Chemistry

The diurnal cycle of airborne mutagens

Until recently, atmospheric chemists had a very poor idea of the day-to-day concentrations of many carcinogens and mutagens in the ambient atmosphere. Now, a team of researchers at SRI International in Menlo Park, Calif., has measured the concentrations of 20 bacterial mutagens and carcinogens and gotten some surprising results.

Hanwant B. Singh, Louis J. Salas and Robin E. Stiles measured the chemicals, which include methyl halides, chloroform, benzene, formaldehyde and carbon tetrachloride, in seven cities. In the December ENVIRONMENTAL SCIENCE & TECHNOLOGY, they report that the substances rose to their highest concentrations at night or during the early morning, and declined to a minimum in the afternoon. Singh concedes that the results are paradoxical: "One would expect more of these chemicals during the day, when industrial plants are operating, than at night."

The investigators don't know enough yet to understand why the reverse is true, but Singh suggests two possible reasons: chemical loss reactions and atmospheric mixing. As some organics are added to the atmosphere, some are lost when they react with the unstable hydroxyl radical. "Generally speaking, the loss reaction is most efficient in the afternoon," he says. Deep vertical mixing in the atmosphere also acts to carry the chemicals higher and farther from the earth's surface.

In addition, based on measurement of a baseline concentration at a marine site near Point Arena, Calif., and at other points around the globe, the researchers conclude that "organic mutagens have always existed in the atmosphere (and the ocean) although at relatively low background concentrations." They speculate that the presence of naturally occurring organic mutagens "may have played a role similar to that attributed to radiation in the processes of biological evolution."

Singh told SCIENCE NEWS that "the levels measured in the air are consistent with the levels measured in the ocean and they are in balance with each other." The exact source in the ocean, he added, is not clear.

The constant low-level presence of mutagens and carcinogens in the air may have important effects on human health. The investigators write that "continuous exposure to low levels of such chemicals could erode any human threshold that may exist or enhance the frequency of cancer's occurring from other primary causes such as cigarette smoking."

Although the effects of these chemicals on evolution is pure speculation, they feel that a comparison between the mutagenic activity of these compounds and the effect of natural radiation might reveal new insights into the process of evolution.

Keeping grapefruit free of fruit flies

One of grapefruitdom's biggest threats is the Caribbean fruit fly. Two scientists at the U.S. Department of Agriculture's Agricultural Research Service in Florida may have found a way of killing them, and in the process saving the $60 million grapefruit business with Japan. Studies have shown the fruit flies can't survive at 35°F, but immediate chilling to this temperature injures the fruit and increases susceptibility to disease. Thurman T. Hatton Jr. and Clarence A. Benschoter have found that the fruits can be kept at 60°F for one week and then stored at 35°F for up to 19 days while en route to Japan. By lowering the storage temperature in two stages, the fruits are kept well-preserved as well as safe from the flies.

Grapefruits headed for Japan are currently fumigated with ethylene dibromide (EDB), but the Environmental Protection Agency announced in 1980 that EDB was under review as a suspect carcinogen, and that approval for its use as a fumigant might be withdrawn (SN: 10/24/81, p. 263). In the meantime, the Japanese are in the process of deciding whether to permit the import of grapefruit kept fruit fly-free by the new process.

Biomedicine

Magnetic lining for human sinuses

If you want to lead someone around by the nose, try using a magnet. British biologists report that bones from the sinuses just behind the bridge of the nose contain magnetic deposits of iron. Magnetic material has been discovered over the last five years in a variety of animals, including bees, pigeons, dolphins and fish (SN: 6/14/80, p. 376). There was one previous report of magnetic material in man: Joseph L. Kirschvink detected ferromagnetic crystals in adrenal glands last year.

The recent work, described in the Jan. 6 NATURE, examined a variety of tissues from corpses soon after death. R. Robin Baker and colleagues at the University of Manchester found no evidence of magnetic material in soft tissue, such as brain, or in a variety of bones including the skull and ribs. The walls of the sinuses (called the sphenoid/ethmoid complex) had magnetic characteristic about 9 times the background level. Microscopy with a stain for iron showed a layer of ferric material 5 microns below the surface of the sinus bone. One of the five subjects examined had no evidence of magnetic material. This subject was suffering from anemia at the time of death.

Baker has claimed in earlier, still controversial work, that people, like some animals, can detect direction by reference to the earth's magnetic field. He suggests that the magnetic deposits in human sinus bone might be concerned with that ability. Other possibilities are that the body uses the sinus bones as a storage site for iron or that magnetic material is involved with growth and repair of bone, he says.

Tuna also have magnetic material in the comparable sinus bones, Kirschvink, who is now at the California Institute of Technology, told SCIENCE NEWS. Kirschvink finds Baker's report interesting because of this parallel. But he points out that the work on human material has more difficulties than does the work on fish because of contamination from the surroundings.

Knockout for boxers' brains

Whether he wins or loses, whether he is knocked out or not, a boxer's likelihood of brain damage increases with the number of bouts he fights, according to physicians at Radiologic Medical Imaging Associates in Mayfield Heights, Ohio. Ronald J. Ross and colleagues report in the Jan. 14 JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION on their examinations of 40 ex-boxers, ranging in age from 14 to 74, with up to 200 amateur and professional bouts. They found a significant relationship between the number of bouts fought and brain atrophy, measured with computed tomography, and abnormalities in surface electrical signals (electroencephalography or EEG). Even boxers with a moderate number of bouts may suffer these changes, the researchers say. Another recent study from Finland reported evidence of brain injury in four of six professional boxers, and one of eight amateurs, who had been national champions.

For more than 50 years physicians have known that many boxers suffer characteristic brain damage, resulting eventually in slurred speech, tremor, abnormal gait and dementia. This condition is called "punch drunk syndrome," or dementia pugilistica. Ross and colleagues hope to be able to predict and prevent the onset of this dementia with computed tomography and EEG, which they argue should be part of a boxer's regular medical examination.

The American Medical Association is calling for improvements in medical standards to making boxing safer. The report of the AMA Council on Scientific Affairs appears in the same issue of the journal. "Although the AMA believes boxing to be no more dangerous under supervised conditions than many other contact sports, it recognizes that the usual cause of deaths in boxing occur from brain injury and recommends that bouts be permitted only where adequate brain surgery facilities are immediately available," it says.