

Unique volcanic subsea specimens

Traveling to the far corners of the world's oceans, the research vessel *Glomar Challenger* has sampled all sorts of diverse material from the ocean floor in the years of the Deep Sea Drilling Project. As if to underscore this diversity, the latest phases of the journey, Legs 51 and 52, have bored into two areas of the seabed only 450 meters apart with results of nearly equal but opposite significance: samples of some of the most- and least-changed ancient volcanic material ever brought to light by the DSDP.

The holes were drilled along the southern border of the Bermuda Rise in the western North Atlantic, a region where the oceanic crust is believed to be about 80 million years old. The crust there is thought to have formed when the North Atlantic was about half its present width, as the world's great ancient land masses were separating to create the present continents. One of the most important goals of the DSDP has been to study the growth of the crust as it was born in, and moved away from, the boundaries such as the Mid-Atlantic Ridge between the earth's moving crustal plates. This has been an even more specific goal of the DSDP's International Phase of Ocean Drilling, of which DSDP Legs 51 and 52 are Legs 4 and 5.

The first hole was drilled high on the slope of a rugged hill in the oceanic crust along the edge of the rise. Although it was planned only as a "pilot hole" to check out the terrain for the deeper drilling to follow, the 200-meter core extracted from the site yielded "what is probably the most-altered basalt ever seen in the deep sea." Leg 51 chief scientists Thomas W. Donnelly of the State University of New York at Binghamton and Jean Francheteau of the Centre Océanologique de Bretagne in Brest, France, feel that the sample has at last provided a clear measure of what happens to basalt that has been exposed directly to seawater for many millions of years. According to an official of the Scripps Institution of Oceanography, which manages the DSDP, "It soaks up water and potassium like a sponge, forming abundant secondary minerals, including masses of brilliant green mica and sparkling zeolite crystals equal in quality to fine museum specimens."

The second hole, though only 450 meters away, was made far down on the hill, where the underlying material was quickly buried as the hill was first thrust up from the surrounding seabed. As a result, glassy material found in the core sample was protected from the ocean almost since birth, and thus appears to be "among the world's oldest samples of truly fresh volcanic glass." Furthermore, the basalts from the two sites apparently resulted from a vertical displacement of the same eruptive sequence, probably due

to faulting, so they provide an ideal example of contrasting submarine weathering effects on matched substrates.

The basalts themselves, although highly uniform in composition, are nonetheless significantly different—higher in calcium and aluminum and lower in magnesium—than what is considered typical for young basalts from the mid-ocean ridges. The scientists are uncertain as to whether this is just a chance variation or a sign that past ideas of "typical" basalt are mistaken. To determine whether the more accepted basalts underlie those in the Leg 51 samples, the *Challenger* was sent on Leg 52 to reenter the second hole, the first time that a drilling site from one leg has been reentered on another. The reentry was successful (and at a record water depth of 5,479 meters, making the task all the harder), but last week the "bottom hole assembly" of the drill string broke off in the hole, leaving engineers and technicians this week still trying to get it out.

The drilling team still has plenty to show for its labors, however. The Bermuda Rise is the site of some of the largest

known anomalies, or irregularities, in the earth's magnetic field. Minerals recovered from DSDP drilling in the area of other magnetic anomalies have failed to show the amount and polarity of remnant magnetization that would explain the effect. But in the Rise samples, the inclination of the remnant magnetization—indicative of the inclination of the earth's magnetic-field axis at the time the basalts were formed—differs by only 6° from what had been predicted for 100-million-year-old basalts in this part of the Atlantic. The magnetic orientations were so well preserved, in fact, that analysis revealed a subsequent minor rotation of the rocks due to faulting.

The sediments overlying the sites, meanwhile, have hinted at a fascinating story of their own. Buried deep in the sediments was a group of rounded, highly polished pebbles that bear a strong resemblance to the wave-worn pebbles found on beaches. If further study shows that they are indeed wave-worn, it may mean that the site region, one of the deepest parts of the Atlantic, was once nearly at sea level. It is possible, in other words, that this portion of the sea floor dropped by as much as 5.5 kilometers during the last 100 million years. □

Cattle drug: 'No evidence of cancer hazard'

Any substance shown to cause cancer in man or animals is prohibited as a food additive, according to the 1958 Delaney amendment to the Food, Drug and Cosmetic Act. But the issue is far from settled in both theoretical and practical terms. Can there be safe, low levels of cancer-causing substances? Can the benefits of a food additive outweigh the risk of a slightly increased incidence of cancer?

