

Quake prediction 'on verge of reality;' geophysicists seek other links

"Earthquake prediction, an old and elusive goal of seismologists and astrologers alike, appears to be on the verge of practical reality." This was the report of three researchers from Columbia University's Lamont-Doherty Geological Observatory, and at the multitudinous annual meeting of the American Geophysical Union in Washington this week, predictions and correlations are, in large measure, the name of the game.

New understanding of the convoluted relationships that link the physical characteristics of the earth (and other worlds) is the goal of the AGU's members, who run the professional gamut from meteorology to volcanology, from oceanography to astrophysics.

Often the connections they find are strange indeed, as in the case of two University of Hawaii scientists who have found that the upper atmosphere may offer advance warnings about tidal waves, or tsunami. The tremors that can produce tsunami also generate vertically polarized waves in the earth called Rayleigh waves. These vibrations pass on to the air and move upward through the ionosphere, where, according to Kazutoshi Najita and Paul Yuen, they can be detected by the ionosphere's corresponding effect on radio waves.

Another investigator theorizes a connection, in the eastern United States at least, between quake-prone areas and low surface elevations. "Either the crust is weaker and breaks more easily where it is thinner," says Benjamin F. Howell Jr. of Pennsylvania State University, "or it erodes more easily where it has been broken in the past, and the low places mark these weaknesses."

The Lamont-Doherty team—Christopher H. Scholz, Lynn R. Sykes and Yash Pal Aggarwal—believe that quake conditions can begin when subterranean rocks crack, releasing the pressure which has been delaying the quake by holding the region stable. As water from adjacent regions seeps in, the pressure rises again until it triggers a quake within the now-fragmented rock. The build-up to a quake has detectable symptoms, however, which could be the key to prediction: small uplifts on the surface, changes in electrical conductivity as the water flows in, increased emission of radioactive radon gas and a decrease in small tremors as the water lubricates the rocks while the pressure is building. All these symptoms have been observed preceding at least 30 quakes in Japan, the Soviet Union and the United States.

Several AGU attendees also discussed the work of a colleague, not reporting at the meeting, who reportedly found such a strong correlation between local increases in the earth's magnetic field and subsequent tremors around California's San Andreas Fault that he took several months for additional observations to make sure.

Not all such connections, of course, are studied with natural disasters in mind, although those links, too, may be present. Perhaps the broadest theory was one presented by Moody L. Coffman of Central State University in Oklahoma, relating changes in the earth's main magnetic field not only to earthquakes, but to volcanic eruptions, tidal motions and continental drift.

Practical or theoretical, the work of the predictors and correlators points to a unified picture of earth.

such a move was being considered, NIH officials avoided any possible controversy and made a final decision. At a demonstration by Roman Catholic schoolgirls an NIH spokesman stated: "We know of no circumstances at present or in the foreseeable future which would justify NIH support of research on live aborted human fetuses." The unofficial statement is expected to become policy. This position will not affect private research but because of the pervasiveness of NIH funding, it is expected that all such experimentation in the United States will be discontinued.

Those who favor research on live human fetuses argue that an aborted fetus is like a removed organ. The mother's decision or whatever caused the abortion, they say, has already doomed the undeveloped child. In such instances it seems more acceptable to these researchers to use the fetus for valid research than to dispose of it. During the few hours the fetus might live, for instance, the effects of drugs and other environmental agents can be seen in the entire organism rather than in cell cultures or single organs. Such work, researchers hope, will eventually clarify the dangers or benefits to the fetus of drugs taken by the mother during various stages of pregnancy. With the new NIH position, however, such research will have to be done out of the country and without NIH funds. □

Don't go near the (drinking) water

If air pollutants don't suffocate you or food additives poison you, drinking water laced with a little arsenic or cadmium may well do the trick. This was some of the less encouraging news to emerge from last week's meeting of the American Chemical Society in Dallas.

Various investigators have noted strong correlations between soft water and heart disease (SN: 2/10/73, p. 89). There is fairly strong evidence that lithium, and perhaps also vanadium, barium and strontium in soft water are the hazardous chemicals, Julian B. Andelman of the University of Pittsburgh reports. Harold W. Wolf of the Water Reclamation Research Center in Dallas has found that deaths from heart disease increased when salt water, high in sodium, was processed into drinking water. Sodium has long been implicated in heart disease. Walter J. Weber of the University of Michigan has found that soft water is more apt to contain cadmium than is hard water. Because cadmium accumulates in biological tissues and may replace zinc in certain proteins, its presence in the human body is probably undesirable. But there is no specific evidence that cadmium is implicated in heart disease.

Clinical and epidemiological studies in several locations throughout the world have shown adverse health effects from arsenic in drinking water, Gordon Robeck of the Environmental Protection Agency in Cincinnati points out. In Taiwan people who use well water rich in arsenic develop hyperpigmentation and eventually skin cancer. Well water on a Nevada ranch that was high in arsenic content caused skin conditions in one child and possibly in another. Wolf has noted a "striking" correlation between the presence of heavy chemicals in water basins throughout the United States and the incidence of bladder cancer. This is one kind of cancer scientists are sure is triggered by environmental chemicals.

On the whole, investigators are far from certain what effects chemicals in drinking water have on health. The health effects themselves are difficult to determine, and the chemicals in drinking water are ever-changing. As Andelman stresses, chemicals put into drinking water at the time of treatment, such as chlorine and aluminum, often dissipate by the time they reach the tap. On the other hand, water may pick up new chemicals, such as cadmium, copper, nickel and lead, after it leaves the treatment plant. Water from treatment systems near each other may differ in chemical content. Water processed from the Allegheny and Mo-

nongahela Rivers in Pittsburgh has been noted to vary markedly in nickel and strontium content. Water that travels through the same pipes and taps may differ from day to day.

