temperature difference that has to be maintained.

The method of Williams and Packard is conceptually simple but technically difficult to achieve. Electrons from a radioactive tritium source are introduced to the rotating helium from below. The electrons form bubbles, which, for certain fluid dynamic reasons, are trapped on the vortex lines. The electrons remain thus trapped for about 10 seconds. Then an electric field pulls the electrons through the surface of the liquid.

Electric and magnetic fields are used to make the electrons form an image on a phosphor screen. Complicated optics are used to carry the image out of the refrigerator, amplify it and record it on high-speed film. The dots in the picture represent the ends of vortex lines as they intersect the surface of the liquid. To make the method work Williams and Packard had to push electron optics to its technical limits, and they had to build the world's only rotating helium dilution refrigerator capable of working at temperatures less than 0.1 K. Now they hope to add television to the system so that they can watch how the vortex lines move around.

Theory predicts that the vortex lines should form a rigid triangular lattice that rotates with the container. Williams and Packard do not find this pattern. The deviation may be caused by some disturbance. On the other hand, some experts believe that even in an undisturbed superfluid, reality is too complex for the theory, and the triangular pattern will not appear. Williams and Packard want to study the matter further. □

Inducing interferon to prevent colds

Interferon is a glycoprotein produced by surface cells in the body in response to a virus attack. Since its discovery in 1957, investigators have hoped that it might be used to prevent colds and other viral infections. The idea would be to enhance the body's natural production of interferon by administering either interferon or some chemical that would stimulate interferon production in the body.

They have had trouble, however, in harvesting enough human interferon to carry out clinical tests and in finding just the right amount of interferon that is necessary to prevent colds. They have also had difficulty finding a chemical inducer that is both effective and without harmful side effects. The synthetic RNA known as poly I:C looked especially promising in tissue culture and animal tests. But when David A. Hill and his team at the National Institute of Allergy and Infectious Diseases used poly I:C to prevent colds in human volunteers, they obtained disappointing results.

But research has been more promising during the past year or so. Thomas C. Merigan of Stanford University School of Medicine and his colleagues have found that by using relatively large doses of human interferon they could prevent colds in human volunteers (SN: 3/31/73, p. 208). And now Charoen Panusarn and his colleagues at the University of Illinois College of Medicine have found that a particular interferon inducer—a type of propanediamine—effectively protected human volunteers against colds.

The scientists conducted a double-blind, placebo-controlled study on young adult volunteers. Seven volunteers who had no antibodies in their blood against cold viruses were given a placebo and exposed to a common cold virus—rhinovirus Type 21. All of them became infected, six became ill, five showed a rise of antibodies against cold viruses. Interferon appeared in the nasal tissue of three out of four volunteers tested for it, but not until after exposure to the virus. Nine antibody-free volunteers were given the interferon inducer and exposed to the same cold virus. Five of them became infected, two became ill and four experienced a rise in antibodies against cold viruses. Interferon was secreted by the nasal tissue of six out of seven persons tested for it, and it was detectable before virus challenge.

These results show that while the interferon inducer did not reduce infections from cold viruses, it did reduce the number of illnesses, probably by mobilizing interferon before the cold virus arrived.

Seven volunteers who already had antibodies against cold viruses in their blood then received a placebo and were exposed to the cold virus. Four became infected, two ill. Interferon appeared in the nasal tissue of four out of seven persons tested, but not until the time of virus challenge. Six volunteers who already had antibodies against cold viruses received the interferon inducer and were then exposed to the cold virus. Four of them became infected, none ill. Interferon was secreted by the nasal tissue of all volunteers tested (six) and it appeared before virus challenge.

These results suggest that if a person already has antibodies against cold virus in his blood, then receives an interferon inducer, his chances of fighting off a cold are even greater than if he only received the inducer. The antibodies apparently assist interferon in fighting the virus. □

Sea floor drilled to record depth

The Deep Sea Drilling Project now more than ever can put the emphasis on "deep." On the thirty-seventh leg of its global mission to sample the ocean bottom, the research ship Glomar Challenger bettered by more than seven-fold its previous record for depth of penetration into the basement rock lying beneath the sediments on the sea floor. Repeatedly changing the bit at the end of its drill string, it drilled, at one point, 1,910 feet into the rock near the Mid-Atlantic Rift.

