Prehistoric flood from ice surge

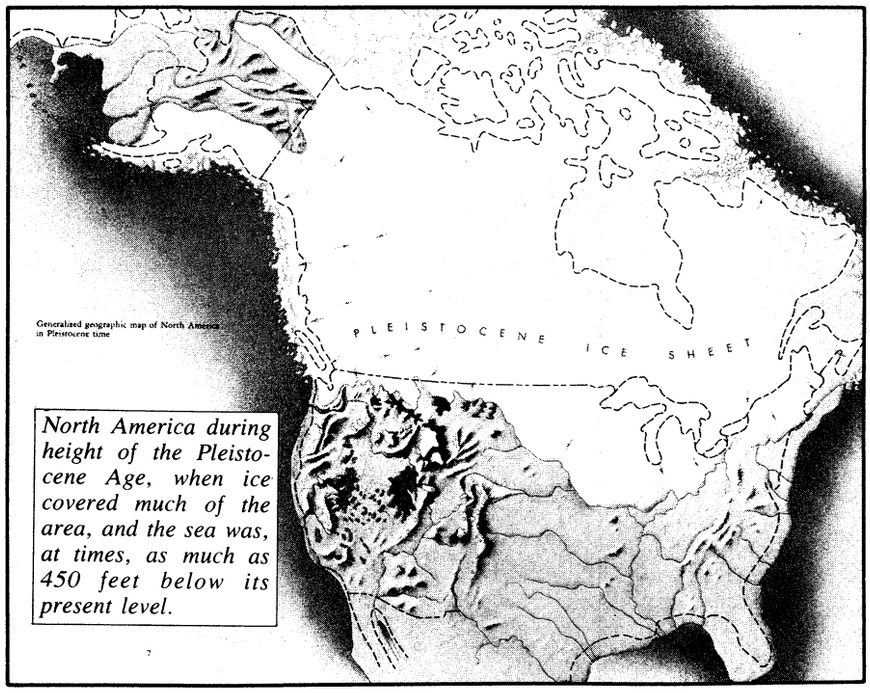
In almost every culture, from the dim, prehistoric recesses of the early Neolithic period, emerge strikingly similar tales of a great flood that swept away emerging civilizations and changed the face of the earth. New evidence gathered from sea-floor cores not only confirms the existence of such a universal deluge and offers a tentative explanation, but raises the possibility that similar flooding could happen again.

Paleoclimatologist Cesare Emiliani and an interdisciplinary team of seven co-workers from the University of Miami conclude from analysis of core samples taken from the Gulf of Mexico near the mouth of the Mississippi River that during the 10th millennium B.C. the Laurentide ice sheet covering much of the Northern Hemisphere underwent a sudden surge, readvancing southward, where it quickly melted. The released water would have caused extensive inland flooding and raised the sea level perhaps some tenths of meters per year. Their report is in the Sept. 26 SCIENCE.

The time estimate for the peak of this flooding, 9600 B.C., coincides almost exactly with Plato's date for the inundation of Atlantis. Other cultures also have records of a great prehistoric flood, from the account of Noah's Ark to American Indian legends, but the timing of these is less certain. Since the sea level was some 150 feet lower at the start of the flooding than it is today, the isolation and submerging of whole civilizations would be well within the realm of possibility.

The Miami team reached its conclusions by analyzing isotope concentrations in fossil shells laid down in the cored sediments, and by noting changes in the plankton species represented. Measurements of concentrations of oxygen 18, using a mass spectrometer, revealed a sudden decline of the isotope in fossil shells at a core depth of about 150 centimeters, indicating that the surrounding seawater had suddenly become fresher when that sediment was being laid down. By then checking the concentrations of carbon 14, using scintillation counters, an age of about 9600 B.C. was established for the layer. Finally, an abundance of cold-water plankton species indicated that the water temperature was then about three degrees C. colder than at present.

The sudden decrease of salinity coincides with a previously recognized glacial event: the so-called "Valders readvance," in which the retreating arctic ice-cap suddenly spread again into what is now the northern part of the United States. (Tree-ring data had been used to establish the event). Emiliani and his colleagues conclude that the warming trend signaling the end of the last ice age caused this broad but thin ice sheet to "surge" toward lower latitudes, melting rapidly as it went, and sending floods of fresh water toward the oceans.



North America during height of the Pleistocene Age, when ice covered much of the area, and the sea was, at times, as much as 450 feet below its present level.

