Earth Sciences

A cloud veiled in mystery

On April 9, 1984, the captain of a commercial airplane en route to Anchorage from Tokyo was so alarmed by a huge mushroom-like cloud looming off the coast of Japan that he issued a Mayday alert and put his crew on oxygen as a precaution. The crews of two other flights that night also saw the strange cloud that eventually spanned 320 kilometers in diameter.

According to Daniel Walker and colleagues at the University of Hawaii at Manoa, Honolulu, one possible explanation might be the explosion of a nuclear submarine. But no fireball was seen and neither the planes nor the dust from the cloud showed unusual levels of radioactivity. To look for evidence of explosions of any kind, Walker's group analyzed data from an array of ocean-bottom hydrophones located southeast of the cloud site. They found no explosion evidence but they did discover that some undersea volcano — probably the Kaitoku Seamount located to the southwest of the cloud — had displayed a peak in activity on April 8 and 9. While no plume had been observed in the Kaitoku area during that time, the researchers reasoned that one might have been released at night, then carried northward 1,470 km across the Pacific.

When they studied the wind data for those days, however, they found that such a plume would have to have traveled to the southeast instead. Moreover, they concluded that no natural mechanism could have caused the cloud to rise as fast as it did, other than a volcanic eruption directly below the cloud site—an idea ruled out by the hydrophone data.

And so the mystery continues. Walker's group writes in the Feb. 8 SCIENCE: "... our analyses indicate that the mystery cloud was produced either by an as-yet-unknown natural phenomenon or by a man-made atmospheric explosion." If the cloud was natural, says Walker, it's important for people with their finger on the red button to know that bombs are not the only cause of mushroom-shaped clouds.

Epitaph stratigraphy: Nuclear ABCs

There may not be much life after a nuclear war, but there will still be geologically interesting rocks. And for any surviving stratigraphers, say two geologists, a nuclear apocalypse, with its concomitant radioactive fallout and mass extinctions, would create in the geological record an ideal horizon—a layer formed in sediments everywhere at once.

Eric Prosh and Sandy McCracken at the University of Western Ontario in London decided that if humankind can't prevent a nuclear war, people should at least get the stratigraphic names straight afterwards. In preparation, the two graduate students outlined their proposal for postapocalypse nomenclature in a semi-satirical paper published in the January GEOLOGY.

Most era and eon names, for example, end in *-zoic,* meaning life or animal. Hence there is the Paleozoic (old life) era and the Proterozoic (before life) eon. For the post-nuclear war world, Prosh and McCracken suggest Hysterozoic eon, meaning after life, and Telozoic era, from the Greek *telos,* or end. Epochs are named by comparing past fauna with living fauna. The Holocene, Pleistocene and Miocene, for instance, combine the suffix *-cene,* meaning new, with prefixes meaning whole, most and less. For postapocalypse times the geologists have two proposals: Kenocene, from the Greek *kenos* meaning empty, and Kerocene, taken from *keros,* or death.

In this naming scheme, they say, there is no reason to consistently favor Greek because all languages would be "dead" and fixed. Possible alternatives for epochs, based on English, include Nothingcene, Changeofcene and Weshouldhavecene.

Prosh says he wanted to show that stratigraphic names are not mere etymological whimsy, but reflect real earth history. "We also wanted to shake up the scientific community.... This nuclear winter stuff is serious," he says.

Physical Sciences

Photon, photon, who's got the photon?

Quantum mechanics has the quality of introducing uncertainties where classical physics would be certain. New instances of such behavior all contribute their bit to the overall philosophical question of whether anything in fact is certain or precise. The latest example, which could be called an instance of quantum chemistry more than of quantum physics, is reported in the Feb. 4 PHYSICAL REVIEW LETTERS. Philippe Grangier and Alain Aspect of the Institute of Optics of the University of Paris-South at Orsay, France, and Jacques Vigue of the Laboratory of Hertzian Spectroscopy of the École Normale Supérieure in Paris did the experiment.

The action concerns the dissociation, by a beam of laser light, of a molecule consisting of two calcium atoms. The energy delivered by the laser light dissociates the molecule, and the two atoms fly apart. One of them gets slightly more energy than the other and, a very short time later, emits a single photon of light. The question is: Can experiment tell which of the two atoms emitted this photon of fluorescence?

Classically it should be able to. By measuring the momenta of the recoiling atoms and the wavelength and polarization of the emitted photon, one should be able to tell which atom emitted the photon. Unfortunately, in real life, quantum mechanics rules this instance, and one cannot measure those things precisely. There are two ways in which the action can go: Either the one atom or the other gets the extra energy and emits the light. In quantum mechanical theory, the probabilities of following the two paths interfere with each other and so it is impossible to tell which one an actual case has followed.

Experiment bears this out. "There is no way," the experimenters conclude, "to know 'which atom emitted the photon.'"

More anomalous nuclear fragments

The existence of anomalons, fragments of atomic nuclei that interact with other nuclei more readily than expected, is a highly controverted topic. If anomalons exist, they could represent a previously unknown and highly reactive state of nuclear matter. Some experimenters claim to have found them; others claim not. Up to now most physicists on both sides have agreed that anomalous behavior occurs only for fairly large nuclear fragments. Now there is a claim of anomalous behavior by alpha particles, fragments consisting of only two protons and two neutrons.

Seven physicists from Jadavpur University in Calcutta, Dipak Ghosh, Jaya Roy, Dipak Banerjee, Anuradha Dutta, Ranjan Sengupta, Kaushik Sengupta and Sadhan Naha, did the experiment. They report it in the Feb. 4 PHYSICAL REVIEW LETTERS.

Working at the Joint Institute for Nuclear Studies in Dubna, USSR, they irradiated a nuclear emulsion with energetic carbon 12 nuclei. As the carbon 12 nuclei struck nuclei in the emulsion, the carbon 12 nuclei shattered. Some of the fragments were alpha particles, and some of these, according to the experiment, showed the anomalously reactive behavior.

Still no superheavy elements

A persistent prediction of nuclear physics is that certain "superheavy" elements — with atomic numbers well above the 109 now known—should be able to form and last long enough to be detected. The belief persists in spite of several negative experiments. Peter Armbruster of the Gesellschaft für Schwerionenforschung (GSI) in Darmstadt, West Germany, and 39 others have tried and failed to make element 116 by bombarding cesium 248 with calcium 48, they report in the Feb. 4 PHYSICAL REVIEW LETTERS. In work at both GSI and the Lawrence Berkeley Laboratory in Berkeley, Calif., they report that they found nothing.