CHEMISTRY

From our reporters at the meeting of the American Chemical Society in New York

Molybdenum: Heart of the matter

The relatively rare element molybdenum plays a disproportionately important role in the lives of both plants and animals—and one of the least understood. This obscure metal now appears to be the key to operation of enzymes controlling a variety of processes, from nitrogen fixation to formation of urine. Understanding its function could lead to such diverse applications as fighting heart disease and gout or lowering the price of fertilizer.

Molybdenum's unique functions appear related to its ability to catalyze chemical reactions that require the simultaneous exchange of two electrons and two protons. Edward I. Stiefel of the Charles F. Kettering Research Laboratory summarized recent discoveries that are helping to unveil the process. Apparently, he says, all Mo-containing enzymes use essentially the same Mo cofactor (a relatively small piece of a large molecule that nevertheless is required for a system to function). The model of operation now gaining acceptance: As molybdenum atoms give up two electrons at one end of the molecule, their attraction for other atoms changes, causing protons to be given up at the other end. Stiefel likens the operation to that inside a battery, with chemical reduction (gain of electrons) taking place at the "anode" end of the molecule, and oxidation at the "cathode" end.

How this process is controlled genetically was discussed by Winston J. Brill, a University of Wisconsin bacteriologist. In some nitrogen-fixing bacteria, he says, the genes controlling production of the Mo cofactor have now been located, together with an "activator" gene that starts the ball rolling. He predicts that when this activation mechanism is more completely understood, it will also be found to depend on molybdenum, which could help explain the complex feedback system that keeps bacteria from bothering to produce nitrogenase in Mo-deficient soils.

Some of this work is already producing practical results. Molybdenum supplements are being commercially produced to increase crop productivity in soils found lacking this essential element. Genetic manipulation has produced mutant bacteria that can fix nitrogen in the presence of fertilizer—probably a commercially important breakthrough.

Recycling umbilical cord veins

There hasn't been much use, until now, for umbilical cords once the baby is delivered and detached. Human placentas are used for medical research, "but umbilical cords," says Irving Dardik, "have only been used as handles to carry them away." Dardik and his twin brother Herbert, however, both vascular surgeons in New Jersey, are now using umbilical cords to save lives and limbs.

Many patients with vascular disease face death or the amputation of feet and legs each year, due to the limited choice of vascular grafting materials. Polyester blood vessels are often successful for heart by-pass operations, but rarely work for long in the legs and feet. Even using the human saphenous vein, which can be removed from the patient's own leg and used to by-pass a worn-out vessel lower on the same limb, can present serious problems. The saphenous vein itself, for instance, is often occluded or weakened by vascular disease. Faced with these unsatisfactory alternatives, Dardik came up with the idea of using umbilical cord veins and arteries—an idea that has been remarkably successful.

The Dardiks, and researchers Robert Baier and Charles Akers of the Calspan Corp. of Buffalo, N.Y., have developed a series of chemical pretreatments that can be used to stabilize, shape, size and preserve umbilical cord vessels for grafting. The group is now working with Meadox Medicals of Oakland, N.J. The Dardiks have grafted the "Biograft" vessels into more than 30 patients who faced death or amputation for lack of other appropriate grafting materials. In each case, Dardik told the ACS division of Colloid and Surface Chemistry, the implant has been successful. Biografts, he says, also should be useful for by-pass grafting in other areas of the body.

New insecticide: A hormone turn-off

The search for effective insecticides has evolved from heavy metals to organic chemicals to insect hormones. A "fourth generation" insecticide, an insect-hormone antagonist, has now been reported. William S. Bowers of the New York State Agricultural Experiment Station at Geneva, told the ACS division of Pesticide Chemistry about precocene I and II, antihormone substances found in the common mistflower.

Bowers looked in plants for natural defensive chemicals that may have evolved. He found two chemicals in *Ageratum* (mistflower) that prevent certain insects from manufacturing a hormone necessary for normal development. The precocenes specifically block formation of juvenile hormone. This, in turn, speeds up larval development to produce sterile adults and can prevent fully developed flies from making sex attractants or normal eggs. Early field tests show that the chemicals are nontoxic, biodegradable and effective against several insect species.

IUD with built-in drug

One of the newest drug delivery systems involves controlled release of an active drug from a polymeric material. The drug and polymer are mixed and shaped into a device that degrades slowly in the body and delivers a small, measured amount of drug to a specific site. Alan S. Michaels of the ALZA Corp. of Palo Alto, Calif., told an ACS symposium on macromolecules about that company's new controlled-release contraceptive device. The "Progestacert System," Michaels says, is a hollow T-shaped intrauterine device filled with the natural hormone progesterone. The hormone exerts a local contraceptive effect rather than a systemic one, and causes no side-effects, since the total hormone content (a year's supply) is less than that in a single birth control pill. A fresh device must be reinserted yearly. Marketing has just begun, Michaels says.

Environmental radioactive wastes

Three unrelated studies reported at the ACS meeting indicate that radioactive wastes can be stored safely. Ernest A. Bryant of Los Alamos Scientific Laboratory told of measuring the spread of wastes from a natural nuclear "reactor" that formed spontaneously underground during Precambrian times in what is now Gabon, Africa. The major part of the long-lived actinide wastes (thought to present the most serious problem) were still in place, despite leaching, lava flow and geological fracturing.

M.A. Wahlgren of Argonne National Laboratory reported that studies of plutonium fallout in Lake Michigan indicate that very little has worked its way into the food chain—95 percent having precipitated and been deposited in bottom sediments. Finally, Sherman Fried of Argonne told of experiments and calculations indicating the use of certain clays that can stop the spread of 99 percent of plutonium waste in deposit sites.