U.S. Geological Survey

"We postulate that ensuing flooding of low-lying coastal areas, many of which were inhabited by man, gave rise to the deluge stories common to many traditions," Emiliani and his colleagues conclude.

Presumably ocean-bottom cores from other coastal areas around the world will now be checked to see whether similar flooding occurred at about the same time as in the Gulf of Mexico. These investigations are sure to shed more light on what happened during the last ice age and the effect on emerging human civilization. In addition, the whole subject has a startling modern footnote: Some scientists hypothesize that similar catastrophic surges could still occur in the Antarctic ice sheet, causing new global flooding. They are likely to gain new credibility. □

Environmental action in China

Like so many other technical ventures in the Peoples Republic of China, environmentalism is largely a grass-roots affair: an effort to mobilize local, rural resources and involve the nation's masses in great voluntary programs. One of the first detailed descriptions of these efforts was presented as a part of the current visit to the United States by 14 Chinese scientists in the Scientific and Technical Association delegation. Speaking to a small group of scientists at the National Academy of Sciences in Washington, environmental chemist Liu Ching-yi described current research in environmental areas and practical programs aimed at purifying China's air and water.

The rural environment, where 80 percent of China's population still lives, has undergone "profound change," she says. The age-old decline of soil, forests and rivers is now being reversed through irrigation, reforestation and fertilization programs coordinated by government agencies but exercised at the local level. Some 1.3 million hectares of land each year are being newly irrigated, "extensive" reforestation projects are reestablishing lost timber reserves and stemming erosion, and human excrement is widely collected for fuel and fertilizer production. Small "marsh gas" fermenters that transform such wastes into gas for heating and light can be afforded by individual families, though some communes choose to pool their wastes and use the produced fuel for running irrigation pumps, and so forth.

In the cities, the aim is to find ways of having "comprehensive utilization" of wastes, Liu says. At trash purchasing stations, people are paid to recycle waste materials. Industrial pollution is controlled mainly through site planning. Factories are moved away from city centers, spaced far enough apart that pollutants are not concentrated to dangerous levels, and located with careful regard to atmospheric conditions, in order to obtain maximum dispersion of wastes. In Peking, for example, prevailing winds are from the northwest, so industries were moved to the southeast part of the city.

Environmental health programs have centered on eliminating the "four evils:" flies, mosquitoes, rats and bed bugs. Smallpox, bubonic plague and some other diseases have thus been successfully wiped out in China, and progress is being

made against others, such as schistosomiasis. (Liu read part of a poem by Chairman Mao praising a successful battle waged by one community against the snail-borne disease.)

Liu received her master's and doctorate degrees at the University of Illinois, returning to China in 1954, where she now works in the Institute of Environmental Chemistry of the Chinese Academy of Sciences. She describes the government's role in environmental protection as one of coordination and support. Research, for example, is largely aimed at conducting effluent-quality surveys, studying natural cycles of ground water, analyzing drinking water and human blood for trace element contamination, and development of catalytic reactors to neutralize industrial wastes. Liu pointed to some specific results of these endeavors, including successful correlation of certain diseases to trace element contamination, and partial control of the "yellow dragon"—nitrogen oxide smoke. Some sophisticated techniques have apparently also been developed; Liu mentioned the use of laser scanning to measure particulate concentrations.

Though "many problems remain," she says, success of initial environmental programs can already be seen in the health of the people and the sight of the land. Even the Yellow River is now less yellow because reforestation has helped control erosion upstream. Addressing her American colleagues as "dear friends," Liu said the delegation hopes to gather useful suggestions from scientists here on how to meet environmental challenges. □

Charging quarks through beta decay

The beta decay of nuclei has been extensively studied since the late 19th century. There are libraries of data on it, and its parameters are very well known. Perhaps this precision can be used to determine things about the particles that make up the nucleus, things that direct particle-physics experiments necessarily have to be somewhat vague or even inconclusive about. "In a spirit of adventurous naivety" D.H. Wilkinson of Oxford University sets out to use beta-decay results to check the theoretical prediction of the electric charges of the quarks. His results, presented in the Sept. 18 NATURE, favor the original quark theory.

The effort is adventurously naive or naively adventurous because to arrive at this quasi-experimental determination one must believe not only the basic hypothesis to be tested but a chain of subsidiary hypotheses as well. As R.J. Blin-Stoyle of the University of Sussex remarks in a commentary in the same issue of NATURE, "This is a remarkable connection to make [between quarks and beta decay] and inevitably intermediary assumptions and hypotheses have to be made in achieving it."

