sargasso Sea.

Because of variations in the currents, the borders of the Sea are not constant or sharply defined. The Gulf Stream shifts and meanders, hence it is small wonder that Winge found the weed boundaries shifting in this region. On the south the equatorial drift also changes position from season to season. And on the east the Canaries Current is so weak and diffuse that it can barely be detected, much less provide a barrier to the movement of water or seaweed.

We must therefore look below the surface to get a clearer picture of the Sargasso Sea. When we do, we find that temperature measurements mark out a distinct, clearly defined body of water. The Sargasso Sea is a huge lens of warm water, separated from the colder layers below by a zone of sharply changing temperature.

It is lens-shaped because the rotation of the eddy piles up water at the center (where the sea surface is about two feet higher than at the outer edges). At its deepest the layer that defines the Sargasso Sea goes down no more than about 3,000 feet. In other words, the Sea proper is a shallow body of fairly homogeneous water lying upon an ocean whose total depth is roughly five times as great as this layer. Tracing the borders of the lens by temperature measurements, oceanographers find it is bounded on the west and north by the Gulf Stream and North Atlantic Current, on the south by the equatorial drift and on the east roughly by a line which runs along the submerged mountain ridge in the middle Atlantic. The Sargasso's seaweed drifts almost 1,000 miles farther east, but from a hydrographic point of view the lens of water that defines the Sea ends here.

What makes the Sea's weeds collect in masses? Most commonly they lie in long parallel bands, sometimes stretching as far as the eye can see. Some of these formations undoubtedly are due to the major current systems, piling



CIRCULAR SYSTEM of currents in the North Atlantic outline the Sargasso Sea. The darker shading represents the Sea as charted by O. Krümmel on the distribution of *Sargassum*. The lighter shading indicates a similar attempt made by the botanist O. Winge.

bands of weeds along the lines where water masses of different densities converge. But winds also can produce them. Winge reasoned that such bands might grow by accumulation as weeds sailed before the wind, picking up more and more weeds in their wake. However, the physicist Irving Langmuir, on a voyage across the Atlantic in 1927, noticed that when the wind veered about at right angles to its former direction, the seaweed bands re-formed in the new direction within 20 minutes. Since mere cohesion could not explain this rapid reorientation of weed streamers, Langmuir suggested that shifts in the flow of water, rather than the wind itself, must be responsible for the formation of the bands. He later demonstrated experimentally that the action of wind over open fetches of water produces counter-rotating eddies, and that between such eddies there are bands of sinking water where floating weeds would collect.

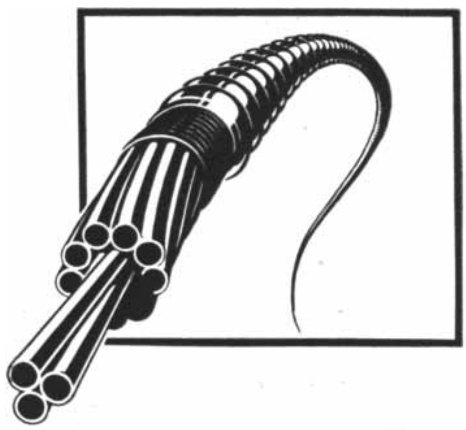
The Sargasso weeds themselves raise many interesting questions. The most intensive study of them was carried out between 1932 and 1935 by Albert E. Parr, then director of the Bingham

SARGASSUM FLUITANS, one of perhaps eight species of the weed, was collected in the Sargasso Sea by Albert E. Parr, then at the Bingham Oceanographic Laboratory at Yale University and now director of the American Museum of Natural History.

BUSINESS IN MOTION

To our Colleagues in American Business . . .

Copper tube is used for hot and cold water lines, radiant panel heating, drainage lines, and to carry fuel or lubricants in automobiles and machine tools. Those are some of the conventional applications. However, during the last few years a new market has developed for this tube. You might like to hear about it. It is in pneumatic or hydraulic recording and control systems. One end of the tube is located at the point where temperature or pressure must be observed, and the other end is connected with a dial, a recording device, or an automatic controller. The tube may be filled with air, an inert gas such as nitrogen, or a fluid. The tube has the great advantage that it carries no electricity, and thus can be installed in places where a spark might cause an explosion, as in a plant handling combustible gases or chemicals.



