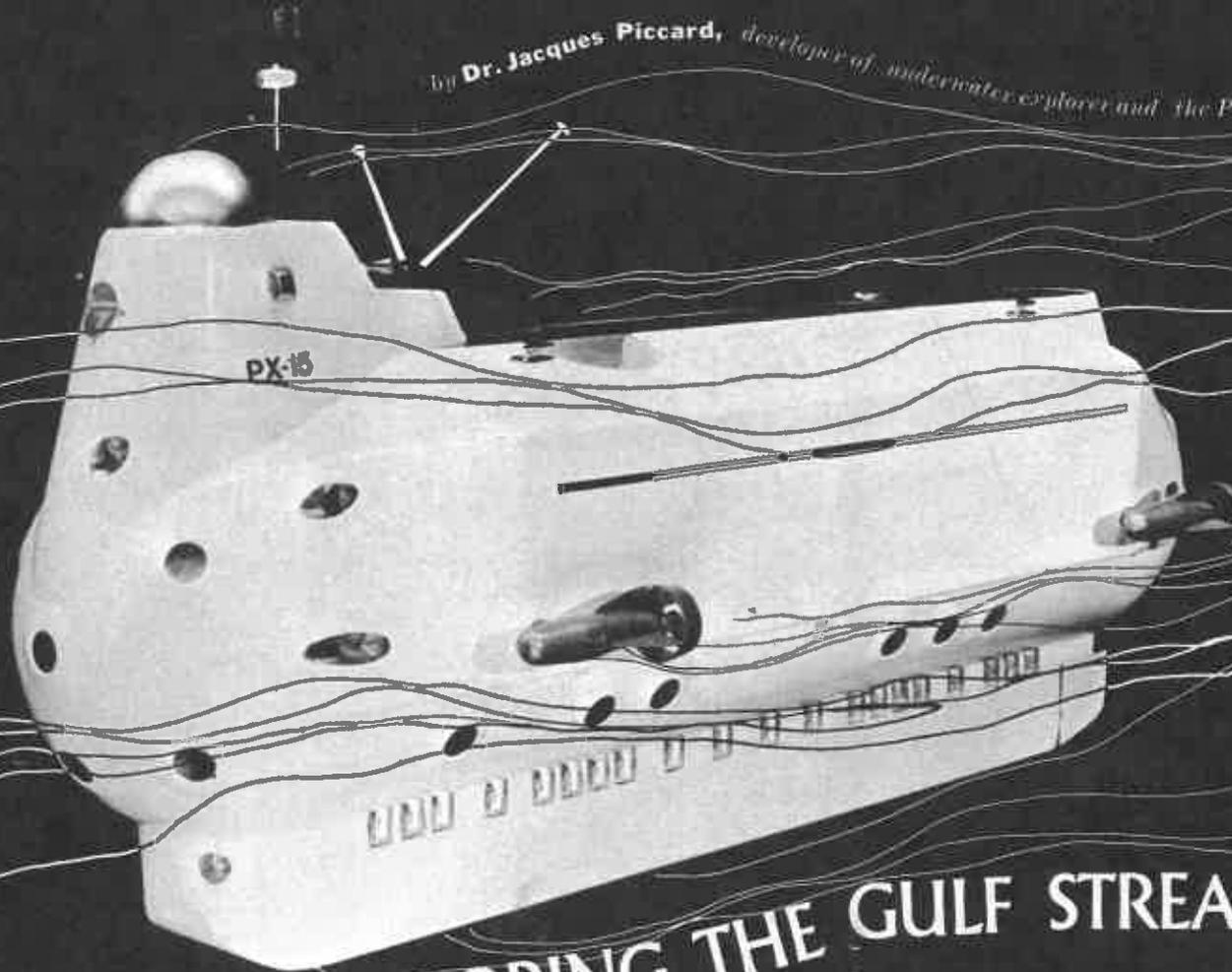