The basic hypothesis to be assumed is that protons and neutrons are made up of quarks. Beta decay involves the change of a neutron to a proton by the emission of an electron and an antineutrino, so it is the quark structure of protons and neutrons that is dealt with. Theory proposes that particles (except leptons) are made of two or three out of three subparticles called quarks. The three are designated: n, p, and lambda (because they have certain properties analogous to neutrons, protons and lambda hyperons). The makeup of neutrons and protons is supposed to involve n and p quarks. The older quark hypothesis says the charge of a p quark is two-thirds that of an electron and is positive. That of an n quark is one-third the electron charge and negative. (A newer suggestion would allow the charges to be equal to the electronic charge.)

Wilkinson points out that there is some independent evidence for quarks in the construction of neutrons and protons from particle-physics experiments. They seem to indicate constituents that act over a radius of 0.02 fermi. Since the size of the neutron or proton is about 0.8 fermi, the quarks are indeed point particles. It also appears that they make up 95 percent of the nucleon, leaving only a small allowance for antiquarks.

Beta decay is mediated by the so-called weak interaction, but since electromagnetically charged particles are involved, corrections for electromagnetic forces are also involved. It is the strengths of these (their coupling constants) that are crucial in the calculation. To arrive at the basis of calculation requires swallowing some hypotheses about the weak interaction, especially that the weak interaction is universal, acting in the same way in all the phenomena it governs, and that it is related to the electromagnetic according the unified field theories now current.

With that basis Wilkinson comes to a relation between the forces and their coupling constants and how those data relate to quark charges. He then uses data from particularly simple kinds of beta decay, which, Blin-Stoyle says, "have been carried out to extremely high accuracy [and] have been the preoccupation of Joan Freeman and her colleagues at Harwell and more recently by other researchers in Canada and the U.S.A." Wilkinson arrives at a charge for the p quark of 0.69 $\pm$ 0.07 and for the n quark of minus 0.29 $\pm$ 0.15. This is compatible with the classic quark theory but not with the integral-charge theory.

Blin-Stoyle points out that this is only one of the properties of elementary particles that can be derived from low-energy work in nuclear physics. Others are being studied (time-reversal invariance, parity-violating nuclear forces, exotic interactions). ". . . There are those of us who feel" he says, "that quite apart from achieving a full understanding of the nucleus as a many-body system, there are these other important reasons for continuing detailed studies of nuclear phenomena." □

A second gamma pulsar

The term "pulsar" now bears two somewhat different and perhaps confusing meanings. Originally it was applied to the pulsating celestial radio sources first discovered by Antony Hewish and colleagues. Later it was applied to pulsing X-ray sources. Generally the radio pulsars do not emit pulsed radiation in other ranges of the electromagnetic spectrum, and the same goes for most X-ray pulsars. The X-ray pulsars are usually part of binary systems, whereas only one radio pulsar is known to be. Radio pulsars are generally held to be neutron stars, but two X-ray pulsars are suspected of being black holes.

Among all this there have been two objects with a broad spectrum of pulsations, both of which were first discovered as radio pulsars. The Crab nebula pulsar pulses in light, X-rays and gamma rays, as well as radio. The Vela pulsar, known to pulse in light and radio, now, according to the latest report (ASTROPHYSICAL JOURNAL 200:L79), joins the Crab pulsar as the second known gamma-ray pulsar.

Gamma rays are the shortest-wavelength end of the electromagnetic spectrum. They carry more energy and are therefore "harder" than X-rays. Exactly where the boundary between X-rays and gamma rays lies is sometimes a matter of taste, but what is at issue is radiation with energy greater than 35 million electron-volts per particle as measured by the second Small Astronomy Satellite. The pulsed emission comes in two peaks that follow the single radio peak by 13 and 48 milliseconds.

The observers, D.J. Thompson, C.E. Fichtel, D.A. Kniffen and H.B. Ögelman of the NASA Goddard Space Flight Center in Greenbelt, Md., report that the luminosity of the pulsed emission above 100 million electron-volts is about a tenth of that of the Crab nebula in the same range, but the luminosity of the pulsed light from Vela is only about two ten-thousandths that of the Crab. The high intensity of the gamma-ray emission from Vela and its double- pulse structure suggest that it may be produced by means different from those of lower-energy emissions, the observers conclude. The gamma rays could be incoherent synchrotron radiation emitted by electrons of 100 to 1,000 million electron-volts energy orbiting in a magnetic field of 10 billion to a trillion gauss. □