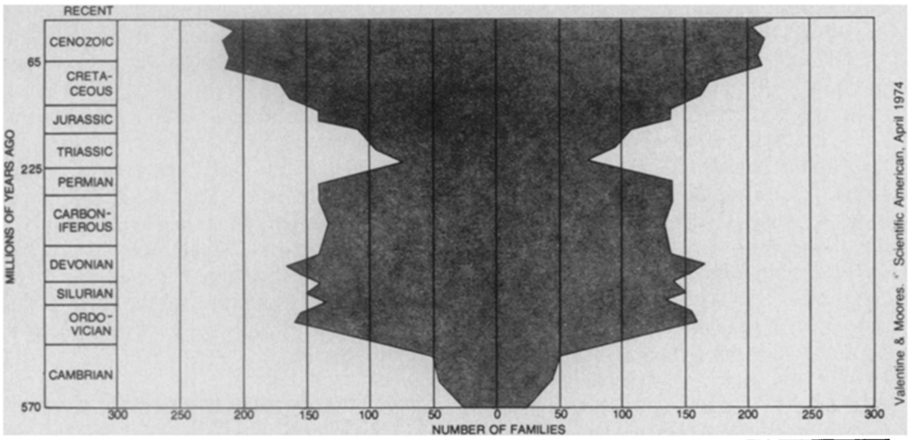
Permian extinctions: Super-salty sea?



End of Permian brought dramatic drop in variety of shallow-water marine organisms.

During a period ending 225 million years ago, life on earth underwent the greatest crisis of survival known before or since. Fifty percent of the kinds of animals and plants living at the beginning of the Permian, 280 million years ago, were extinct by its close, 55 million years later. The number of families of shallow-water marine invertebrates, for example, the most common forms of ocean life, plunged dramatically.

This great wave of extinction through the Permian has held the interest and imagination not only of geologists, paleontologists and biologists, but of astronomers and geophysicists as well. The low-point in diversity of life on earth at the end of the Permian defines the transition between two great eras of life on earth, from the Paleozoic to the Mesozoic, when life began rapidly to diversify again.

In the last decade, geologists and biologists have been given an entirely new framework—the theory of plate tectonics—in which to examine the conditions of the past and to explain fluctuations in the diversity of life. It is now known that the configuration of the earth's continents has gone through several dramatic cycles, a Precambrian supercontinent breaking into a Cambrian world 570 million years ago consisting of four continents, followed by welding of the continents back together to form the Pangaea supercontinent of 225 million years ago. In Mesozoic time Pangaea broke up into separate continents, which have gradually spread to their present positions.

In the past few years a number of geologists have been busy assessing what all this continent rearranging would have meant for life on earth. James W. Valentine and Eldridge M. Moores have been especially active in this area (SN: 11/21/70, p. 396 and 12/11/71, p. 395), and last year they published an important article showing how the breakup of Pangaea apparently triggered a long-term evolutionary trend that led to the present unprecedented diversity of life (''Plate Tectonics and the History of Life in the Oceans,'' SCIENTIFIC AMERICAN, April 1974).

In their view of events, the Permian extinctions of 225 million years ago were a consequence of the formation of the giant supercontinent Pangaea. The assemblage of Pangaea vastly reduced the total area of continental shelves (so important as habitats for marine life), lessened the number of shallow seas, and in general caused less geographically diverse and less seasonally stable conditions (because of the effects of land masses). Once Pangaea split up and its pieces spread apart, these trends were reversed, and the diversity of life flourished again.

Richard L. Bowen, a geologist and paleooceanographer from the University of Southern Mississippi, believes the Valentine-Moores hypothesis gives too much attention to the treatment of continents or crustal plates ''as disposable jigsaw pieces'' and too little attention to something else that changed: the nature of sea water. At the annual meeting of the Geological Society of America in Salt Lake City last week, he cited abundant data demonstrating that sea water has varied markedly in its characteristics, especially salinity and temperature, in the last 300 million years.

From the data, he pieces together this series of inferences: The Permian, he notes, began with extensive glaciation over the supercontinent. In his view, the glacial meltwater dropped the temperatures of deep ocean water, polar and subpolar waters to near-freezing. Cold, dense water has a greater capacity to hold certain chemical nutrients and thus is an aid to biologic diversification. In the middle and later Permian, when ocean temperatures warmed due to the absence of glacial meltwater, the supply of nutrients available for marine life was markedly reduced.

The same early Permian glaciation that produced the cooler temperatures vastly accelerated the weathering and erosion of the landscape, leaching large amounts of salts into the ocean. Bowen believes oceanic salinity increased by nearly one-third (to 46 to 48 parts per thousand) during the Permian and dropped correspondingly afterwards, generating great stress upon marine organisms of narrow salinity tolerance.

The combination of stresses from these salinity and temperature fluctuations resulted, Bowen proposes, ''in the striking mortality and extinction rates recorded during the Permian.''

Among the evidence Bowen cites for higher oceanic salinity in the Permian are data showing that since the beginning of the Permian, about 6 million cubic kilometers of salts have been permanently extracted from the world ocean. He says 4.5 million cubic kilometers of this amount were extracted in the Triassic, the period immediately following the Permian. Salt masses of this age are found in such places as Algeria, Morocco, Szechuan, Indochina, and the Gulf of Mexico. The Louann Salt, a huge salt deposit 1.5 km thick in the western Gulf of Mexico has a total volume of 4 million cubic km. ''Extraction of the Louann Salt alone is sufficient to change oceanic salinity by 9 per mille,'' Bowen says. He believes the bulk of the deposit is of Triassic age.

Bowen's ocean-geochemistry hypothesis is not likely to replace the Valentine-Moores plate tectonics scenario for explanation of the great Permian extinction. But it offers a supplementary, and partly alternative, view that is sure to provoke discussion. In any event, he makes a strong case for not ignoring sea water itself when playing the plate-tectonics-and-the-history-of-life game. □

Genes mapped: Clues to cancer message

The same week that the Nobel Prize for physiology or medicine was shared by three researchers for their work on RNA tumor viruses and cancer, an important, related finding was being reported. Researchers from the University of California at Berkeley have mapped the specific sequence of nucleic acids in the so-called ''onc'' gene of an RNA tumor virus. This is the ''on button,'' contained in the RNA of the Rous sarcoma virus, that causes cells of certain birds and animals to form tumors or leukemias.

The work was reported by virologists Peter H. Duesberg, Lu-Hai Wang, and Karen Beemon at the 7th International Symposium on Comparative Leukemia Research in Copenhagen in mid-October. In addition to mapping the oncogenic gene, they mapped a gene (''env'') that directs the formation of the protein envelope that surrounds each virus particle. The knowledge of these base pair sequences, in addition to those of two more