The latest argument about food additives and human cancer focuses on a synthetic hormone, diethylstilbestrol (DES), that is added to livestock feed. The hormone has caused cancer in laboratory animals and in daughters of women who were given high doses during pregnancy to prevent miscarriage. The federal law contains a provision, referred to as the DES clause, that allows cancer-causing agents in livestock feed provided that no residue is measurable in the meat. The Food and Drug Administration will soon be holding hearings in its third attempt to ban DES from livestock feed.

The Council for Agricultural Science and Technology (CAST), a consortium of 19 agricultural science societies, recently charged that DES is safe as used in livestock and that the FDA prohibition of any substance causing cancer is unrealistic and unscientific. A group of 20 agricultural scientists, toxicologists, physicians, economists and lawyers prepared the CAST report which concludes, "There is no evidence of a cancer hazard attributable to use of hormonally active substances in

livestock production."

The report compares the low levels of DES that may remain in meat with the much higher levels of estrogen and estrogenlike hormones in normal human bodies, in plants and in birth control pills. It says DES has no known biological effect beyond that of estrogen. The CAST scientists calculated that a woman's body contains hormones with natural estrogenic activity 2,500 to 25,000 times higher than the maximum amount they estimate would be absorbed from beef liver, the organ with the highest DES concentration.

Plants also contain estrogenlike hormones. "In a meal consisting of whole wheat bread, green salad, mashed potatoes, green peas and ground round steak from DES-implanted cattle, the component of the meal that would contain by far the least estrogenic activity is the ground round steak," the report claims.

Finally, by assuming that the effect of a cancer-causing agent is proportional to dose and noting that there is no evidence of increased cancer from birth control pills, the CAST scientists reason, "The use of DES in beef production is 600,000 times safer than a widespread practice that has shown no evidence of a cancer hazard."

An FDA spokesman said the report is under review, but the FDA position remains that DES is carcinogenic and should be banned from livestock feed. Scientists in the FDA counter the CAST report conclusions by arguing that the current tests for monitoring DES in meat are not sensi-

tive or accurate enough, that animal tests have not indicated what level of DES does not cause cancer, and that birth control pills have not been in use long enough to indicate whether estrogen intake will increase cancer incidence after a typical lag of 20 to 30 years.

The CAST report also hits the current food additive regulations because there is no consideration of possible benefits. It describes a 10 to 12 percent saving in feed due to DES use and a higher proportion of lean meat in animals receiving the hormone. "The uses of these substances in livestock production are of great value to the American public in terms of food costs and nutrition," it says. If benefits are to be weighed against risk of cancer, however, it would be a major change in regulatory policy that would probably have to come from Congress rather than the FDA. □

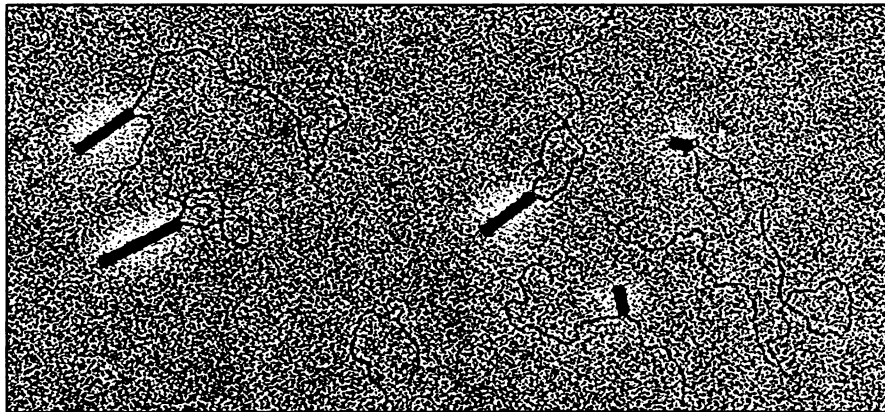
Cambridge resumes genetic research

The Cambridge, Mass., city council has finally approved an ordinance regulating research on recombinant DNA, the splicing of separate strands of genetic material. The ordinance is essentially the same bill that passed the council's preliminary vote two weeks ago permitting moderate-risk research (SN: 1/29/76, p. 70), although some clarifying amendments were added during the council vote Feb. 7.