Originally the idea of using copper tube for this purpose was carried out by running separate lengths of bare tube from the originating points to the panel board. This meant considerable care in installation, and it was also necessary to run the tube where it would not be subject to mechanical damage, or to protect it otherwise. Then a new development appeared: cabled tube. A way was found to put as many as 19 quarter-inch copper tubes in a single armored cable, so that instead of rigging 19 separate runs of tube, just one cable is run, the tubes being fanned out at each end as required. Installation time is cut markedly, and the armor provides self-protection. Cable runs as long as 1,000 feet are possible without joints. The tubes are color-coded.

Just to give you an idea of the usefulness of tubes in cables, here are a few of the applications in the plant of just one public utility: boiler temperatures, main and reheat steam pressure, boiler feed and condensate pump pressure, condensate temperature, fuel oil and gas pressures, liquid levels, tide level, boiler drum water level, control of fuel feed, draft dampers, and numerous other controls.

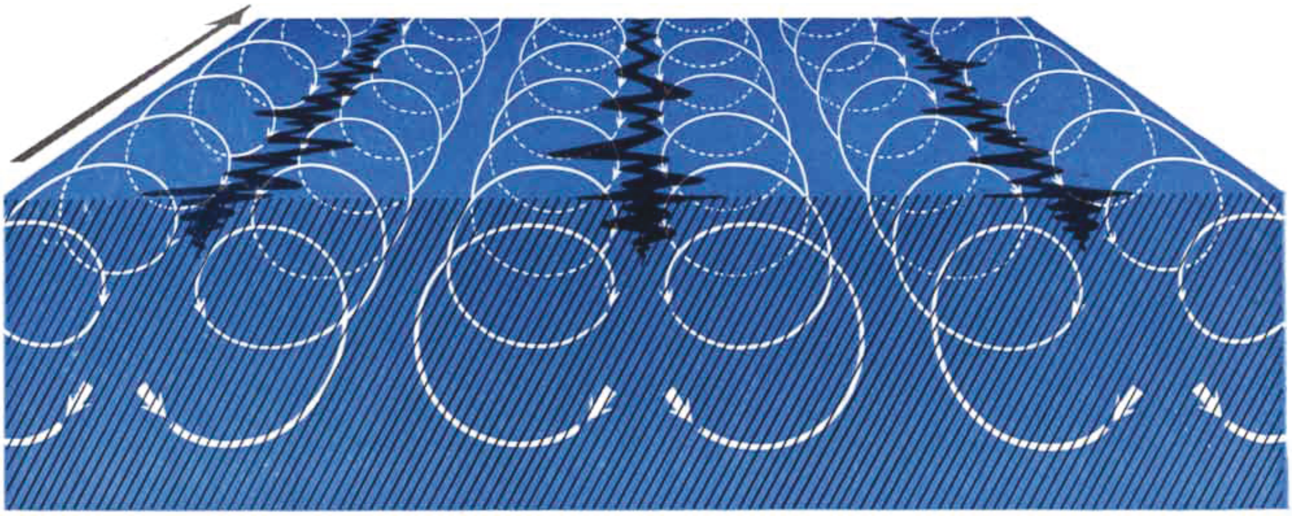
This is a fast-growing use for copper tube, and while it will not match the demand for tube in commercial structures and private homes, nevertheless it is an important subject for industry and instrumentation engineers. In fact, a couple of years ago we thought that cabled tube had enough news interest to justify running an advertisement about it. Revere does not make cabled tube, but a Revere customer does, so we reported the matter as a service to industry. Mail began to arrive immediately, asking for further information. It is still pouring in, as the result of a second advertisement on the subject, appearing less than a year ago. American business certainly watches the advertisements for news it can use.