So with the effects of various chemicals on health uncertain and the chemical content of drinking water hard to pin down, it is little wonder that national drinking standards are inadequate. "Drinking water standards," Robeck flatly admits, "have little scientific basis for existence." What is needed, he says, is better research into the chemical content and hazards of drinking water. The National Academy of Sciences and the National Academy of Engineering will soon publish suggestions on research needs in water supplies. Several bills before Congress would also provide research so that better standards can be set. □

Meteorite material is oldest yet found

Meteorites preceded moon rocks in the laboratories of earth. Now it appears that meteorites may well have preceded the moon in condensing from the early solar nebula. At least *some* material found in the Allende meteorite is older than anything yet dated on the moon. In fact it is older than anything ever dated so far, 4.61 billion years.

C. M. Gray of the California Institute of Technology announced the findings this week at the annual meeting of the American Geophysical Union in Washington. The Caltech group concluded that the results indicate that many planetary bodies such as the Allende meteorite, Angra dos Reis (another meteorite), other meteorites, and the moon condensed from the solar nebula over a distinct time interval of about 10 million years that ended 4.6 billion years ago.

The Caltech group dated calcium-aluminum rich inclusions in the meteorite. Scientists have accepted for several years now the hypothesis that highly refractory materials such as aluminum and calcium were among the first condensates of the solar nebula.

The relative age of these inclusions is based on what scientists believe to have been the ratio of rubidium to strontium in the early solar nebula. These values were derived by studying strontium 87/86 ratios in meteorites such as Angra dos Reis, which is a little younger (in cosmic terms) than Allende. Before Angra dos Reis, the most primitive strontium had been found in basaltic achondrites, and dated 4.6 billion years old.

Another significant finding is that the inclusions have been altered recent-

ly in space—since 3.6 billion years ago, maybe by collision with a comet.

The aluminum- and calcium-rich inclusions in the Allende meteorite have attracted more than usual interest because the moon's highlands are rich in these same elements. Some geophysicists have gone to great lengths to demonstrate how the moon could be made of the same material as the Allende inclusions. But at this year's conference, serious objections were raised to this model. The trace element differences between the lunar material and Allende are great. According to Lawrence Grossman of the University of Chicago, Allende is enriched in iridium and siderophile elements compared with the moon. Also the oxygen isotope content differs by two percent. "You have a serious problem making the moon out of Allende inclusions," he says. "The Allende inclusions are a fantastic geochemical anomaly. There are no rocks on earth like them."

How part of the moon was made of much the same material as inclusions found in the meteorite remains unanswered. But Allende is gaining new fame. "Allende is a Rosetta stone," says Grossman, "because it demonstrates spectacularly that chemical fractionation involving major elements took place as early as the condensation of the nebula." □

Salyut 2: Signs of difficulties

The Soviets were not talking this week about the Salyut 2 space station, launched April 3 (SN: 4/14/73, p. 237). Such silence usually means the mission is not going as planned.

There are ways of cracking the silence curtain, however. Last week spacecraft trackers noted that the station had been shifted to a higher orbit 161 miles above the earth. Experts had been expecting a Soyuz launch around April 7 to take cosmonauts up to dock with the station.

The orbital shift seemed to indicate the Soviets have parked the station because of either trouble on the ground with Soyuz or unresolved trouble with the station itself. (Placing the station in a higher orbit will allow it to survive. Otherwise the atmospheric drag would have slowly pulled the station's orbit down.)

Solar physicists speculated that the Soviets delayed Soyuz 12 because of unusually high solar activity which began about the time they would have launched the cosmonauts. There was an increase in sunspot activity around April 7 leading to more than 35 flares. Most bets this week, however, were on trouble with Soyuz. □

Developing vaccines for hepatitis A and B

Hepatitis attacks the human liver from two directions. Infectious hepatitis is transmitted by a virus (Type A) that lives in the intestines and sewage. Serum hepatitis (Type B) is transmitted through the blood via transfusions or from contact with nonsterile instruments such as hypodermic needles. Progress in developing vaccines against both forms of this disease was announced last week.

In 1967 an infectious hepatitis virus (CR326) was isolated in marmosets (a South American primate), but there was some doubt that this was the same virus that attacked humans. Now there is good evidence that it is and researchers have been using it in attempts to develop a vaccine. CR326, together with blood serum from humans with infectious hepatitis (and therefore antibodies to the disease) was given to uninfected marmosets. These animals developed fewer cases of hepatitis than did animals given the virus alone or the virus with blood from humans without the disease. This work indicates that the antibodies can destroy the virus, and is the first step in developing a vaccine. The work was done by researchers at the Merck Institute for Therapeutic Research in West Point, Pa., and scientists at the Louisiana State University International Training Center in San Jose, Costa Rica.

Progress toward the development of a vaccine for the prevention of Type B hepatitis is reported in the April 12 NEW ENGLAND JOURNAL OF MEDICINE. Two years ago Saul Krugman and Joan P. Giles announced the development of a prototype for such a vaccine (SN: 3/27/71, p. 211). Patients at the Willowbrook State School in Staten Island, N.Y., were exposed to serum hepatitis after being inoculated with inactivated (boiled) serum from infected patients. Immunity was produced but the results were not conclusive. Now Krugman and Giles report, after two years of follow up and retesting, that the immunizing process produces a decrease in the incidence of acute hepatitis as well as a decrease in the incidence of the hepatitis carrier state. This means it is possible to prepare a vaccine for the prevention of viral hepatitis. However, the researchers note, the rate of progress toward the development and ultimate licensure of an inactivated vaccine will depend upon the successful propagation of the virus in cell culture or a suitable animal (or both). Sensitive, reproducible tests will be needed to provide objective evidence of lack of infectivity. □