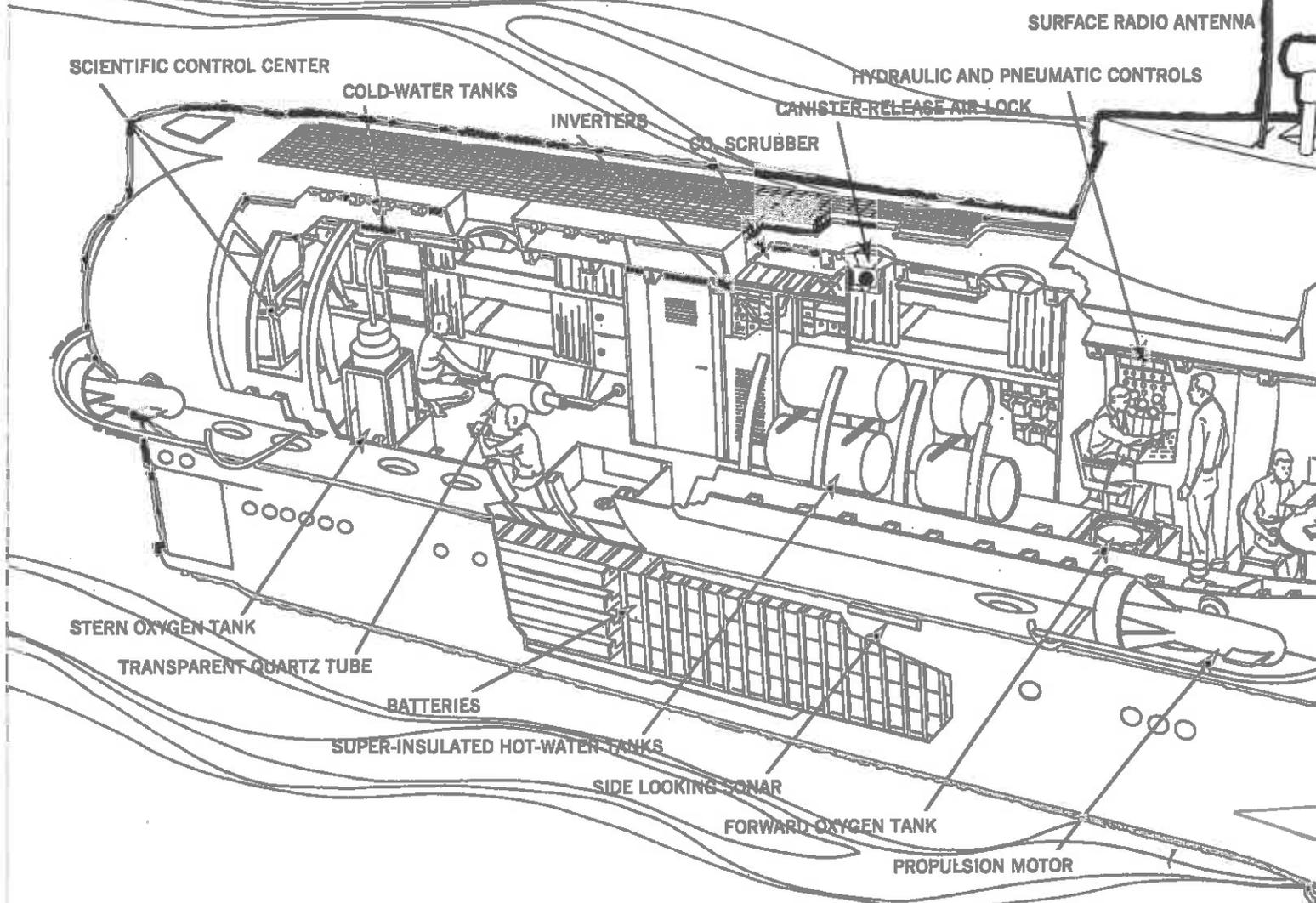