This is an example of imagination applied to a product that literally is as old as the pyramids. We have said in the past that "copper is the metal of invention," because it is so adaptable to man's genius. But there are many other materials, not merely metals, but such substances as glass, wood, plastics, fabrics and fibres, that also respond to an inspired touch. Why not get in touch with your suppliers, and let them know your problems? Perhaps they can arrive at a new way to use an old product, or even develop something new to solve an old problem. Just let it be known what you need, and watch people respond!

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Avenue, New York 17, N. Y.

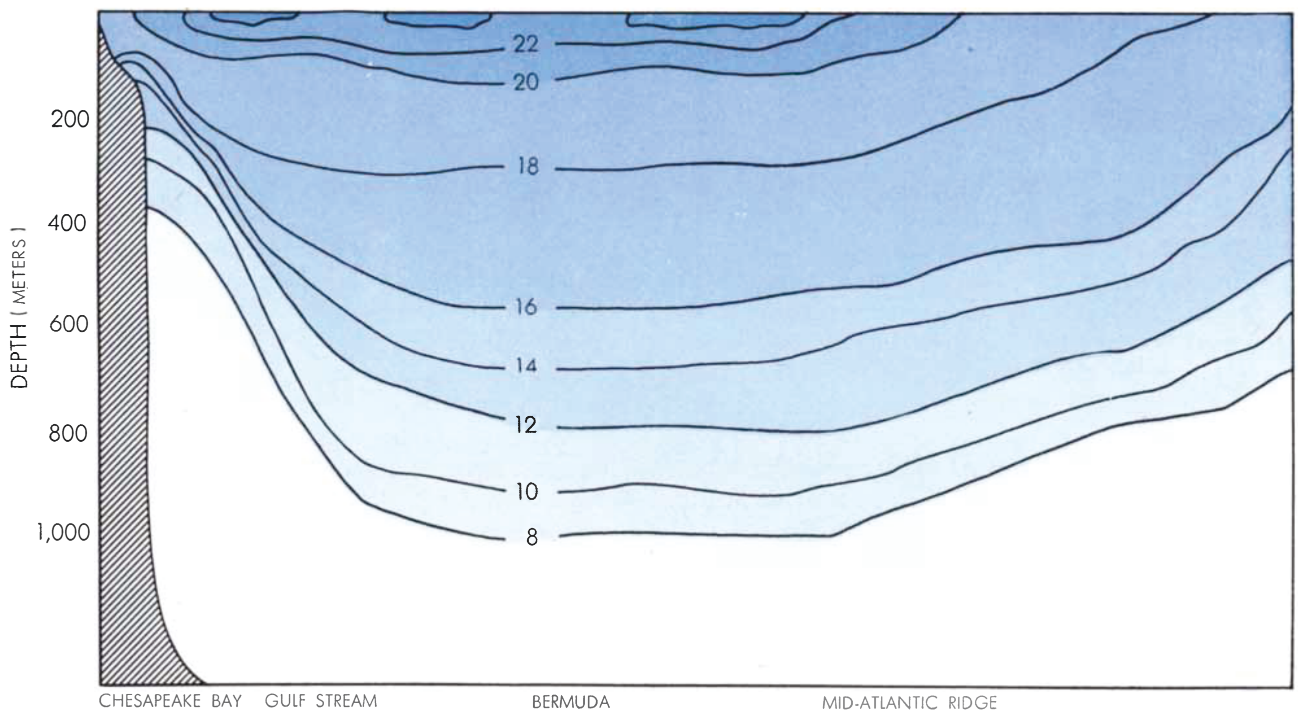


LANES OF SARGASSUM (*dark gray bands*) are believed to form as shown in this diagram. The drag of the wind (*arrow at upper left*) on the surface of the water sets up counter-rotating horizontal eddies (*white arrows*). The weed collects where the water sinks.

Oceanographic Laboratory at Yale University. In three cruises on the Woods Hole research ship *Atlantis*, covering 7,000 miles, he collected nearly 5,000 pounds of drifting Sargassum. More than 90 per cent of the weeds by bulk were of two floating species which are never found attached to the ocean bottom and lack organs for sexual reproduction. The question therefore arises: Where do the weeds come from, and how do they grow and reproduce?

