# Fluorine: Sticky bonds for safer drugs

Medical researchers are cashing in on a simple fact about fluorine: When it bonds to carbon, it won't let go. Well, at least not as easily as chlorine and other halogens. This fact is enabling them to design safer anesthetics and X-ray contrast agents.

Chemist Donald Denson of the Stanford Research Institute in Menlo Park, Calif., reported some new fluorinated anesthetics at the American Chemical Society's meeting in Chicago last week. The compounds, linear and cyclic fluorinated ethers, are effective at much smaller levels than presently used anesthetics and seem to be inert in the body. This inertness, Denson believes, is due to the strength of the carbon-fluorine bonds. The Stanford anesthetics do contain some chlorine, but a complex seems to be formed between the carbon, fluorine and chlorine, Denson says, that prevents successful attack by enzymes.

Chlorinated inhalation anesthetics, such as the widely used halothane, have been implicated in learning defects and behavioral changes (SN: 9/17/74, p. 103). Halothane does break down in the body, and researchers are finding evidences of neuron degeneration in test animals. Halothane has been pronounced safe enough for short-term use on most patients, but there is growing concern over long-term exposure of operating-room personnel. Halothane can also cause a slowing and irregularity of the heart.

Denson and colleagues Robert L. Simon, Edward T. Uyeno and Howard M. Peters have completed initial screening of several fluorinated anesthetics on laboratory animals and have not observed the side effects that often accompany their chlorinated counterparts. Less than a third as much of one of the fluorinated compounds is required to produce anesthesia as with halothane, and Denson thinks this may be due to fluorine's hydrogen-bond-breaking potency. Hydrogen bond breaking may be the answer to the mystery of how anesthetics work (SN: 1/4/75, p. 10).

Several years of testing remain before the fluorine anesthetic could be marketed, Denson says.

The strong bonding of fluorine to carbon is also leading to the development of safer X-ray contrast agents. It was discovered several years ago that perfluorocarbon compounds (chains or rings of carbon atoms completely surrounded by fluorine atoms) are inert in animals and can dissolve large amounts of oxygen. They are being used now by Leland C. Clark Jr. of the Children's Hospital Medical Center in Cincinnati to create breathable liquids and artificial blood (SN: 9/28/74, p. 202). David M. Long and colleagues at the University of Illinois at Chicago have now applied a modified version of a perfluorocarbon compound to hospital radiology.

Long reported to the ACS that a brominated fluorocarbon, perfluoroctyl bromide, is radiopaque—it will show up on X-rays—but is inert and therefore safer for use in the body. Long's team has used the tracer substance for X-raying the lung and bronchial passages and the gastrointestinal tract in test animals and humans. Barium- and iodine-containing compounds are now generally used for X-raying these organs, but if the organ wall is perforated, barium can seep into the body's internal cavity and set up a chronic infection, Long says. This problem is eliminated with the brominated perfluorocarbons, since they are not broken down and pass completely out of the system within a few hours. Long plans to expand his clinical trials. □

# Did Olmecs have first compass?

Analysis of a 3,000-year-old, handworked bar of magnetized iron ore indicates that Middle American cultures may have discovered the principle of the compass a millenium before the Chinese. Scientists are now trying to find out whether such bars were used to align ancient Middle American cities, some of which are oriented very nearly in a north-south direction.

The artifact in question, designated M-160 (Michigan sample number), was found in 1967 at the site of an early Olmec city, being excavated near San Lorenzo, Veracruz, Mexico. The polished, squared-off black bar was a little over three centimeters long and just under a centimeter wide, with a straight notch running along its length slightly off-axis. It appears to be part of a larger instrument. The unique shape immediately suggested to Yale University archaeologist Michael D. Coe that it might have been used as a compass, and after determining that the bar was indeed magnetic, he loaned it to John B. Carlson, a physicist at the University of Maryland, for analysis. Carlson's findings are reported in the Sept. 5 SCIENCE.

The Olmec peoples built sizable cities centered around elaborate ceremonial buildings during the later part of the second millenium B.C. There they evolved a complex culture that included an early number system, hieroglyphic writing, and skill in working iron ores. (One parabolic mirror fashioned from a polished piece of ore has been used to start fires.) The meridional alignment of many ceremonial buildings has prompted speculation about their use of geomancy—divination and other religious practice based on signs from the earth.

To use magnetic minerals in such divination would require invention of what Carlson calls a "zeroth-order compass." Such a device would be used for its self-orienting properties without knowledge of its tendency to point north and south. If the pole-seeking properties were also recognized and used to orient buildings, but not for navigation, this step would represent a "first-order" compass, Carlson says. Such first-order compasses were in use during the Chinese Han Dynasty around the time of Christ. If the Olmec bar was indeed used in orienting ceremonial buildings before 1,000 B.C., it would represent a major link in the understanding of early civilizations, and rank the Olmec culture at an even higher state of development.

Until further evidence is discovered, however, such conclusions remain merely speculation. Carlson's experiments showed that the bar is oriented along a line that falls some 35.5 degrees west of magnetic north, although the groove allows sighting to half a degree accuracy and was itself inscribed very nearly parallel to the sides of the bar. This deviation could be explained by wandering of the earth's magnetic pole, which can produce declination changes of 30 degrees in as little as 400 years. But so far local geomagnetic orientations of the Middle American region during the first millenium B.C. have not been determined.

According to some theories, geomancy could have played an integral part in development of widely separated civilizations. Cities may have begun as central public shrines that developed into ceremonial centers and finally into urban dwelling places.

Both China and the Olmecs may thus have followed parallel, though not identical, lines of development—certainly both were stable agrarian cultures as opposed to the nomadic and maritime civilizations developing elsewhere at the same time. If the use of a compass could be proved for the Olmec culture, new insight would be provided into the theory of parallel development, particularly as it relates to geomancy. □

# Delay of Viking 2

The Viking 2 spacecraft, which would have taken off for Mars on Sept. 1, was delayed until Sept. 9 or 10 when engineers at Florida's Kennedy Space Center discovered that the signal from the main earth-aimed antenna aboard the vehicle's orbiter section was mysteriously weak. If it departs on Sept. 9, it should reach Mars orbit Aug. 7, 1976—the same day as if it had been launched on Sept. 1. If the launch is delayed the additional day, the relative positions of earth and Mars will push back the arrival until Aug. 10. Viking 2 had previously experienced a power-switch problem. Viking 1, fortunately, is already safely on its way. □