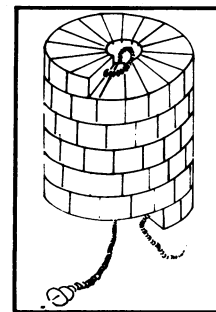
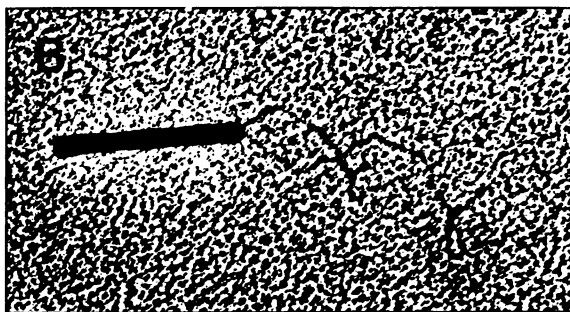
One of the most significant alterations appearing in the final ordinance was the expressed restriction of any P4 (high-risk) research, an area only implied in the earlier version. Neither MIT nor Harvard, the two research centers affected by the law, has any present facilities or future plans to conduct P4 research. Another amendment specifically set a \$200-a-day fine on any violation of the ordinance, answering some critics who charged the law had no enforcement powers. A third amendment expressly authorized the public health officials to close down any violating laboratory, a power already inherent in existing city ordinances. The final ordinance, then, permits all P3 research in Cambridge, provided the facilities use the EK2 organisms, genetically deficient bacteria and viruses that cannot survive outside the laboratory environment. Cambridge mayor Alfred Vellucci, the research's most persistent critic, attempted at the last minute to add another amendment restricting all but P1 research, but the amendment failed.

Although Cambridge now becomes the first city in the United States to regulate research on recombinant DNA, other cities are now considering similar proposals. Public hearings and study committees continue to debate the problem in San Diego, Madison and Bloomington and in New York State. □

How the virus builds itself



The growing tobacco mosaic viruses have two RNA tails, here magnified 68,000 ×.



Left, virus at 136,000 ×. Right, model of the RNA looped inside the protein helix.

The agent that causes mosaic blight in tobacco plants was recognized in 1899 to be a new type of organism, a subcellular form of life. Since then scientists have been repeatedly amazed by this virus's extreme simplicity but perfect competence to do what all forms of life must do—reproduce itself.

When the genetic material, RNA, of the virus enters a tobacco cell, it subverts the cell's machinery to copy viral RNA and to make viral coat protein. New RNA and protein then spontaneously aggregate into mature virus particles. Each complete virus consists of about 2,000 identical protein molecules arranged in a helix. The single-stranded RNA molecule fits into a helical groove that winds around the long axis of the rod-shaped particle.

Laboratories looking at the way the virus assembles were recently surprised by evidence that the virus builds from the inside out. Previously, researchers assumed the protein subunits added to the immature virus as if they were beads and the RNA was a string. The RNA molecule, they predicted, would extend from the growing end of the virus. Now researchers in two laboratories report evidence that in the partially assembled virus the RNA chain forms a loop at the growing end and returns down the virus's hollow core. The extended RNA tail would be pulled up into the cylinder as RNA from the loop is inserted into the protein helix.

Electron microscopic pictures provide the main evidence for this model. G.

Lebeurier, A. Nicolaieff and K. E. Richards of Université Louis Pasteur found that almost all the incomplete virus particles they observed when they mixed viral protein and RNA had two RNA tails protruding from the same end of the particle. One tail was approximately the same length on all the particles, whereas the length of the other, usually longer, tail was inversely related to the length of the incomplete rod, the researchers report in the January PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

Other researchers at the Medical Research Council in Cambridge, England, arrived at the same model from experiments with partially disassembled, as well as growing, rods. P. G. J. Butler, J. T. Finch and D. Zimmern used a chemical treatment to strip part of the protein from completed viruses. In these disassembled particles, the long RNA tail did extend from the growing end, in contrast to the observations of partially assembled rods. When more protein was added to the suspensions of incomplete viruses, partially assembled rods seemed to elongate more than ten times as fast as the partially stripped rods. This result supports the idea that the looping back of the RNA is important to the virus's growth. The researchers suggest in the Jan. 20 NATURE that a loop inside the elongating virus would allow RNA greatest access to binding sites on incoming protein, while holding the bulk of the RNA out of the way of the assembly activity. □