DEEP SEA DRILLING

Going back for more

Since soon after the beginning of the United States' Deep Sea Drilling Project in 1968, project managers have wanted the means to re-enter a borehole on the bottom of the ocean. The outstanding scientific successes of the drilling from the Glomar Challenger have come despite the frustrating inability to replace a worn or broken-off bit and resume drilling in the same hole.

Layers of steel-hard chert frequently dulled the bits and forced drilling to stop. When this happened all the effort spent trying to penetrate the chert to deeper layers of sediments was wasted; a new hole had to be started. Scientific objectives were often not achieved.

At other sites the sediments were penetrated but drilling could not continue far enough into the bedrock to prove to everyone's complete satisfaction that no more sediments lay beneath.

After completion of Leg 11 earlier this month (SN: 6/6, p. 547), the Challenger sailed 300 miles out into the Atlantic from New York to test a newly developed re-entry system. This week success was achieved.

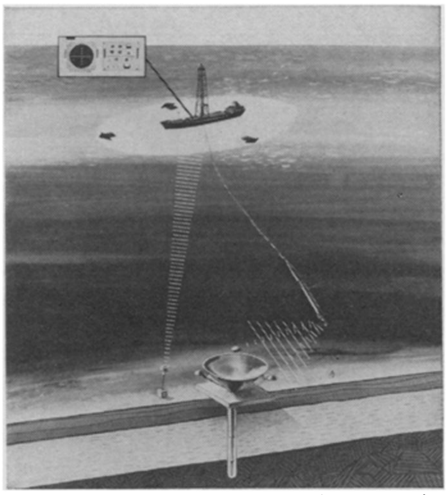
At 7:54 p.m. Sunday, in 10,000 feet of water, a new bit was for the first time successfully placed into a previously started hole. The first core recovered with the re-entry capabilities came aboard at 1 a.m. Monday.

Project manager Kenneth E. Brunot termed the trials a complete success.

Project engineers faced formidable problems. The target was tiny: a five-inch-diameter hole 10,000 feet away. In addition the target was not visible, and both the drill stem and the vessel were being constantly affected by currents.

To make the task easier, the drill stem and the first bit were inserted at the surface through the stem of a metal funnel 16 feet in diameter at the brim. Then the entire assemblage was lowered to the ocean bottom. When the funnel's heavy base was secure on the ocean floor, drilling began. The drill stem was then raised to the surface, a new bit was attached, and the stem was lowered toward the hole. A small scanning sonar unit extending through the end of the bit sent out sound pulses. Three acoustic reflectors on the funnel brim bounced them back to the bit, and the resulting information on position was seen on a display aboard ship. The stem was then maneuvered into the funnel by jets of water forced out a hole on one side of the drill stem 60 feet above the bit.

The system had never been tested in water more than a few hundred feet deep. Some difficulties were encountered before the successful re-entry and one of two funnels available for the tests was dropped and lost. But the scientists found nothing to prohibit use of the technique on future missions.



Scripps Institution of Oceanography

Re-entry system: A complete success.

According to Dr. Melvin N. A. Peterson, director of the Deep Sea Drilling Project for the Scripps Institution of Oceanography, the first operational use of the system will be in the Caribbean Sea during Leg 15 about six months from now. The system will be used selectively, at sites where extreme drill wear is expected. Someday it could also be used to emplace a small seismograph deep in the ocean floor at the bottom of a borehole. Oil companies will also be interested in the re-entry technique. □

GRAPHITE FIBERS

Not yet for the birds

Graphite fibers offer great promise as an engineering material. Their high strength, light weight and stiffness without brittleness, coupled with such properties as electrical and heat conductivity and heat resistance, make them a potential rival for conventional structural materials.

One of the earliest applications for them has been in the fan blades of jet engine turbines (SN: 6/21, p. 601), because they can reduce an airplane's weight and because they are easier to manufacture than titanium blades. For these reasons, Rolls Royce selected Hyfil graphite fibers for the fan blades of its RB-211 engines being built for the Lockheed airbus. Rolls Royce had anticipated some problems, and maintained a parallel titanium fan-blade program in case the graphite program came a cropper. It turned out to be a wise hedge.

The Hyfil blades were first flight-tested in 1967 and then used in commercial flights in 1968, but only to the tune of about two blades per engine. Since then, they have had a total of nearly 18,000 hours flight experience.

It was during this experience, aboard British-built jets, that the troubles were detected.

Since then it has been a case of solutions breeding new problems for every one solved.

First, there was the rain, grit and erosion problem. This combination was found to pit the blades. Rolls Royce engineers nickel-plated the leading edge of the blades, and coated the rest with polyurethane paint. Although this solved the corrosion difficulty, it did not take care of the next problem: birds. A four-pound bird hitting an engine on takeoff generates about 2,000 pounds of residual impact. The nickel-plating treatment proved inadequate in distributing the impact, and as a result of shear stress, slippage in a composite material, the fan blades took a beating.

Rolls engineers attempted to solve this problem by laminating the leading edge with thin sheet steel. And that remedy produced two new predicaments of its own: blade flutter and fatigue stress.

Ordinarily blade flutter is not an uncommon problem, and the answer is to change the blade tip incidence, or angle, by twisting the fan blades. However, because it is a composite, the graphite blade cannot be twisted once it has been manufactured. So instead of twisting, Rolls engineers just took the root of the blades and reattached them at a slightly different angle.

But that still left the fatigue problem, which has not yet been completely resolved. To overcome it, alterations in the arrangement of stainless steel braces have been incorporated, and the trouble lessened.

"These changes have already resulted in worthwhile improvements to the fatigue properties of the blade, and intensive development is continuing," notes J. M. S. Keen, project engineer of the RB-211.

Despite the setback, which the company regards as temporary, Rolls Royce is still confident. "The flight standard engines will undoubtedly have Hyfil fan blades," states a company spokesman. "In order to meet the RB-211 program requirements, Rolls Royce will deliver the initial flight-test engines with titanium fan blades, about a dozen or so. Following that, Hyfil fan blades will be delivered."

Because of strict delivery schedules to Lockheed and the airlines, however, if the problems are not ironed out in time, titanium fan blades might be used instead of Hyfil in the first few flight engines. No decision has been made on this yet.

As for the graphite fiber movement in general, the fan-blade troubles are not expected to hinder it. □