Iceland Research Drilling Project

Samples from drill site and cliff in foreground yield 3,220-meter continuous core.

ical data have never before been available, Wilkens said. Data about the layer responsible for magnetic anomalies and the effects of depth on magnetism indicate depth has some effect on the intensity of magnetism, Shaul Levi of Oregon State University told SCIENCE NEWS. Temperatures of 72°C recorded at 1,600 meters indicate the possibility of economically feasible geothermal energy for eastern Iceland.

Preliminary data from the core samples, which will be kept at Dalhousie University for two years and then returned to Iceland, will be published in March. But at least two years' more research is needed, according to Levi. At a total cost of $250,000 for the drilling, it's "a great deal," Wilkens says. □

New data put quasars sky-high

To determine the distance to any object beyond, roughly, the remote boundary of our so-called local group of galaxies — about 100 billion billion kilometers away — astronomers must rely on an ingenious technique involving redshifts. That is, the faster an object is departing from you, the lower will appear the frequency of its radiation (thus visible light is shifted toward the red end — the low frequency end — of the spectrum and hence the term "redshift"). Furthermore, it has been observed that the distance to a galaxy is proportional to its speed of recession. Redshifts are therefore a form of yardstick.

Using this strategy, astronomers infer that quasars are very far away — approaching the very edge of our universe. This property of quasars coupled with their other eccentricities, however, has disquieted astronomers so that some have even suggested and made notably successful efforts toward proving that in some instances, at least, redshifts should not be trusted in the ordinary way. Now, Alan Stockton of the University of Hawaii has reported results that he concludes make "virtually certain" the conventional belief that most quasars are at immense distances from the earth.

First discovered in 1960 by Allan Sandage with the 200-inch Palomar telescope, quasars (quasi-stellar objects; also called QSO's) look deceptively like stars. But unlike stars, some emit huge quantities of radiation in the radio frequencies; others have luminosities that vary wildly (by factors of twenty-five and greater) within periods only weeks long; and most typically are extraordinarily bright — that is, if their redshift distances from us are to be believed. If these were unreliable for some reason, then quasars might actually be closer to us and therefore less anomalously bright.

This prospect and others that would follow from learning that quasars were in reality close by, seem to have been dealt a serious blow by Stockton's research. Inspecting the immediate celestial neighborhoods of 27 exceptionally bright quasars, Stockton found that in each of eight cases there is at least one ordinary galaxy with a redshift not too unlike that of the neighborhood's resident quasar. Because the odds, as Stockton calculated, are overwhelmingly against these being simply chance coincidences or illusory companionships due to an accidental superposition of remote objects along a common line-of-sight, there is reason to surmise that the quasars are indeed associated with the galaxies. And since astronomers are quite convinced for a history of reasons that the redshift technique is valid for galaxies, then by association it must be valid for these quasars. It remains unclear due to other studies' conflicting data, however, just how generally true for all quasars are Stockton's findings, which appear in the Aug. 1 ASTROPHYSICAL JOURNAL. □

The South: A resource greater than oil

In the 1930s, President Franklin Roosevelt declared that the South was the nation's number one socioeconomic problem. He was right. It was rampant with tenant farming, racial segregation, a dearth of industry and a poor educational system. During the past 40 years, however, the South has made dramatic strides in eradicating these deficiencies. What's more, the South today has two other major bonuses that other areas of the United States cannot necessarily claim — valuable untapped natural resources and a largely uncontaminated natural environment so crucial for a high quality of life.

So declared Eugene P. Odum last week at the annual meeting of the American Institute of Biological Sciences, held at the University of Georgia in Athens. In addition to being a professor at the University of Georgia and one of the nation's leading ecologists, Odum was also the meeting's keynote speaker. The title of his talk was "The Nature of the Southeast in Transition."

