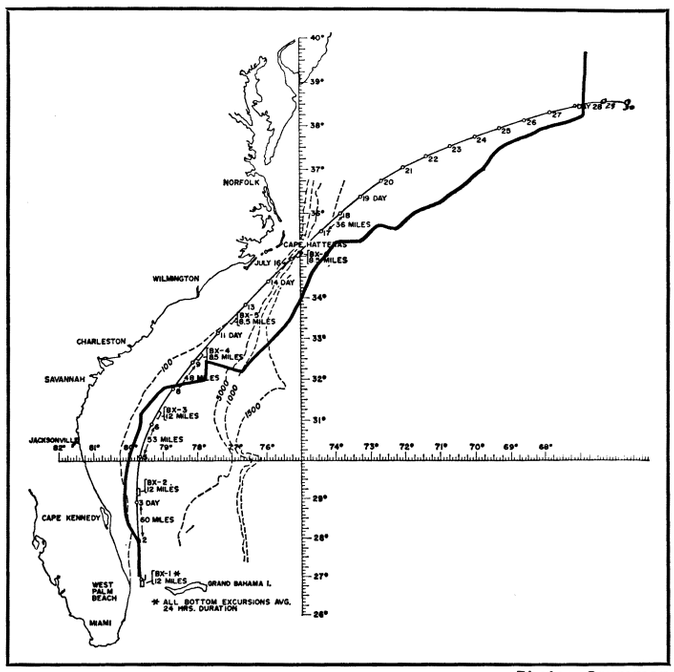
Getting the drift of the Gulf Stream

Unexpected hills, surprisingly deep waves and too-deep coral formations all showed up in 1,650 current-powered miles under the sea



Photos: Grumman

Franklin's course (dark line) varied unexpectedly.

The Gulf Stream is the world's major ocean current. It flows northward from the Caribbean along the East Coast of the United States, turns east off the North Carolina coastline and stretches almost to the Azores before becoming diffused into the other flows of the North Atlantic.

The uncharacteristic warmth of the Gulf Stream makes it, in effect, a temperate river along the ocean's edge, easing the clash between sea and land and soothing the weather over European as well as U.S. shores. For more than 200 years, seafarers have known and reckoned with the mighty current, which could speed or slow their Atlantic crossings or separate them with surprising speed from hunted whales or migrant fish.

Yet the picture of the Gulf Stream is not complete. Even today, it is patched together with uncharted stretches of bottom, data that fail to account completely for the current's seasonal variations and isolated measurements that have had to be assembled bit by bit like a jigsaw puzzle.

On July 14, six men set out from Palm Beach, Fla., to take a close, continuous, scientific look at as much of the Gulf Stream as possible. Their vehicle was an unusual submarine, designed for its task from the ground up (SN: 7/20/68, p. 54), named for the man who first took a scientific interest in the current, Ben Franklin.

One month and 1,650 miles later, about 310 miles south of Halifax, Nova Scotia, the Ben Franklin bobbed to the surface. Its biggest finding: Scientists do not even know as much about the Gulf Stream as they thought they did.

Even the speed of the current, perhaps its most directly measurable characteristic, was a surprise. The 50-foot vessel, although equipped with propellers, was designed to drift along with the current, and at times reached speeds as high as 4.5 miles per hour, almost twice as fast as was expected.

A major goal of the mission, says its mentor, Dr. Jacques Piccard, was to investigate the deep scattering layer, a vast horizontal sheet of plankton and other sea life that rises and falls periodically during the day. The layer is notorious for playing havoc with sonar and other underwater sounding equipment, and the Ben Franklin was loaded with sensors, cameras and other gear to study it in every possible way. But the infamous layer almost never appeared.

There appeared, in fact, to be a startling lack of marine life in general, though the crew did sight several species of shark, a 30-foot jellyfish with tentacles as much as four inches thick, a squid which attached itself to the outside of a porthole for several hours and a pair of broadbilled swordfish which had a brief joust with the submarine some 650 feet down before swimming away unharmed.

The behavior of the water itself, however, was enough to keep the scientists fascinated. At one point, 13 days into the mission, a giant, unexpected eddy 600 feet below the surface pushed the sub completely out of the Gulf Stream's core, forcing it to surface for a 50-mile tow by one of the two accompanying surface ships to get back on course. During the surface tow, all hatches were kept sealed for the sake of the National Aeronautics and Space Administration, which was studying the close, confined situation to learn about similar circumstances expected on long-duration space flights.

One of the most interesting discoveries of the $5 million project, run and largely financed by the Grumman Corp., was the presence of strong vertical waves within the current, caused by previously uncharted hills looming up from the ocean bottom. So strong were the surprise waves that skipper Donald Kazimir had to raise the Ben Franklin away from the bottom in order to keep it stable.

The mission also has implications for the study of the continental coastline. On the ninth day out, during a continuous, 24-hour survey of the sea floor in more than 1,300 feet of water, the vessel suddenly came upon a series of giant coral heads reaching almost 100 feet up from the bottom. Such formations are believed normally to occur only near the surface, which could mean that the Atlantic coastline once extended farther out to sea. The coastline may have eroded away, or the melting north polar cap could have raised the water level, thereby both submerging the coral heads further and shifting

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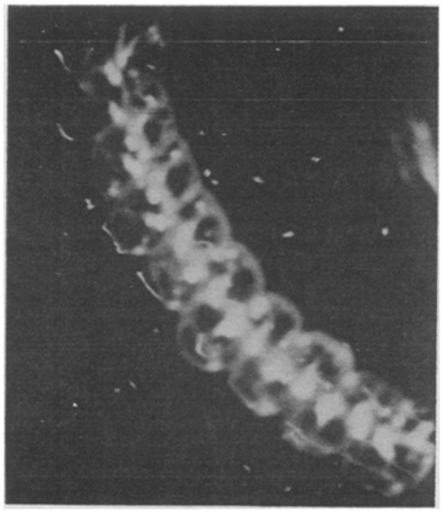

Grain plankton viewed from Franklin.

the shoreline farther away from the main land mass.