Columbus theorized that the drifting weeds were torn loose from great submerged beds of plants near the Azores, and his theory was later shared by Alexander von Humboldt and other naturalists. But no such beds have ever been found, either near the Azores or Bermuda. Some botanists consequently have proposed that the weeds come from banks in the West Indies or the Gulf of Mexico. This theory too has been proved unlikely. From his sampling of the Sargasso Sea, Parr estimated that the Sea has an average standing crop of some seven million tons of weeds. No more than a small fraction of this crop could be supplied by all the available sites for beds along the entire Caribbean and Atlantic Coasts, even assuming that such beds exist. Moreover, it would probably take several years for weeds torn loose from the West Indies to drift far enough to span the whole Sargasso Sea, and weeds uprooted from their beds could not live more than a few months.

The floating Sargassum gives every evidence of growing, reproducing and



TEMPERATURE of the Atlantic is analyzed in this cross section along a line running due east from Chesapeake Bay. The contours, in degrees centigrade, indicate that the Sargasso Sea is a lens-shaped body of warm water. The vertical dimension is greatly exaggerated.

Hughes-equipped T-29 "flying laboratory" for systems evaluation.

Flight evaluation of advanced interceptor electronic system uses unique approach.

T-29 "INTERCEPTOR"

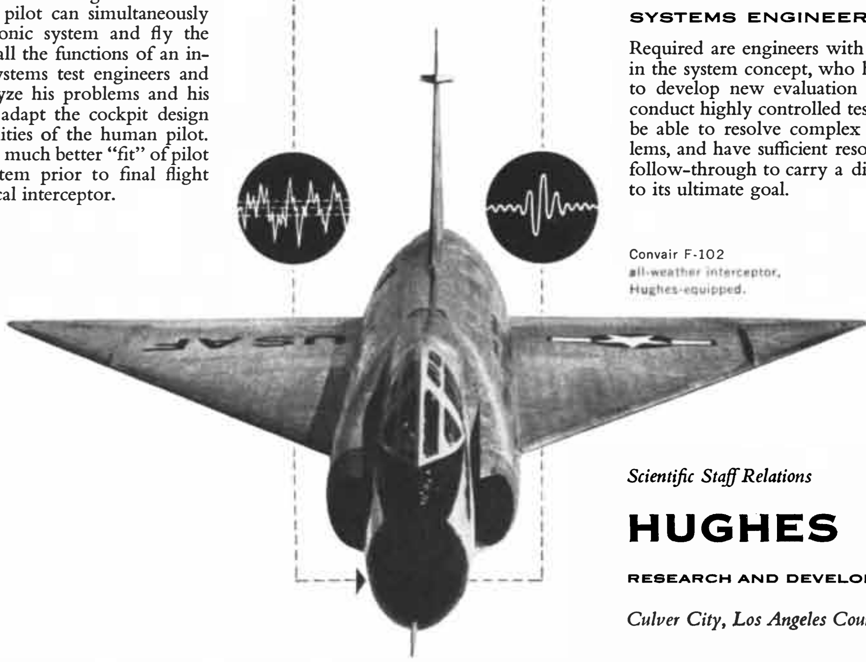
THE DEVELOPMENT OF AIRBORNE ELECTRONIC SYSTEMS REQUIRES THOROUGH FLIGHT EVALUATION OF BREADBOARD AND PROTOTYPE EQUIPMENT PRIOR TO FINAL DESIGN. AT HUGHES, SYSTEMS FOR INTERCEPTORS ARE FIRST TESTED IN "FLYING LABORATORIES" IN WHICH THE EQUIPMENT IS READILY ACCESSIBLE TO SYSTEMS TEST ENGINEERS.

One interesting problem recently confronting Hughes engineers was that of evaluating the requirements imposed upon the pilot of a high-speed one-man interceptor. This arose in the development of a new integrated electronic system to control several phases of an all-weather interceptor's flight. Because of the great importance of providing the pilot with the optimum design and arrangement of displays and controls, it became necessary to determine accurately the pilot's work load during flight, and the human factors that affect his ability to carry out his task.