Georgia, Odum explained, is a good ecological microcosm for the rest of the Southeast of the United States. The finest ground water in the world lies under this state, and ground water is indispensable for cooling power plants, farm irrigation and various industrial and municipal purposes. There will probably be a scramble for ground water in the years to come. Thus the South is "better off with water than with oil," he concluded, especially as oil is replaced by alternative power sources. Georgia also has a largely uncontaminated natural environment, consisting of rich farm and grazing lands, hundreds of swamps, coastal marshes and exquisite islands lining the coast and protected by the state, Odum continued.

But Georgia and other Southeastern states must be careful to preserve their natural resources and their natural ecosystems, Odum warns. A prime example of an omission in this area is the Copper Hill, Tenn., smelter, whose sulfuric acid fumes have carved out a 25-mile-square desert that is virtually devoid of vegetation and almost impossible to rehabilitate even 40 years later. Today Southeastern cities, he suggests, should learn from "Bo-Wash" — the strip of cities and industries that extend from Boston to Washington — and be sure to leave green "life belts" around themselves as they expand. That way people's quality of life can be maintained. So far, all Southeastern cities are surrounded by such belts with the exception of coastal Florida.

The construction industry in the Southeast must become more conscious of the dangers of erosion, because construction sites lose a lot of soil, Odum advises. Forests can help prevent erosion. So can grasses and wetlands. (For the past two years Odum and his colleagues have had a contract from the Environmental Protection Agency to probe every possible aspect of erosion.) The Southeast must also start conserving water, their most precious natural commodity. For instance, water off the eastern coast of Georgia is deteriorating in quality, as is water up and down the entire East Coast of the United States. The Southeast must start keeping track of how much ground water it has. Industry currently has to report how much water it uses, but farmers do not. If too much water is drawn off the Chattahoochee River before it reaches Atlanta, the river will not have enough water for Atlanta by the year 2010. The river is the city's sole source of water.

Finally, "we have to get ecology and economics together," Odum advises. Southeast residents must learn to draw up ratios between the advantages of jobs and environmental devastation, in order to achieve the best for both people and environment. For instance, Georgia does not need oil processing since it provides few jobs for the poor and less-educated, yet creates a lot of pollution. In contrast, the textile and food processing industries now provide most jobs in Georgia, yet do not use all that much water, thus providing a good example of the marriage between economics and ecology. □

Mars contamination looks less likely

The phrase "planetary quarantine" is one of the more pungent bits of jargon in the Space Age lexicon. In science fiction, it has sometimes described the activities of extraterrestrial beings "sealing off" the earth to prevent contamination of other, more civilized worlds by this planet's warlike ways. In fact, however, it has a very real purpose. The Viking spacecraft sent to Mars, for example, were first rigorously sterilized, not only to avoid confusing the biology experiments on the landers, but to keep the planet from being overrun by any earthly microorganisms that might have prospered in the new environment. The sterilization process was both expensive and technologically demanding, often requiring engineers to adopt alternative designs, components or materials that could withstand the many hours at high temperatures required by the sterilization procedures.

Thanks to Viking, however, the designers of some future Mars-bound craft may have it a little easier, judging from the findings of a panel of the National Research Council's Space Science Board. After studying the Viking data, the panel has concluded that conditions on Mars are "considerably harsher to terrestrial life than was heretofore assumed," and that NASA should assume a lower "probability of growth" for transplanted earthly microorganisms when planning future sterilization criteria. In fact, says the group's report to the space agency, "we would object to the elimination of an experiment or the degradation of its performance because of the imposition of unessential sterilization requirements."

The probability of growth, or P_g, is officially "the estimated probability that growth and spreading of terrestrial organisms on the planet surface will occur." The chance, in other words, that a given germ — having survived the clean rooms, the sterilization procedures (if any), the cold and vaccuum and radiations of space, and the heat of entering the other planet's atmosphere — might then survive or even thrive on the alien world, altering it for all time in what would be an ecological disaster of truly interplanetary proportions — particularly if indigenous life-forms are already present.

