earth sciences

More on Cannikin

In addition to the shock produced by the explosion itself, last year's nuclear test on Amchitka Island in the Aleutians, called Cannikin, produced two types of seismic effects: those related to collapse of the underground cavity carved out by the explosion and those related to changes in the stress surrounding crust.

E. R. Engdahl of the National Oceanic and Atmospheric Administration reported last week that most of the several hundred aftershocks from the explosion were caused by cavity collapse. A total of 22 "real" earthquakes, caused by structural readjustments in the earth's crust, were linked to the test. The first and largest had a Richter magnitude of 3.5 and occurred more than seven days after detonation. The last occurred almost three months later. Earthquake activity stimulated by the test, he said, was actually less than that produced by tests at Nevada. Comparisons of post-Cannikin earthquakes with the background of natural seismicity in the region, said Engdahl, indicate that Cannikin did not affect regional, natural earthquake activity.

Oxygen effects on the ozone screen

Because atmospheric oxygen is largely a product of photosynthesis, there must have been less oxygen in the atmosphere during early stages of the evolution of life than there is now. Atmospheric oxygen is the source of ozone, and it is ozone that shields life on earth from harmful ultraviolet radiation.

According to Michael I. Ratner of the University of Colorado and James C. G. Walker of Yale University there was an effective ozone screen despite lower oxygen levels. They suggest in the latest JOURNAL OF THE ATMOSPHERIC SCIENCES that a larger proportion of existing atmospheric oxygen was converted to ozone. They calculate that as the oxygen content of the atmosphere is reduced, the ozone layer moves downward and the rate of production of ozone and the density of the ozone layer increase. The process reaches its maximum at one-tenth present levels of oxygen and then reverses. Conversely, an increase in oxygen content over present levels will decrease the density of the ozone screen. Ratner and Walker estimate that as little as one five-thousandth of present oxygen levels could support an ozone screen dense enough to protect life from damaging levels of radiation.

Noisy drift bottles

One of the simplest and least expensive methods of oceanography is the old reliable drift bottle. Placed in the ocean at one point and recovered when they reach shore again, they have long been used to study ocean currents. They have some drawbacks, however. For one, an average of only 10 percent of the bottles put to sea are recovered. Also, there is no way to trace the routes the bottles travel from release to recovery.

Scientists at the Woods Hole Oceanographic Institution are working on a system of "talking drift bottles"; small buoys that transmit radio signals. The buoys will be tracked from stations on shore. The Woods Hole team have proposed a system with a range of 250 miles. Under a one-year contract from the National Oceanic and Atmospheric Administration, they will design, build and demonstrate two shore stations and the buoys.

physical sciences

Superconducting 'fountain' effect

Superconductivity and superfluidity are in many ways similar phenomena. In both cases a frictionless or resistanceless flow takes place: of conduction electrons in the one case, of liquid helium atoms in the other. Many effects of superconductivity have analogues in superfluidity and vice versa.

One of the most unusual superfluid effects is the fountain effect. If two vessels containing superfluid helium and connected by a thin capillary tube are maintained at different temperatures, liquid will flow from the colder to the warmer vessel and pile up there in apparent disregard of the law of hydrostatics that liquids in connected vessels come to at same level.

John Clarke and S. M. Freake of the University of California at Berkeley report in the Aug. 28 PHYSICAL REVIEW LETTERS that a superconducting fountain effect also exists. They found that if they set up a lead-lead point contact junction and maintained the two sides at different temperatures, a small supercurrent was produced by the temperature difference.

Centaurus X-3 and gravitational disruption

The X-ray source Centaurus X-3 appears to be a member of an eclipsing binary. According to the usual theory of binary systems, the X-ray source in Cen X-3, which is the smaller of the two bodies, cannot have a mass greater than 0.23 of the solar mass. If it had, the observed size of the larger component would exceed its Roche limit, the size beyond which it is susceptible to disruption by the gravitational pull of the smaller companion. This provides a problem for theories of how the smaller body produces the X-rays. These theories assume that the X-rays are generated by matter falling into a highly compact body (white dwarf or neutron star), but to be effective they require the body to have at least one solar mass.

In the Aug. 15 ASTROPHYSICAL JOURNAL LETTERS D. W. Weedman and D. S. Hall of Vanderbilt University argue that it may be possible for the larger body to exceed its Roche limit if it has a thick expanding atmosphere. They conclude that both bodies might share the same atmosphere and that matter that must leave the larger will flow toward the smaller.

Cosmic-ray abundances

Observations of atomic nuclei in the cosmic rays that have been made at relatively low energies—less than 30 billion electron-volts (30 GeV) per nucleon—indicate that the relative abundances of the different elements and isotopes are the same for all energies.

Astrophysicists have wondered whether the energy independence extends over the whole range of possible energies. In the Aug. 14 PHYSICAL REVIEW LETTERS Einar Juliusson, Peter Meyer and Dietrich Müller of the University of Chicago report that it apparently does not.

Cosmic-ray nuclei are divided into two classes. The first is those emitted by the primary cosmic-ray sources; the other is secondary galactic nuclei, which are produced by fragmentation when primary-source nuclei strike interstellar matter. Juliusson, Meyer and Müller find that the ratio of galactic secondary to primary-source nuclei depends on energy above 30 GeV per nucleon.