Antarctic bacteria survive millennia

Bacteria that may be as much as a million years old have been found alive in rock and ice from hundreds of feet beneath the surface of Antarctica. They were found in core samples gathered as part of the Dry Valley Drilling Project, a multi-national investigation of Antarctica's evolution (SN: 1/26/74, p. 60), by Roy E. Cameron and Frank A. Morelli, both of the Darwin Research Institute and Jet Propulsion Laboratory in California. The find was announced this week by the National Science Foundation.

The bacteria may be the oldest living forms ever found on earth. A 1960 finding of dormant bacteria in 180-to-230-million-year-old salt crystals met with scientific disfavor, says Cameron, because the research did not rule out the possibility that the salt had recrystallized much more recently.

Like scientists examining samples brought back from the moon, Cameron and Morelli must rule out the possibility of outside contamination before they can be certain of their results. They have already ruled out the most obvious sources—bacteria carried down the coring tubes by the drill lubricant or introduced later by human contact. They are reasonably confident of their findings, but, Cameron points out, there are several hundred lesser sources that must also be considered.

The bacteria seem to represent about three to five different types. One, recovered from 86 meters down in the mouth of Taylor Valley, an ice-free valley formed by the retreat of a glacier, is a rod-shaped organism gathered by Cameron early this year, late in the Antarctic scientific season. Cameron finds it similar in appearance to a type of bacteria known as coryneform, commonly found in air, land and water forms. Morelli's finds were of rod- and club-shaped bacteria, discovered in samples taken at 130, 230, 330 and 430 meters down on Ross Island to the southeast.

The ages of the bacteria cannot be accurately pinned down until geophysical studies date the different depths in the core samples, which cover a span ranging from at least 10,000 to as much as a million years ago.

The bacteria were lying dormant at temperatures from about 7 to 19 degrees F., says Cameron. To take samples from the frozen cores, the tubes were first swept with a butane torch to remove any possible contamination, then drilled in the side with a heated bit, after which sterile cotton swabs were used to sample the freshly exposed material. The bacteria, apparently shocked into activity by the heat, were already moving when they were discovered under a microscope.

"We were sort of flabbergasted," says Cameron. "We had never worked with material that was this old and frozen. We didn't expect this at all." All but one of the types of bacteria have not only lived, but reproduced, with one type forming an unusual ring-shaped colony.

The survival of the bacteria in extreme conditions could be important in the search for life on other worlds, such as Mars. If the Viking robot, which will carry life-detection experiments to the Martian surface in 1976, finds no life, says Cameron, there are now some grounds for looking beneath the surface. He suggests that a permafrost layer on Mars might be far enough down that life-encouraging moisture escapes from it less slowly.

The Antarctic findings further underscore the hardiness of bacteria, which have been found in hostile conditions ranging from high alkalinity to no oxygen. Even so, Cameron points out, a given species may be found on a sunny slope yet not on the shady side of the same ridge as little as a meter away.

An important resource for such studies is now in danger. As a result of NASA's tight-budget personnel cutting, both Cameron and Morelli are being "involuntarily terminated" from JPL in a few weeks. Cameron, who has been with NASA for 13 years, has been coordinating research that uses JPL's Antarctic Simulator, a large "cold room" that contains six tons of frozen soil and water samples gathered since 1966 from Antarctica and another 20 tons from warm desert regions around the globe. "It's the world's major stockpile of soil and water samples for microbiological studies of extreme environments," Cameron says, "and there is a strong probability that they will be destroyed or disposed of."

The reason is that the stockpile may be cost-cut right out of existence. "JPL has said in a letter to the NSF [which sponsors the U.S. Antarctic Research Program] that they can no longer afford to maintain the Antarctic Simulator after July 1."

