RECENT DEATHS

John P. Bowler, 79; former dean, Dartmouth Medical School; 22 January.

J. Russell Bright, 65; professor of chemistry, Wayne State University; 20 December.

Eleanor B. Browne, 64; former professor of education, University of Florida; 2 February.

Herbert E. Buchanan, 92; professor emeritus of mathematics, Tulane University; 17 January.

David L. Crawford, 84; former president, University of Hawaii; 17 January.

Vincent J. Dardin, 73; professor emeritus of pathology, Georgetown University; 31 January.

Edward T. Donovan, 74; professor emeritus of mechanical engineering, University of New Hampshire; 3 January.

George M. Hollenback, 87; former chairman, fixed prosthetics department, University of Southern California; 30 November.

Hubert A. Jones, 88; professor emeritus of mathematics, Wake Forest University; 6 February.

E. Henry Keutmann, 77; professor emeritus of medicine and pharmacology, University of Rochester School of Medicine and Dentistry; 28 January.

Desmond Magner, 60; head, pathology department, University of Ottawa; 17 November.

Charles F. Metz, 69; group leader, chemical and instrumental analysis group, Los Alamos Scientific Laboratory; 10 February.

Robert B. B. Moorman, 69; professor emeritus of civil engineering, Polytechnic Institute of Brooklyn; 2 February.

Elmer L. Ritter, 90; professor emeritus of education, University of Northern Iowa; 17 January.

George Scatchard, 81; professor emeritus of chemistry, Massachusetts Institute of Technology; 10 December.

Joseph R. Stern, 54; chairman, biochemistry department, College of Dentistry, New York University; 15 January.

Darrell R. Williams, 44; chairman, electrical engineering department, Illinois Institute of Technology; 20 February.

J. Enrique Zanetti, 89; professor emeritus of chemistry, Columbia University; 26 January.

Erratum: In the 12 July issue, page 126, described George C. Guenther, former assistant secretary of labor for occupational safety and health, as the "former boss" of Marcus M. Key, director of the National Institute for Occupational Safety and Health (NIOSH). NIOSH in fact is part of the Department of Health, Education, and Welfare.

RESEARCH NEWS

Plate Tectonics: Do the Hot Spots Really Stand Still?

With plate tectonics firmly established as a theory that explains to a large extent why the earth looks as it does, what do you do with the features that the theory doesn't explain? For instance, major oceanic ridges have been identified where plates are spreading apart, in the Atlantic, Pacific, and Indian oceans, causing many earthquakes underneath the ridges. But large ocean ridges are also found that have no earthquake activity underneath. How are they formed? What produced the long chain of volcanoes, mostly underwater, in the northern Pacific from the Hawaiian Islands almost all the way to Siberia? This island chain is far from the boundaries of the Pacific plate, and does not parallel any of the geologic features of the ocean floor in the region.

The tendency of most geophysicists is to group such inexplicable features together and say they were formed by "hot spots" under the moving plates. The Hawaiian chain, which includes approximately 80 volcanoes, was the first to be explained by a fixed hot spot periodically erupting through a plate. Now perhaps 200 features are called hot spots by one researcher or another, but they are not well understood. What causes the hot spots, whether they are really fixed in the deeper parts of the earth, and how applicable the term is to all the features left over from global tectonics are open questions.

The term hot spot sounds innocuous enough, like a soft patch in an asphalt road, but in fact it is the name for a source of prodigious energy. The hot spot in the earth's mantle under Hawaii is capable of producing volcanoes equal in height to Mount Everest, as measured from the ocean floor. The volcanoes that formed the Hawaiian archipelago and its northward underwater continuation, the Emperor seamounts, are broad, smooth structures called shield volcanoes which reach a diameter of 120 km at the base. The chain appears to have been formed along a number of loci, often with more than one volcano active at a time (Fig. 1). The oldest volcanoes are at the northern end of the chain and the youngest are on the island of Hawaii, where Mauna Loa and Kilauea are still active.

Radioactive dating of samples by G. Brent Dalrymple and his colleagues at the U.S. Geological Survey in Menlo Park, California, shows that the volcanoes are progressively older to the northwest, but not in a linear fashion. Until recently data were available for dating the chain only as far out as Midway, which is 2400 km from Kilauea and about 18 million years old. Using data from this section of the chain, Dalrymple and his associates estimated that the average velocity of the plate over the hot spot was 13 cm/year, too fast for the hot spot to be considered fixed, according to most estimates.

New data from volcanoes farther out in the Hawaiian-Emperor chain show that the age progression, averaged over a longer time, was considerably slower. Samples from the Koku and Yuryaku seamounts now indicate that the age of the Hawaiian bend is 41 to 43 million years. Those dates, obtained by Dalrymple, David Clague of the Scripps Institution of Oceanography in La Jolla, California, and R. Moberly of the University of Hawaii, Honolulu, indicate that the average rate of migration of volcanism has been about 8 cm/year, a number that jibes well with the motion of the Pacific plate at the present time (the last 10 million years). While they do not prove that the Hawaiian chain was caused by a fixed hot spot, the new dates seem to many geophysicists to indicate that the data are more favorable than ever before.

The Hawaiian-Emperor chain is not the only string of volcanic islands in the Pacific that could have been produced by a hot spot. In 1971, W. Jason Morgan at Princeton University, introducing the plume hypothesis (see be-