by **Dr. Jacques Piccard**, developer of underwater explorer and the *PN-17*



EXPLORING THE GULF STREAM

The PX-15 research submarine will drift from Florida to Boston in exploring the mysteries of the Gulf Stream.



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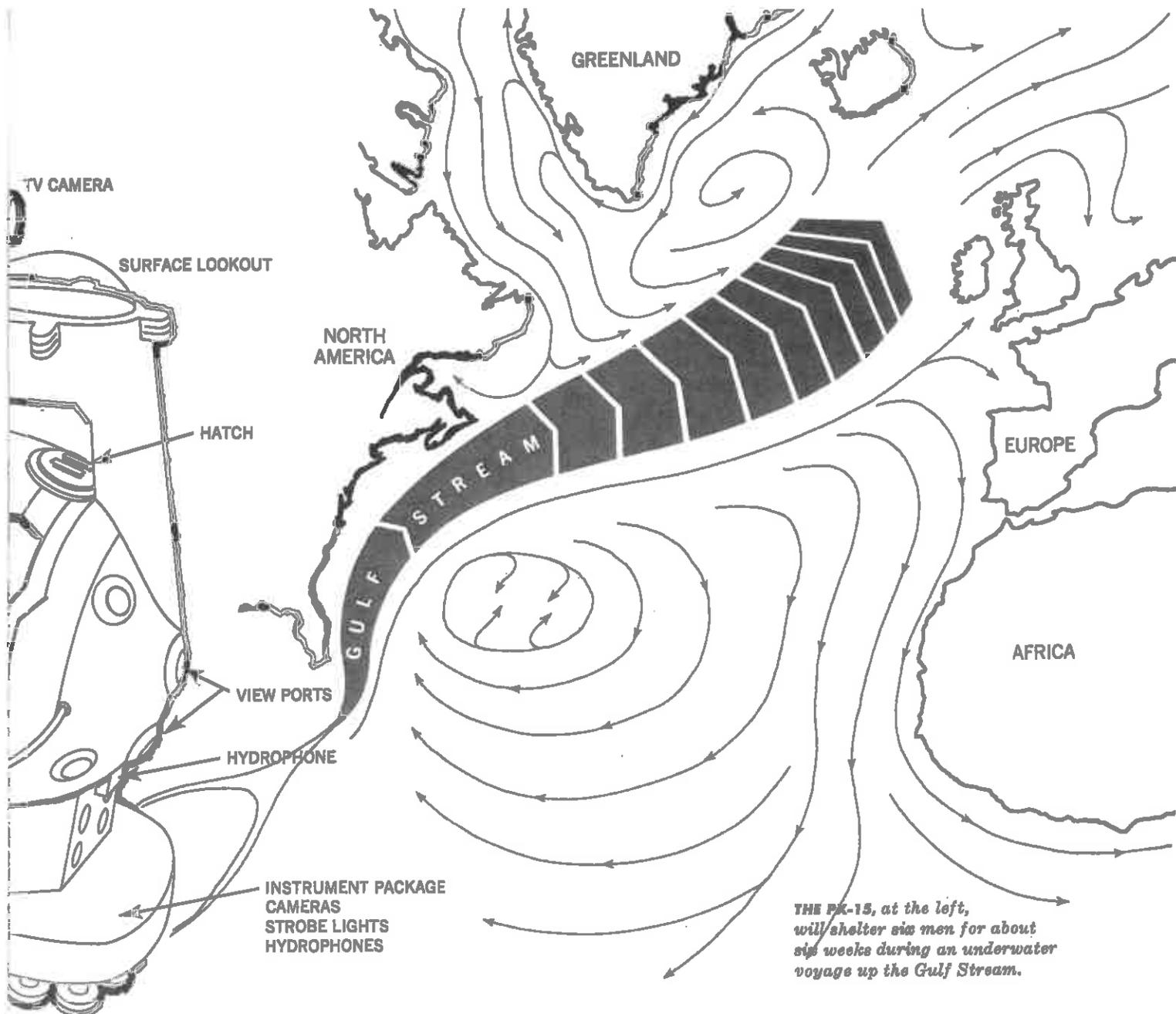
WITHIN A FEW MONTHS, the research submarine PX-15 will be placed in the water for the first time—a milestone in the unfolding of a challenging new undersea project, the Gulf Stream Drift Mission.

Earlier developments in this plan for a four- to six-week manned submerged drift from Florida to Massachusetts have taken place far from our dockside facility at West Palm Beach. And the story of the events leading up to the decision to explore the Gulf Stream, while perhaps not as adventuresome as the trip itself, are significant. They reflect pioneering effort, and frustration, uncommon confidence and even luck.