Numerous other scientific studies were carried out during the mission. Dr. Piccard was particularly interested in bioluminescence, the natural light given off by some forms of life, as well as any fluorescent minerals that might affect the undersea light level. The Naval Oceanographic Office made repeated salinity, temperature, density and other measurements in conjunction with simultaneous airborne measurements by the Navy's Anti-Submarine Warfare Environmental Prediction Service. Other Navy research included visual and acoustic studies of the sea floor in an effort to understand the phenomenon known to sonar operators as bottom loss, which shows itself when sound pulses sent out from a ship or submarine mysteriously fail to return, presumably due to absorption by the bottom.

The experiment by NASA was a detailed one, with medical and psychological investigations including eight different kinds of psychological tests before and after the mission. Bacterial counts, air and water freshness measurements and even the applicability of the submarine's design features to a spacecraft were all on the agenda.

Meanwhile, the two surface ships, the Privateer and the Kellar, were taking measurements of their own, as well as samples for later analysis in laboratories ashore, all to be correlated with data from the Ben Franklin. In addition, the USS Lynch gathered surface data from as much as 60 miles ahead of the submarine's path. The data could aid in determining the stability of conditions in the little-known current.

As is usual in explorations of a new frontier, the Gulf Stream drift raised as many questions as it answered, if not more. "The true impact of this mission on oceanography," says Piccard, "is still to be determined." ◇

SENATE ACTION

Defense research takes its licks

"It goes up so fast that I cannot follow it," says Senator J. W. Fulbright (D-Ark.), speaking of the Defense Department budget. "However, $80 billion is what is proposed to be spent (in fiscal year 1970). This amounts to about 60 percent of the total budget when social security and all the other trust funds are not included."

About a tenth of the $80 billion, $8.227 billion, was requested for research, development, testing and evaluation; the request is contained in a military procurement bill now before the Senate.

Items under this heading are drawing especial fire from Fulbright and other senators this year—as they did last—because it is here that the critics feel they can convict the Defense Department of overstepping its bounds. It supports research it has no business bothering with, they say, research that could better be administered by other agencies.

As a result of last year's battle, the Pentagon announced that it would begin to divest itself of responsibility for various kinds of basic research that seemed far from its mission (SN: 2/10/68, p. 134). This year, testifying before the Senate Armed Services Committee, Dr. John S. Foster Jr., director of defense research and engineering, cited, as examples of the department's present basic research interests, global thunderstorm studies, high-temperature lubricants and ultrashort laser pulses. These are a long way from the particle physics and radio astronomy that the department used to take pride in.

Nevertheless the committee trimmed the budget request by a billion dollars to $7.18 billion. This is about $400 million less than fiscal 1969's $7.551 billion.

In that form the bill went to the floor, where several senators also had scissors out.

The bill as approved by the committee included a $100 million emergency fund that the secretary of defense could spend at his discretion for contingencies. A bipartisan group of senators introduced an amendment to cut this fund to $50 million. The argument against the fund was that the secretary had used such money for items related to the Vietnam war in the past and was likely to do so in the future. A compromise left the emergency fund at $75 million.

Then came Fulbright with an amendment to trim $45 million more from other items in the research and development budget, namely: 10 percent or $27 million from Federal Contract Research Centers, one-third or $2 million from research in foreign countries, 20 percent or $5 million from counterinsurgency research, $3 million from other social science research and 25 percent or $8 million from project Themis, by which the Department of Defense tries to build up the capabilities of science departments in various universities.

In debate before passage of the Fulbright amendment Sen. William W. Proxmire (D-Wis.) expressed concern that the Department of Defense was being given more money to support research than the National Science Foundation. "The problem is," he said, "that whereas we have established a Science Foundation for the purpose of making the inquiries and making this research ... on behalf of all the agencies of Government, we provide the Department of Defense with six to seven times as much as we provide for the National Science Foundation."

Earlier in the week the Senate took a blow at research in an area that belongs in Defense if it belongs anywhere: chemical and biological warfare. Some $16 million for research and development on offensive CBW weapons and agents was cut out of the budget in committee in the aftermath of heavy controversy (SN: 7/26, p. 80) and the Senate passed an amendment banning open-air tests of lethal chemical and biological agents unless the secretary of defense determined that national security demanded them.

The bill was still under debate when the Senate recessed on Aug. 13.

PATENT LAW

The more things change . . .

Basically unchanged since 1836, the U.S. patent system is staggering under a growing mountain of patent applications. The result is an average wait of two and a half years before a patent is granted.

Through the years, of course, there have been cries for sweeping reform. In 1965, the Johnson Administration set up the President's Commission on the Patent System, which urged complete revision. Senate and House bills flourished in response to the report, only to die in committee (SN: 2/4/67, p. 114). Now, in 1969, a new champion enters the lists with every likelihood of passage. But the new bill represents conservatism rather than revisionism and will have no substantial effect on the backlog problem.

Introduced by Sen. John L. McClel-