earth sciences

Volcanic evolution of the Canaries

Very little is known about the chronology of volcanism or the correlation of eruptions between closely associated volcanoes. A. Abdel-Monem and Paul W. Gast of the Lamont-Doherty Geological Observatory and N. D. Watkins of the University of Rhode Island determined ages and magnetic polarities for 51 lava samples from the Canary Islands.

They report in the December AMERICAN JOURNAL of SCIENCE that the Canary Islands are separate volcanic edifices that evolved independently for at least the last 20 million years. Volcanism occurred throughout most of that period. This long period of volcanic activity contrasts with the rapid evolution and relatively brief volcanic history observed in such purely oceanic islands as the Hawaiian Islands, they write. The Canary Islands straddle a transition zone between oceanic and continental crust.

Winds of the past

The ratio of oxygen 18 to oxygen 16 in ancient ice samples depends on the temperature prevailing at the time of precipitation and can be used to determine past temperatures (SN: 11/7/70, p. 369). A. T. Wilson of New Zealand's University of Waikato and C. H. Hendy of Lamont-Doherty Geological Observatory use this data to determine the windiness of past climates.

The temperature difference between equatorial and polar regions, they write in the Dec. 10 NATURE, largely determines the storminess of weather. The water vapor in a cloud becomes depleted in O-18 as it moves northward to colder regions. The researchers used statistics on present-day precipitation to determine the relationship between the isotopic composition of precipitation at a given point and the temperature difference between that point and equatorial regions. Ice cores from Greenland and Antarctica enabled them to determine past isotopic compositions of precipitation at those points.

They found that during glacial periods the temperature difference between equatorial and polar areas increased 20 to 25 percent, indicating more vigorous winds. There is some geological evidence of this increase in storminess, for example, fossil sand dunes in Australia. Increased storminess, the scientists conclude, may explain why the Vikings abandoned their North Atlantic route when a cold period came, rather than simply finding a more southern route.

Mantle anomaly in Pacific

Seismic waves passing through the upper mantle in the region between the Tonga Island arc and the Lau Ridge become severely weakened. The Tonga arc is a subduction zone where the western edge of the Pacific crustal plate sinks into the mantle.

Muawia Barazangi and Bryan Isacks of Lamont-Doherty Geological Observatory have found that material that attenuates seismic waves is present throughout the upper 150 to 300 kilometers of the wedge of mantle above the descending plate. The mantle in this area, they explain in the Dec. 10 JOURNAL OF GEOPHYSICAL RESEARCH, is probably much weaker than normal. Similar anomalous regions exist behind several other island arcs, and Barazangi and Isacks' data on their geometry should help define their role in subduction.

physical sciences

Vibrating black holes

Black holes first appeared in cosmological theory as highly collapsed objects that form a kind of bottomless gravitational sink down which energy and matter could escape from the observable universe (SN: 12/26/70, p. 480). But as William H. Press of California Institute of Technology emphasizes in the Dec. 15 ASTROPHYSICAL JOURNAL LETTERS "a black hole can be a dynamical entity rather than merely an arena for dynamics."

Press's letter indicates how a black hole that has been perturbed from a spherical shape may become a long-lasting source of gravitational radiation. At first blush, he says, one would expect that a perturbed black hole would return quickly to a spherical shape, radiating energy in one great belch. But his numerical calculations show that in certain cases (perturbations of high multipolarity with Fourier components having wavelengths in a certain range) the energy that caused the perturbation is radiated only slowly.

Loosely speaking, he says, the black hole vibrates around spherical symmetry, and this vibration is gradually damped by emission of gravitational radiation. The frequency of the radiation is determined by the mass of the black hole and the multipolarity of the perturbation.

Detecting superheavy elements

Experiments aimed at manufacturing superheavy chemical elements encounter a number of difficulties in examining their end products to determine what element has been made. The samples are too small for chemical or mass-spectroscopic analysis, so physicists have to rely on examinations of the radiations the samples give off, particularly alpha particles. But there are many ambiguities in the alpha-particle data, and spirited arguments rage over the few experiments done so far (SN: 12/4/71, p. 273). In the Dec. 13 PHYSICAL REVIEW LETTERS P. Armbruster of the Society for Heavy-Ion Research in Darmstadt, West Germany, and P. H. Mokler and H. J. Stein of the Nuclear Physics Research Center at Jülich suggest using X-rays. The collision between an ion and an atom that makes the new element should displace certain electrons in such a way that, as it flies along, the new element emits a characteristic spectrum of X-rays. This spectrum should provide an unambiguous nuclear-charge determination, they say.

Organic compounds in a carbon star

Two isotopes of hydrogen cyanide ($H^{12}C^{14}N$ and $H^{13}C^{14}N$) have been found in the carbon star IRC + 10216, report M. Morris and Patrick Palmer of the University of Chicago, Benjamin Zuckerman of the University of Maryland and B. E. Turner of the National Radio Astronomy Observatory in the Dec. 15 ASTROPHYSICAL JOURNAL LETTERS.

So far only organic molecules have been found in IRC + 10216. Carbon monoxide has been detected, but searches for water, hydroxyl and ammonia have failed. The present group suggests further searches to see whether organic compounds are really the only ones that form there.

The data lead to a $^{12}C/^{13}C$ ratio different from that on earth. This contrasts with determinations of the ratio for interstellar clouds, where it has so far been found similar to that of earth.