In a way, I think this prologue to the drift mission mirrors the common difficulties confronting the oceanology community today, for it combines elements of the technical, managerial, fiscal, and operational problems facing the industry at this moment.

The origin of a concept is hard to place, but the formalization of the idea to plumb the depths of the Gulf Stream is easier to pinpoint. I announced my plans in Washington in September 1964. Robert B. Abel, then executive secretary of the Interagency Committee on Oceanography, arranged for me to speak at the National Science Foundation to anyone who cared to listen.

If there ever was any doubt about the serious scientific usefulness of such a mission, it was dispelled that day, for the response was electric. After my talk, I was surrounded by scientists and engineers from every branch of government concerned with underwater research. There was no dearth of ideas, no lack of practical experiments, no shortage of willing volunteers to plan, program, or participate in the drift mission. All that was lacking was a vehicle and financial support.



Middle-depth vehicles

Following the deep dive of the *Trieste* in 1960, the idea of a middle-depth vehicle or mesoscaph occupied all of my time. In 1963, while my home city of Lausanne was preparing for the Swiss National Fair, which is held every 25 years, I proposed that a tourist submarine be built and operated in Lake Geneva, as tangible proof of the technological and industrial capability of Switzerland. The idea was favorably received and the world's first mesoscaph — the *PX-8* — subsequently named for my father, Auguste Piccard, soon was a reality.

Not everyone fully understood or appreciated my decision to build a tourist submarine, and many people confused the autonomous deep-diving 30-meter-long submarine with a toy or amusement park "gimmick." But, in fact, the *Auguste Piccard* was eminently successful and valuable. For

one thing, it introduced more than 30,000 people to the allure and thrill of the underwater world. In Lake Geneva, more than 1,100 dives were completed on a regular schedule.

Perhaps of greater importance was the valuable experience provided by this pioneering effort. This fact is brought back to me every day as the world's second mesoscaph is readied for its special mission. Our handling of high-quality steel, the unique welding and testing problems, and the stress, mechanical, hydraulic, and electrical techniques devised in the building of the *PX-8* have been put to use continually in our *PX-15* program.

And yet, the Gulf Stream Drift Mission and the *PX-15* itself still might be only a dream had it not been for the confidence and support of the Grumman Aircraft Engineering Corp., which is the builder, owner, and operator of the *PX-15*. With the same sort of vision and engineering expertise

THE PX-15, at the left, will shelter six men for about six weeks during an underwater voyage up the Gulf Stream.

that catapulted this company into the space business, Grumman has appraised and evaluated the future of oceanography and, happily, concluded that deep-work vehicles on the order of the *PX-15* hold great promise. The decision to support the Gulf Stream Drift Mission, I am sure, eventually will win for Grumman the praise and gratitude of all ocean scientists.

The *PX-15* program began visibly in March 1967 when a dozen or so plates of high-quality steel arrived from Germany and Austria at the tiny Swiss town of Monthey, some 240 kilometers from the nearest ocean. In a little less than a year, we had finished the European building activities — approximately 95% of the construction — and the vehicle was disassembled and transported to West Palm Beach. There we currently are completing installation of subsystems and testing and modifying in preparation for sea trials and the drift.

As it is presently conceived, the crew of the *PX-15* will be made up of six people. Three will be operators or pilots, and three will be scientists or observers. I will head the mission, but each man will have very specific chores, and will be "master unto himself" for the most part.

We are hopeful that the Naval Oceanographic Office will cooperate in the project, and at this writing, Grumman is very close to such an agreement. This arrangement would mean Naval Oceanographic Office participation in the precise definition of the scientific mission. Two crew members would be drawn from that office and perhaps a surface support vessel would be supplied by the Navy.

As a corollary, I should mention that Grumman is preparing the exhaustive documentation necessary to earn Navy certification, and each step of the construction process has been monitored and approved by the American Bureau of Shipping—making the *PX-15* the first submersible certified by that worldwide group.

Good-bye to sunlight

After a series of operational and training dives this summer and fall, we will begin to prepare in earnest for the drift mission. Then one morning early next year, the *PX-15* will be towed to the Gulf Stream, a mile or so outside Palm Beach, and my companions and I will say "good-bye" to the sunlit, airy world above the waves.

