

# CHEMISTRY

Janet Hopson reports from the meeting in Anaheim, Calif., of the American Chemical Society

## Body scanner gives chemical data

A body scanning device has been developed that provides chemical as well as structural information about soft tissues. The current generation of brain and body scanners uses a technique called computerized axial tomography — a pictorial reconstruction of tissue density determined by X-radiation. The new scanning device, called Fonar, employs nuclear magnetic resonance (NMR), the analytic tool of the physical chemist.

Raymond Damadian and colleagues at the State University of New York's Downstate Medical Center announced the first chemical images of the live human body using Fonar, plus the detection and visualization of a tumor tissue. NMR has traditionally been used to determine the chemical properties of minute traces of unknown substances. Damadian's team kept the operating principle (a strong magnetic field and radiofrequency signals), but enlarged the equipment so that the same analyses could be made point by point on a "material" as large, dense and complex as a human cross-section. A two-dimensional colored read-out shows healthy bones, organs and tissues, as well as areas of chemical and structural irregularity.

Normal tissue, says Damadian, contains about 65 percent water, while a tumor can contain as much as 89 percent. By analyzing the cross-section of a human chest, for example, for the hydrogen content of its internal tissues, Fonar can detect areas of hydrogen density that indicate a lung tumor. The densities of other biological substances known to differ in tumor tissues, such as the energy carrier adenosine triphosphate, can also be measured, Damadian says, and might make the early detection of various types of tumors possible without biopsy. Fonar might also be used to detect metastases, to help physicians choose cancer drugs on the basis of the tumor's precise chemical composition, and to monitor the tumor during treatment.

## Processed proteins a potential hazard?

Recent food processing techniques have made it possible to extract proteins from relatively unpalatable sources such as soybeans, and turn them into analogs of more attractive foods — among them, meat substitutes, nondairy creamers and whipped toppings, baby formulas and corn chips. These ubiquitous processed foodstuffs have long been suspect among health food devotees, and are now being looked at askance by members of the chemical community as well.

Chemist Mendel Friedman of the United States Drug Administration's Western Regional Research Laboratory in Berkeley, Calif., reported that alkalai and heat treatments used to extract protein cause some natural primary amino acids, such as lysine and alanine, to crosslink into structurally different, unnatural amines, such as lysinoalanine. This particular hybrid, when fed to rats, has been found to cause precancerous lesions in the kidneys.

Home preparation of some natural protein foods, such as simply boiling an egg for three minutes, can also cause lysinoalanine to form. But the important variable is concentration: That egg would contain 140 parts per million lysinoalanine. A simulated cheese food can contain 1,070 ppm, calcium caseinate 400 to 6,900 ppm and whipping agents 6,500 to 50,000 ppm.

The specific human health hazards of consuming high levels of lysinoalanine are unknown, and the unnatural crosslinks of other amino acids may have been partly responsible for the rat lesions. But feeding a human infant, for example, a virtually exclusive diet of extracted protein "formula" may be inadvisable, and future studies of crosslinked proteins will be subject to close scrutiny by processed food fanciers and government health officials alike.

## Dating hot beryllium in old rocks

Radioisotope dating with cyclotrons — the most promising technique for determining the age of very old objects since the development of carbon 14 dating in 1947 — is itself only one year old. But already the technique is fulfilling promises made for it last year. Richard A. Muller, Terry Mast and Edward Stephenson, using the 88-inch cyclotron at Lawrence Berkeley Laboratory, have detected "with very great sensitivity" minute amounts of beryllium 10 from a meteorite and other rocks. The same cyclotron has already been used for precise carbon 14 dating (SN: 1/14/78, p. 29).

Tiny samples of rock containing the radioactive beryllium were vaporized and accelerated in the cyclotron to 1,000 miles per second, or one percent the speed of light. The resulting beam of ions was then passed through a detector and the atoms of beryllium counted one by one. This system is faster and more accurate than traditional carbon 14 dating (which measures the decay products from radioactive atoms rather than the atoms themselves), uses only one one-hundredth as much original material and, of course, has utility for inorganic substances like rocks and minerals, as well as for carbon-containing specimens.

Beryllium has a half-life of 1.5 million years, giving beryllium 10 cyclotron dating a range of 30 million years. This, says Muller, should be useful for dating rocks from the plate tectonics era. The instrument can also be tuned to detect tritium (H-3) and, by measuring the age and seepage rate of ground water, may indicate the safety of proposed nuclear waste storage sites.

## Wiring bugs for pesticide safety

A British researcher has tethered cockroaches with tiny electrodes to learn how pesticides kill insects and, perhaps, how to make these compounds more effective.

Derek W. Gammon of the University of Cambridge wired cockroaches — some of them for as long as four months — and then sprayed them with allethrin, a member of the new class of pesticides called pyrethroids. Chemists have assumed pyrethroids are poisons to the central nervous system. But by monitoring nerve impulses, Gammon found that the peripheral motor nerves are most affected during spraying and, furthermore, that allethrin is ten times more effective when sprayed at 15°C than at 32°C — a seeming breach of the rule that biological activity increases with temperature.

This study, says Gammon, will very likely change current thinking about how and when to apply pyrethroid pesticides, as well as about how to design them in the future so they hit the targeted nerves. This might allow for pest control with lower levels of environmentally toxic compounds and less chance for the rapid development of insect resistance.

## Busting bogus antiques at the border

In art circles, the precise determination of "antique" may be a matter of subjective judgment, but in the eyes of the U.S. Customs Service, it is a matter of law, dollars and, increasingly, of science. Antiques from Asia and Europe may be imported duty-free if more than 100 years old, but have high duties otherwise. With recent increases in imported "antiques" — in 1976, \$9.5 million in Chinese goods alone — the Customs Service has launched a program to analyze suspicious antiques.

Customs Service chemist Paul A. Doemeny of San Pedro, Calif., described microscopic, metallurgic and chemical analyses of such varied objects as Thai bronze statues, pre-Columbian gold swords and Chinese cloisonné cranes, all of which were fakes.

Some large museums have already rejected artifacts on the basis of Customs Service analyses.