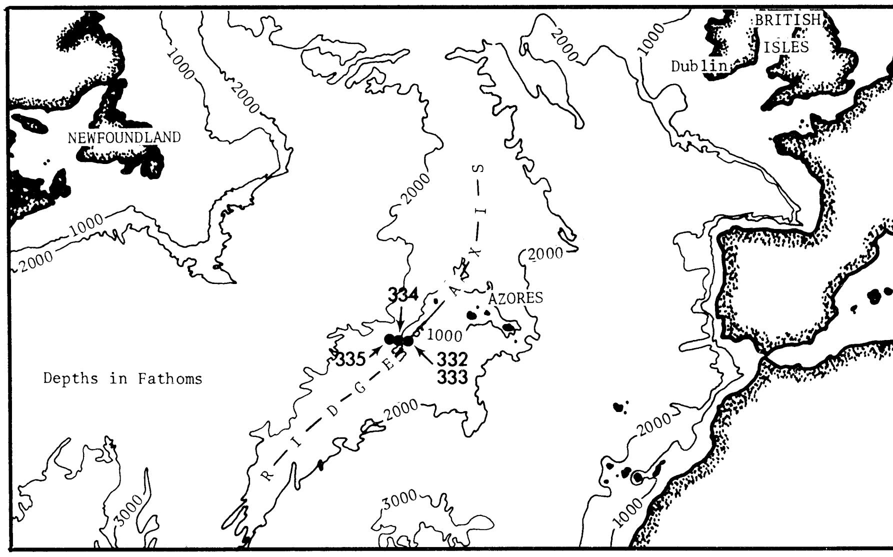
Prior to Leg 37, the Challenger's deepest penetrations into the igneous rocks underlying the bottom sediments had been 260 feet. But on the latest leg, only a few miles from where a school of submersibles under Project Famous were probing the Mid-Atlantic Rift, the drills bored their way into depths of 333, 405, 1,023, 1,092 and 1,910 feet. On the deepest attempt, nine reentries were required (three of them to change bits, the others for such causes as the collapse of the hole sides, requiring the bit to be removed and reinserted), more than the total in all the previous holes, according to a project official.

The results from Leg 37's holes were striking. Chief scientists Fabrizio Aumento of Dalhousie University in Nova Scotia and William G. Melson of the Smithsonian Institution in Washington report the discovery of layer upon layer of alternating marine basalt (lava) flows and sediment. That the layers seem to have been deposited in a span of as little as 100,000 years, about 3.5 million years ago, is further evidence identifying the Rift region as the birthplace of new material in the Atlantic Ocean floor.

The most significant find may turn out to be a complex sequence of plutonic rocks—igneous rocks formed at great depths—which just may represent samples of the deep crust material that underlies both the sedimentary and basalt layers. Yet strangely, they seem to contain no traces of basalt, which ought to be the middle layer in the sea floor "sandwich." A possible theory, the scientists suggest, is that the plutonic rocks were originally upthrust to sediment level just before a volcanic episode began, so that the subsequent lava would be on top.

Replacing a drill bit is no major achievement itself. It is the ability to put the new bit back into the old hole, after first having to lower it through more than 6,000 feet of water, that has added new potential to the Challenger's already fruitful mission.

In the past, a dull drill bit almost



Scripps Institution of Oceanography

Challenger's record-deep holes, including 1,910-footer at site 332, near Rift.

invariably meant that a borehole was as deep as it was going to get. Once the flexible, multi-sectioned shaft called the drill string was pulled out of the hole it had created, the odds against relocating the hole from the ship overhead were astronomical. Dull bits were not always to blame. Currents and wave motions could have an effect, as could the mere bobbing and turning of the ship.

Deep Sea Drilling Project engineers found their answer in a technique originally conceived but never implemented for the Mohole, a stillborn idea for drilling through the so-called Mohorovicic discontinuity between the earth's crust and mantle. It's simply an embodiment of that time-honored implement for pouring things into awkwardly small holes: the funnel.