The solution was to install a complete mock-up of the actual interceptor cockpit in a large T-29 aircraft in which a breadboard model of the system was being tested. From this cockpit a test pilot can simultaneously operate the electronic system and fly the T-29, performing all the functions of an interceptor pilot. Systems test engineers and psychologists analyze his problems and his performance, and adapt the cockpit design to the natural abilities of the human pilot. The result will be a much better "fit" of pilot and electronic system prior to final flight testing in the tactical interceptor.

SYSTEMS ENGINEERS

Required are engineers with a basic interest in the system concept, who have the ability to develop new evaluation techniques and conduct highly controlled tests. They should be able to resolve complex circuitry problems, and have sufficient resourcefulness and follow-through to carry a difficult program to its ultimate goal.



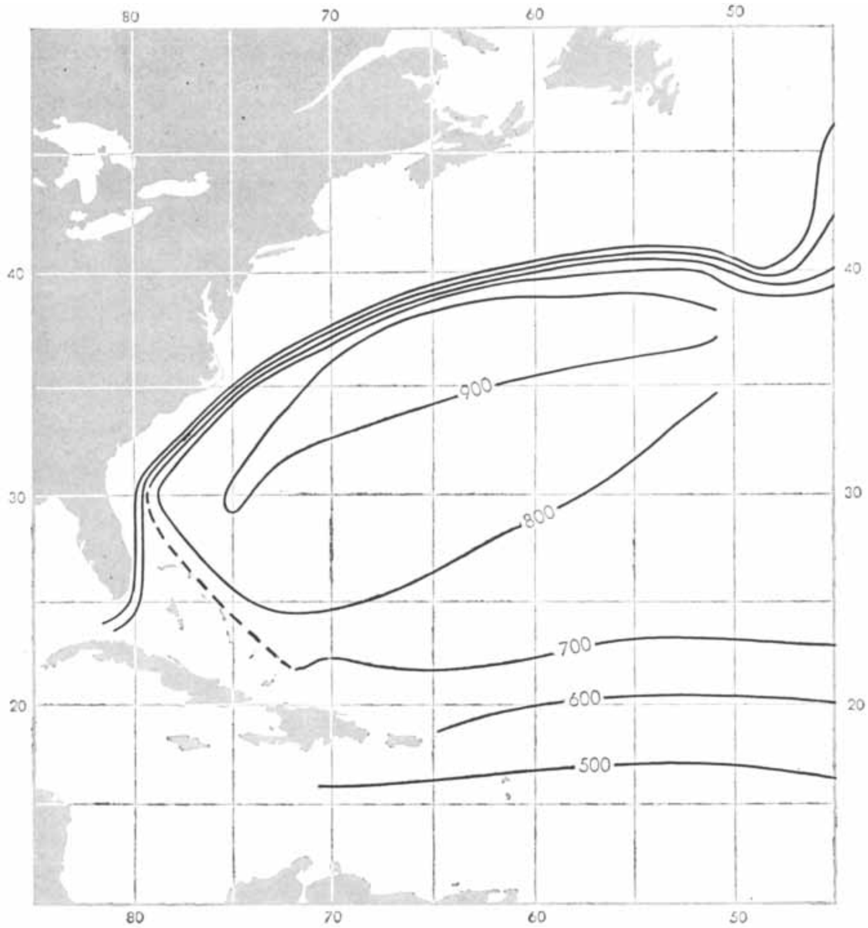
Convair F-102 all-weather interceptor, Hughes-equipped.

Scientific Staff Relations

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

Culver City, Los Angeles County, California



PLAN VIEW of the same Atlantic temperature structure again outlines the Sargasso Sea. Here the contours represent the depth in meters at which 10 degrees C. is encountered.

living an independent life in the Sea where it is found. It has a healthy color and shows new leaves and vigorous young shoots. For this reason and because of the absence of sexual fruiting bodies in the prevailing species, many oceanographers now favor the theory that the great bulk of the seaweed in the Sargasso Sea is native to the Sea itself. Its forebears may originally have come from beds on the bottom, but it has now evolved the ability to live a free, floating existence on the surface of the Sea. It can reproduce vegetatively—that is to say, by putting forth shoots which eventually break off as new plants.