The samples stored there were gathered largely from depths of one meter and less, Cameron says, which means that it would be virtually impossible to replace them with samples from the same areas that have not been contaminated by man. The operating cost of the facility is less than $3,000 a year, he says, and it could even be duplicated elsewhere for under $25,000. "It's just a plain waste," he says with a sigh. □

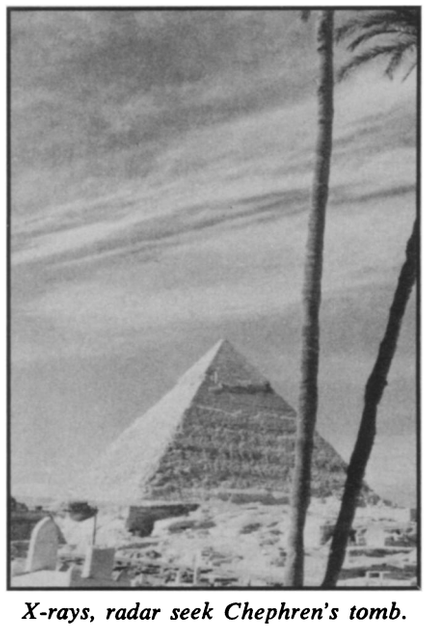
Technology seeks pyramids' secrets

The ancient Egyptians believed in life after death. In the afterlife, they thought, the deceased would need the artifacts of daily life, from combs and makeup kits through household furniture, money and items of transport. The tombs of the wealthy, especially those of the kings, were lavishly provided with such things.

The tombs have thus been quite literally a mine of information for archaeologists interested in the life and customs of ancient Egypt. However, only one royal tomb, that of the relatively minor pharaoh Tutankhahmen, has ever been found intact. In the millennia that the tombs have existed, grave robbers have often got there before archaeologists.

For the last eight years an Egyptian-American group of physicists and archaeologists has been searching for another royal tomb, that of Chephren. Unlike Tut, who died before he had hardly ruled, Chephren, the son of Cheops, was a man of whom history takes note. If his tomb were discovered intact, it would be one of the major archaeological finds of the century. It would also be somewhat ironic because, unlike Tut's tomb, which was overlooked by robbers because its entrance lay buried under the debris of someone else's tomb building, Chephren's has been a tourist attraction throughout almost the 4,500 years since it was built. It is the Second Pyramid at Gizeh.

The investigating scientists are from



X-rays, radar seek Chephren's tomb.

the University of California and Ein Shams University in Cairo. They have been using cosmic rays in an attempt to find chambers within the bulk of the Second Pyramid. One of the group, Luis W. Alvarez of the University of California at Berkeley, reported at last week's meeting of the American Physical Society that the result is negative. "I am convinced there are no chambers in this pyramid," he says, "and I'm surprised."

The search and the surprise both arise from experience with the nearby Great Pyramid. Once upon a time, in the tenth century of our era, there was a caliph of Cairo, Mamoon by name, who needed cash. Knowing that the ancient tombs were often full of it, he commenced driving a tunnel through the bulk of the Great Pyramid starting in the middle of the north face. He intended to drive right through to the middle of the south face, thinking that an architect with a sense of proportion would have put the burial chambers in the middle of the bulk. Had Mamoon continued as planned, he would have missed the burial chambers of Cheops entirely. The ancient Egyptians, wily as always where grave robbers are concerned, had put the chambers 26 feet to the east of the center line of the pyramid. An accidentally dislodged stone caused Mamoon's sappers to alter their direction and discover the Cheops chambers.

Under the Chephren pyramid is a chamber that has been known for a long time. Archaeologists hope it is a decoy, an empty chamber set up to fool thieves into thinking the tomb had already been looted. In this known chamber equipment was placed to measure the cosmic rays that come through the pyramid. The idea was that if there were chambers in the bulk, more cosmic rays would get through in the directions where the chambers lay because there would be less material to absorb the rays.

Alvarez says he does not quite understand why there are no chambers in the Second Pyramid, but the archaeologists in the group have an explanation. As presented by one of them, the late Ahmed Fakry, it goes like this: The pyramid builders were engaged in experiment. In Cheops' pyramid they put chambers, but by the time they got to Chephren's, they had decided they didn't want chambers in the bulk of the pyramid.