As the Challenger applies it, a 150-foot section of pipe topped with a 14-foot-diameter cone is lowered to the ocean floor via the drill string (a tube made of 30-foot, threaded sections of steel pipe), where it settles into the bottom sediment until the cone rests on the sediment surface, large end up. A wire, lowered down the pipe, trips a latch that frees the drill bit to begin working away until it becomes dull. Drill string and bit are then pulled up, the bit is changed on shipboard, and the whole string is lowered again, this time carrying a scanning sonar device that seeks out three sonar reflectors mounted on the rim of the cone. The sonar can spot the reflectors from as far away as 500 feet.

Guiding the drill string to relocate the cone requires moving the entire ship, following the sonar blips on a monitor screen. The Challenger is particularly qualified for this task, being equipped not only with regular ship's propellors, but with additional screws that point sideways—the ultimate answer to parallel parking. (When the Challenger pulls into a port, says one project official, the captain sometimes likes to wave off the assisting tugboats and glide laterally—and dramatically—over to the dock.) Once the cone is directly beneath the sonar transmitter on the drill string, the rim of the cone itself acts as a reflector, signalling its presence by showing up as a ring on the monitor screen. The bit slides in.

The reentry technique was first tested three years ago during Leg 11 of the project, when its success was greeted with a pleased and lusty cheer from those aboard. It was first used operationally during Leg 14, on Christmas Day of 1971, and has since worked at water depths as great as 13,000 feet. But it was not until Leg 37 that it really began to show its true potential.

To further evaluate the technique, next week one of the Famous submersibles, Woods Hole Oceanographic Institution's Alvin, is scheduled to visit one of the drill sites to see, for example, how far the cone sinks into the sediment with use. □

What's happening to inventions?

Something very peculiar is happening to the American technological innovation process, at least to that part of it reflected in patent applications stemming from Federal research and development funds. According to a new report by the Federal Council for Science and Technology (FCST), the total number of patent applications resulting from public funding has decreased sharply and steadily since 1966 and the total number of invention disclosures (for which patent applications might or might not be made) has also declined steadily since 1968. The total number of these invention disclosures in 1972, the last year included in the study, was 9 percent less than the number registered a decade earlier. In the same period, patent applications for *all* inventions (not just those resulting from Government funding) rose.

No one has rushed forward with a comprehensive explanation for the sudden dropoff. Earlier in the decade, a rise of patent applications by Government employees and contractors paralleled rising R&D budgets. But when the budget bottomed out in 1971 and then rose some 7 percent in 1972, the descent of invention disclosures actually sharpened its rate of decline slightly. Even more puzzling, in 1971 the President issued a memorandum instituting a new policy permitting private industries, for the first time, to be granted exclusive rights to Government-held patents, under special circumstances. But the result, instead of an anticipated upswing in applications for such licenses, was the decade's first substantial downturn in that phase of national innovative activity.

Some industries have been disgruntled by moves in Congress to change patent laws to make results of work funded by the Government more widely available. "Under these circumstances," testified N. Bruce Hannay of Bell Laboratories, "the companies with the greatest competence to carry out the [resulting] program may be discouraged from participating." Sen. John L. McClellan (D-Ark.) told an interviewer recently he thought the problem centers on uncertaintly in what restrictions a patent owner may place on the licensing of his patents without violating antitrust statutes, and he called for clarification of the issue in upcoming legislation. On the one hand stands the public's right to benefit from publicly funded projects; on the other, a company's disincentive to produce an invention it will immediately have to give away.

The patent-granting procedure has come a long way since gadget-loving Thomas Jefferson (then Secretary of State) first reviewed all applications personally. More than three-quarters of patents now go to corporations, with those resulting directly from Government R&D representing about 3 percent of the total. Though the procedure is costly and time-consuming—involving about $225 in official fees, an average of $1,000 for a patent lawyer, and a two-year wait—these should not prove major impediments to big companies. A more serious threat, one industry patent expert told SCIENCE NEWS, is the inability of companies to patent computer "software." Another industry source said this might cut down on new patents but could not account for the decline reported by FCST. Another blamed the shift to "systems" contract-