The odds are thought to be extremely small, but because the consequences could be horrendous, considerable effort is spent on minimizing the possibility. Not surprisingly, NASA uses a formula, in which the probability of contaminating the planet equals the number of microorganisms on the spacecraft at launch multiplied by several other probabilities: that the organisms will survive space and entry conditions, that the spacecraft will reach its destination, that the organisms will get out of the vehicle into the planetary environment, and finally, P_g, that they will grow. For Viking, NASA assumed a P_g of 10^{-6} — a chance in a million.

The Space Science Board's Committee on Planetary Biology and Chemical Evolution, headed in its study by Peter Mazur of Oak Ridge National Laboratory, gives the invading germ a P_g of no more than a chance in ten million, and for most of the planet's surface only one in ten *billion*.

The committee divided the planet into three regions: the nonpolar regions within 6 centimeters of the surface, the nonpolar regions below that depth and the poles themselves. For the nonpolar near-surface, the panel feels that the key factors in its minuscule assigned P_g of 10^{-10} are the extremely active oxidants detected by the Viking biology instruments and the lack (down to parts per billion) of detectable organic molecules, plus the fact that the thermal mapping instruments on the orbiters showed the planet to be generally cold all over. The landers sampled only two sites, but elemental analyses showed them to be very similar, and the oxidants appear derived from atmospheric — and hence essentially global — reactions. The 10^{-10} is derived from a 1 in 10 chance that the deposited microorganism can live without free oxygen (about 10 percent of terrestrial microorganisms are anaerobes, Mazur says), another 1 in 10 that it can survive multiple freezing and thawing, yet another tenth for the avoidance of lethal ultraviolet radiation (a little surface dust would do the trick), a chance in 100 that there will be enough (and useful) organics to eat, another chance in 100 for the presence of liquid water of sufficient "activity" (indicating how hard it would be for the organism to incorporate it) and the big blow — a final chance in 1,000 that the already much-threatened creature would somehow escape the vicious oxidants.

More than 6 cm down, the committee gives the organism a better chance of survival: one in 100 million, still 100 times worse than NASA was willing to count on before the Viking data were in hand. A key factor here is temperature, since the data suggest that the maximum temperature falls rapidly with depth. In the northern hemisphere, even only 4 cm down, says the committee's report, "the maximum temperature is estimated to be 20°C below the minimum confirmed growth temperatures (−15°C) observed for terrestrial organisms. By a depth of 24 cm, the *maximum* temperature is estimated to be −50°C. . . ." In the south, it's nearly as chilly. At greater depths there is the possibility of finding permafrost — water ice — which could conceivably be accompanied by a liquid layer, but water that is liquid below −20°C and is in equilibrium with ice "has an activity below that which will support the growth of any known terrestrial organism capable of growing under the partial pressure of oxygen on Mars." The conclusion is not absolutely certain, the panel points out — there could be warm "oases" too small for the orbiters to detect, or currently unknown organisms that could handle the cold — but the environment is still "exceedingly harsh," and the low P_g is still recommended solely "for the specific purpose of determining quarantine requirements for future Martian missions."

The residual polar caps get only a 1 in 10 million rating. Viking scientists have concluded that at least the northern residual cap appears to consist entirely of water ice, and the atmospheric interactions there are less known, but the cold is still the key. The rating is thus roughly that of the nonpolar subsurface, backed off a bit to allow for the uncertainties.

The committee has never been particularly happy about having to boil all these scientific questions down into a single exponential value, "when nearly nothing is known about the identification and metabolic capabilities of the organism, the size of the initial inoculum, the presence of associated microorganisms, the details of the environment in question, and most important the detailed changes in all of the relevant environmental factors with time." The panel recommended replacing the "probabilistic method" with studies of known organisms most likely to thrive under known planetary conditions. Such a qualitative approach, however, is hard to translate into specific sterilization methods, and it has yet to be done. □