The search for Chephren's grave is not over, however. Soon a team from the Stanford Research Institute will go to Egypt to use short-wave, short-range radar that can penetrate limestone to look for chambers under the known one. The radar will also look up because there is one outside chance of a chamber that escaped the cosmic-ray search, a room full of just enough gold to absorb just enough cosmic rays to look like solid limestone. If there is such a golden chamber it will give a banging big signal on the radar because gold is a good electrical conductor.

Meanwhile the swirling sands of the desert still conceal the secret the ancient priests intended them to keep. Will modern technology finally foil the intentions of these early morticians? We shall have to wait and see. □

Chemistry: Looking at the solution

Chemists go busily about their work producing, observing and trying to understand complicated chemical reactions. Many of these reactions, and some of the most important take place in solution. The basic processes of life, for instance, are the result of chemical reactions that take place in solution in cells. In many cases such reactions have been investigated as if nothing were involved except the reacting molecules. The solvent or solution in which the reaction takes place has been largely ignored.

Recent work suggests that the influence of solvents on reactions is much more important than has been previously realized. Some of the evidence for this conclusion comes from work done by John Brauman of Stanford University who used a technique developed by a colleague, John Baldeschwieler. The technique, called ion cyclotron resonance (ICR), works on the same principle as cyclotrons used in physics. It allows chemists to record which ions or charged particles are or are not taking part in a reaction.

The Stanford researchers used the ICR method to study the relative acidity of various molecules. "The results have astounded chemists," says a summary in the newly issued annual report of the National Science Foundation, which has supported the research.

Strong acids transfer a hydrogen ion to weaker acids. This transfer can be detected by ICR and a scale of the relative acidities of molecules can be built up. Surprisingly, the experiments showed that the methyl alcohol, toluene and propylene are all stronger acids than water. In solution, water appears to be 100 times stronger an acid than the alcohols. Toluene and propylene show almost no tendency to act as acids in solution.

If the ICR findings are correct about the true acidity of these molecules, then it is the solution that is responsible for the observed acidity or lack of it. Or as the NSF report puts it, "the only remaining explanation was that the interactions between reacting molecules and solvents were so important that they could completely control the chemistry observed."

In 1935 Michael Polanyi theorized that the energy of certain reactions should be that needed to remove solvent molecules from between reactants so that they could get together. The ICR work of Brauman and Baldeschwieler, for which they have received the American Chemical Society's Award in Pure Chemistry, seems to confirm this as does other recent work. "The studies," says NSF, "should help bring order out of many phenomena that have been difficult to understand, as well as turn up new surprises." □

Hormone switch: Clinical promise

A year and a half ago, Paul Brazeau and his colleagues at the Salk Institute in California reported that they had isolated, characterized and synthesized a substance from the hypothalamic region of the brain that switches off growth hormone. The factor was dubbed "somatostatin." They hoped that somatostatin might prove useful in treating patients with acromegaly, an abnormal enlargement of the face, hands and feet caused by an oversecretion of growth hormone. Tissue experiments with somatostatin indicated that it might (SN: 1/13/73, p. 26).

Now five acromegaly patients have been treated with somatostatin. It almost completely wiped out the production of growth hormone in their bodies. Samuel S. C. Yen and his colleagues at the University of California at San Diego School of Medicine report their findings in the April 25 NEW ENGLAND JOURNAL OF MEDICINE. Unfortunately, though, somatostatin's impact on growth hormone was brief. For this and other reasons endocrinologists are not sure that somatostatin is the answer to the treatment of acromegaly.

Still, Yen and his colleagues did find some unexpected effects of somatostatin on the patients. Aside from turning off growth hormone, which is secreted by the pituitary gland of the brain, it also turned off three other hormones: glucagon, insulin and prolactin. Prolactin is released by the pituitary, but glucagon and insulin are made by the pancreas. So somatostatin's "multitude of action at the level of the pituitary (possibly pancreas and peripheral tissue as well)