Seaweed is not the only plant life in the Sargasso Sea. Like other seas it contains a subsurface floating population of the microscopic plants known as plankton. This material bulks much larger than the seaweed: estimates of the plankton production in the Sargasso range from 10 million to 100 million tons per day. Such a figure may seem huge, but it is small when one considers the vastness of the Sargasso. It amounts to something of the order of five hundredths of a gram of organic carbon per day for each square yard of the Sea's surface.

The Danish botanist Einer Steemann Nielsen, during a recent cruise of the research ship *Galathea*, made sample measurements of the plankton production in all the major oceans of the world. He found that the Sargasso Sea had the poorest production rate of all—only about one third of the average.

Here is the odd paradox. In spite of its show of life on the surface, the Sargasso Sea is in reality the most barren of waters. Alain Bombard was not far wrong when he wrote of the Sargasso as "a great dead expanse." The best evidence of its low biological content is the extreme clarity of its dark-blue waters.

There is a possibility that below the top 100 feet these clear waters, where sunlight can penetrate for an unusual distance, may contain more plant life than appears near the surface. But even allowing for this possibility, there can be no doubt that volume for volume the Sargasso Sea is the clearest, purest and biologically poorest ocean water ever studied.

C-123 TURBOJET COMBINATION PROVES OUTSTANDING

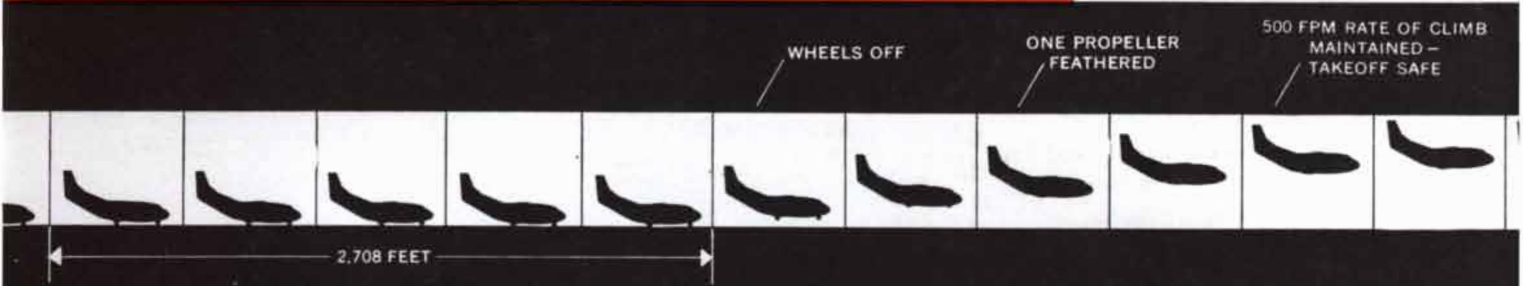
MISSION: Combat Test Problem

WEIGHT: 13,000 lbs. Overload

TAKEOFF CONDITION: Power Failure

RESULTS: Successful

NUMBER 7 OF A SERIES



In a recent test for the U. S. Air Force, the Fairchild C-123 proved the value of thrust assist in meeting emergency single engine conditions!

A C-123 was equipped with two Fairchild J-44 jet engines and loaded to achieve gross weight of 66,742 pounds – *13,000 pounds overload.*

During takeoff and climb, both jets were operated to provide 2,000 pounds continuous thrust in addition to the two piston engines. At 2,708 feet, wheels were off the ground, and a moment later at a speed of 122 knots, one propeller was feathered!

From this takeoff position, the C-123 climbed out at 500 feet per minute – proving again its *big job capability and assault versatility,* heightened by jet augmentation to give extra power and extra safety in any emergency.

A Division of Fairchild Engine and Airplane Corporation

WHERE THE FUTURE IS MEASURED IN LIGHT-YEARS

FAIRCHILD

AIRCRAFT DIVISION • HAGERSTOWN, MARYLAND

A colorful need . . . a colorful