Earth Sciences

The quaking ionosphere

On April 12, 1978, something strange happened to the ionosphere above Chatanika, Alaska. Scientists routinely monitoring the flow of ionospheric particles detected very large verticle oscillations corresponding at times to ion velocities of up to 100 meters per second. Normally, ionospheric winds travel almost exclusively in the horizontal direction. And any verticle motions — rarely larger than 2 m/sec — are usually associated with changes in the magnetic field, but no such variations were recorded that day.

The mystery was solved when Michael Kelley at Cornell University in Ithaca, N.Y., and Robert Livingston and Mary McCready at SRI International in Menlo Park, Calif., linked the nine-hour-long ionospheric disturbance to an earthquake that had occurred 1,000 kilometers from the radar site just before the oscillations began. As discussed in the September GEOPHYSICAL RESEARCH LETTERS, the researchers found that their data compared well with a theory developed 18 years ago, which predicts that a nuclear explosion or earthquake will excite atmospheric motion near the event much like that created when a pebble falls in water.

In order to fit the data to the model, however, they had to assume that the ionosphere was hotter than normal, suggesting that the earthquake had heated the upper atmosphere. According to Kelley, energy from earthquakes, tornadoes and weather in the lower atmosphere may play a much more important role in warming the upper atmosphere than has usually been assumed.

The climate, it is achanging

Ever since scientists realized that the earth's history is punctuated by fairly regular episodes of glaciation, they have tried to untangle the multitude of forces that could trigger climate change. One idea, called the Milankovitch theory, pins the responsibility on periodic changes in the earth's orbit, which alter the amount of solar radiation received by the planet; variations in the eccentricity, tilt and precession of the earth are thought to drive climate cycles at intervals of roughly 100,000, 41,000 and 23,000 years. The Milankovitch theory has had a controversial past, but within the last decade it has gained wide acceptance. Now, a number of papers further assure the theory a place in the club of forces that govern the earth's climate.

In the September GEOPHYSICAL RESEARCH LETTERS, Atsuyuki Yamamoto at the Osaka Electro-Communication University in Osaka, Japan, and colleagues discovered that the size of mineral grains that had been deposited over the last 260,000 years in Lake Biwa, one of the oldest lakes in the world, rose and fell at the same frequencies as Milankovitch cycles. According to the researchers, the grain size reflects erosion rates, which in turn depend on climate changes such as rainfall, temperature and wind; high precipitation rates, for example, increase erosion and the amount of coarse grains carried to the lake.

In another paper in the Sept. 12 NATURE, John Kutzbach of the University of Wisconsin in Madison and F. Alayne Street-Perrott of Oxford University in England conclude that Milankovitch cycles have been largely responsible for changes in the levels of tropical lakes in the Northern Hemisphere. The researchers used a computer model of the atmosphere to simulate how variations in the earth's tilt changed January and July monsoon circulation and rainfall patterns over the last 18,000 years. In general, their model agreed with long-term changes observed in the geologic record; shorter fluctuations in lake levels lasting 1,000 years or so still must be explained. Complementing this work, Edward Pokras and Alan Mix of Lamont-Doherty Geological Observatory in Palisades, N.Y., recently found Milankovitch rhythms in the abundance of land-based dust in deep-sea cores taken off the coast of Africa; peaks in such dust correspond to times of arid land conditions.

Science & Society

No laughing matter

Laughing gas (nitrous oxide) may help a patient feel no pain, but health officials have suspected for years that dental workers regularly exposed to the gas may develop serious health problems. Despite the threat, some dental offices contain excessive levels of nitrous oxide leaking from faulty equipment, says a new survey by the Georgia Institute of Technology in Atlanta.

Researchers Paul Middendorf and David Jacobs found waste gases at levels of 600 parts per million (ppm) and higher during their survey of 30 Georgia dental offices. In the late 1970s the National Institute of Occupational Safety and Health suggested 25 ppm as an acceptable level.

Jacobs attributes the excessive levels to poor equipment design and inadequate maintenance programs. "Dental offices need scavenging systems [to remove excess gas] and many dentists don't have them," he says. "They also should have local exhaust systems, which hardly any have."

When claims that nitrous oxide could cause liver damage and other illnesses surfaced several years ago, the American Dental Association (ADA) issued a "strongly worded" message cautioning dentists to be careful, says Edgar W. Mitchell of the ADA's Council on Dental Therapeutics. But, he says, the study suggests a "complacency" among dentists. "We may need to get that flag out and wave it again," he says. "We know if there's an exposure problem, there's an effective way to remove the gas."

Participants at a National Institutes of Health conference this spring also produced a consensus statement calling for renewed study of nitrous oxide's effects on dental personnel.

Baby walker warning

The Canadian Pediatric Society recently issued a public condemnation of circular, wheeled baby walkers, but it's unlikely their colleagues in the United States will follow in their footsteps. According to Victor Marchessault, executive vice-president of the Canadian society, a study of walker-related accidents prompted the warning. "Parents think the walker's a safety device, but it's really a danger device," he told SCIENCE NEWS.

U.S. data indicate from one-third to one-half of infants who use walkers eventually experience an injury, says Joseph Greensher, chief of the American Academy of Pediatrics' Committee on Accident and Poison Prevention. "Walkers offer no advantage as far as learning to walk — not earlier or better," he adds.

Although the Canadian group plans to ask for a recall if unsatisfied with steps taken by the Canadian consumer affairs department, Greensher says legal implications prevent a similar effort in the United States. But he says U.S. doctors are being advised "unofficially" about the dangers. "As pediatricians, they shouldn't be advising [the walker's] use," he says.

Another cancer culprit?

Fears that a cancer-causing chemical may be leaching out of teething rings and soft plastic toys prompted the Consumer Product Safety Commission last year to call for a study into the hazards of di(2-ethylhexyl)phthalate (DEHP), used to soften polyvinyl plastics. A report issued last week confirmed low amounts of DEHP, known to cause liver cancer in lab animals, may be absorbed from certain infant products, dialysis machine tubing and plastic blood bags.

Chemical and plastic industry officials were quick to point out that the levels of DEHP needed to cause cancer in animals were far greater than those being absorbed from their products.

But, although the outside advisers to the commission who compiled the report concluded there was no hard evidence that DEHP-containing plastics cause human cancer, the report said "DEHP must be considered potentially carcinogenic to humans" and called for more research on DEHP levels in children.