We will flood the ballast tanks and slowly submerge into the northward, Europe-bound ocean river—the Gulf Stream. By alternately pumping out or taking in water ballast, we soon will achieve equilibrium or neutral buoyancy, a special characteristic of the *PX-15*, and be able to hover in mid-water.

Theory almost always precedes practical application, and it long has been recognized that a submersible constructed so as to be less compressible than water could achieve this state of perfect equilibrium at any depth desired. This ability to hover in mid-water without the need for blowing or pumping ballast results in a unique operational platform for scientists.

By electing to submerge in the Gulf Stream, we will not drop down and loiter in one spot for hours or days. That, it seems to me, would not be taking full advantage of our capability. Thus, we combine several natural phenomena: our hover capability and the movement of the currents to learn more about some of the mysteries of the world of inner space.

Once we have reached our programmed depth, hydrophones will begin recording sounds from every quadrant, and externally mounted and hand-

held cameras will document the sights which pass before our 29 viewing ports. We expect to make several excursions to the proximity of the bottom during the early part of our trip, when we will photograph its topography and make gravity and other measurements.

For our biologist, a plankton sampler permits study of small samples of marine life under ambient pressure and specimens can be retained for future study or even sent to the surface, using a small lockout hatch we have incorporated in the *PX-15*'s



THE AUTHOR

Dr. Jacques Piccard conceived and worked with Grumman Aircraft Engineering Corp. in developing the PX-15 mesoscaoph that will follow the Gulf Stream from Florida to the Boston coastal area.

Together with his late father, Auguste Piccard, he designed and operated the first deep diving vessel, which they named "bathyscaph," and its successor, the Trieste. The Swiss-born scientist has made many deep underwater explorations.

design. This releases 5-inch spheres which float freely to the surface with film, tapes, written notes, or other "cargo."

Our life on board will be relatively comfortable—each man has his own bunk; there is a roomy wardroom forward, where a game of gin rummy can be enjoyed; and we will have a fresh-water shower, washing, and toilet facilities. Our hot meals will be prepared from freeze-dried, dehydrated foods, reconstituted by adding near-boiling water kept hot for the mission in superinsulated tanks.

The most critical commodity on board the *PX-15* is electrical power—

and the determination to bring our mission to a close probably will be based on how much power remains in our 378 lead-acid cells. The electrical system contains some unique concepts, too, since the cells are exposed to ambient sea water and pressure. A sophisticated venting/manifold arrangement was devised to accommodate the gas created within each cell when charging and discharging.

The unsung heroes of the Gulf Stream Drift Mission might well be the crew of the surface support ship, which will remain approximately above us at all times. In addition to giving us our location by underwater telephone, the surface vessel will be conducting its own "topside" variations of the measuring and recording operations we will initiate below. An aircraft also may perform other surveys aloft to assure a complete correlation of data from below, on, and above the sea/air interface. Further correlation with existing satellite measurements also is being investigated.

When the signal to end the drift is given, we will blow the negative tanks and rise gently to the surface. We are not deluding ourselves about the north Atlantic off the coast of Massachusetts in early spring—it will be rough. But we should not be affected in the *PX-15* until we are quite near the surface.

Once we transfer to the mother ship, and go through a sort of debriefing, the *PX-15* will be towed to the nearest port—probably Boston. From there, it will go to our home base at West Palm Beach for a complete evaluation and overhaul. Its capabilities proved by the Gulf Stream Drift Mission, the vehicle will continue to help turn back the veil of mystery which shrouds the underwater world.

The mechanical flange joint designed in the *PX-15* allows us to consider wholesale modifications of the hull, including diver lockout and hyperbaric chambers, coring, drilling, and other attachments. Several possible future uses for the vehicle are being studied now.

The Gulf Stream Drift Mission may answer many questions in the minds of oceanographers, and it should stimulate many new ones, too. Some of these avenues of inquiry can be further developed by the *PX-15* itself, and others must await the appearance of newer and more sophisticated advances in the state of the art in materials, power sources, instrumentation, and other areas.

But the Gulf Stream Drift will be a significant beginning, one which will give added impetus to the quest for knowledge about the sea, which is, after all, the proper starting point for any venture. ■