Chemistry

From our reporter at the spring meeting of the American Chemical Society in Philadelphia

Carbon dioxide: Lost and found

As fossil fuels are burned, carbon dioxide is given off. By knowing how much fuel is burned worldwide, one can calculate the expected amounts of carbon dioxide given off, and how much should be found hanging in the atmosphere. There is, however, one interesting problem with such calculations. Comparison of actual and expected CO_2 levels has revealed that most of it is "missing."

By studying global cycles of the elements, geologist Fred T. MacKenzie of Northwestern University has figured out where the missing carbon dioxide is going. And, for a change, the environmental news is not too bad. "Man," MacKenzie says, "has inadvertently and clumsily balanced his own pollution problem."

MacKenzie explains that about 355×10^{12} moles of CO_2 are released to the atmosphere each year. Twenty-five percent of that can be measured. The other 75 percent, or about 270×10^{12} moles per year, is missing. At the same time, industry is presently fixing about 3.1×10^{12} moles of nitrogen per year in the form of urea and ammonium nitrates for fertilizer, and is mining about 0.4×10^{12} moles of phosphorus per year. These chemicals can be volatilized and wind up in the atmosphere, too, MacKenzie says. The ratio of available carbon to nitrogen to phosphorus represented by these figures is about 800 to 9 to 1, MacKenzie says, the exact ratio needed during photosynthesis and the building of plant tissues. The missing CO_2 is being incorporated into plants. The biomass of vegetation may have increased by 10 percent since the late 1800's, he says, when CO_2 emissions rose along with rising use of fossil fuels.

The incorporation of CO_2 with available nutrients into plants may represent a global feedback mechanism that helps to prevent imbalances in the atmosphere, MacKenzie says.

Plants and the *papillon provocant*

Modern chemistry has robbed a bit of romanticism from a tale of butterfly courtship. That irresistable something about male African monarchs actually comes from the milkweed plant. Chemist Jerrold Meinwald of Cornell University reports that like the oak leaf roller and other insects, the African monarch gets his special something from a plant. But, unlike other insects, at least any reported thus far, the monarch alters an alkaloid from a milk weed plant into his seductive agent, a heterocyclic ketone.

The male monarch might not manufacture his own charm, but he uses it cleverly. As a female African monarch floats by on spring breezes, the male flutters after. He maneuvers around so that he can brush her antennae with seductive agent from his special courting organs called hair pencils. The female, interested, floats to a branch. With a bit more encouragement, she folds her wings and they mate.

The male is probably attracted to the milkweed plant by the alkaloid itself, Meinwald says. If he fails to imbibe the seductive precursor or fails to convert it, he fails with the females, too.

Chemistry and clean sheets

One of the recent trends in home decorating is using colorful designer sheets and towels. Hospitals have stayed with plain white cotton, but may soon switch to their own kind of designer linens—designed by chemists, that is. Chemists at the U.S. Department of Agriculture's research center in New Orleans have developed new ways to make cotton fabrics inhospitable to bacteria. The antibacterial finish could help prevent the spread of infection.

Cotton material is either treated with chlorine or with chlorine, sulfur and nitrogen. The chemicals attach and give the fabric fairly long-lasting germ resistance.

To test the new fabrics, bacteria were smeared on samples of the chlorinated and thiocyanted cotton (treated with sulfur and nitrogen) and plain cotton. The two treated cottons showed little or no bacterial growth, even after being machine-washed 10 times. The untreated cotton showed abundant bacterial growth. The main obstacle now, says Tyrone L. Vigo, who reported the work, is to make the treatment more permanent, since much of the chlorine, sulfur and nitrogen eventually washes out.

Minerals, milk and heart disease

Studies of deaths due to coronary heart disease, the nation's biggest killer, have shown that a person's chances of dying from the disease are greater in some geographical areas than in others. The factors involved in this regional pattern are not yet known, although some, such as air pollution and "hard" drinking water, have been suggested.

Leslie M. Klevay of the USDA's Human Nutrition Laboratory in Grand Forks, N.D., is now suggesting another possible contributory factor on the basis of a statistical study. He compared coronary heart disease death rates from 47 American cities with data on the average amounts of zinc and copper in the milk in each of those cities. The ratio of zinc to copper in milk and other foods differs from area to area. Studies on laboratory animals have shown that a high ratio of zinc to copper is correlated with high concentrations of cholesterol in the blood. This led Klevay to suspect that a high zinc-to-copper ratio in human food might be a factor in heart disease. His study confirms this.

He chose milk (rather than other foods) as a zinc-copper monitor since milk is supplied on a regional basis and is much less likely than most foods to be transported from other regions. He found a definite correlation between high zinc-copper ratios and higher death rates from heart disease.

This disease is probably long-term and progressive, Klevay says, starting as early as two or three years of age. Analysis shows that, regardless of geographic area, the zinc-copper ratios in human milk are lower than cow milk. A benefit from breast feeding may, therefore, be a reduction in coronary heart disease. More studies are needed on the role of zinc, copper and other dietary minerals on cholesterol production and heart disease, Klevay says.

Pain in the back for fish

Man-made chemicals can affect the physical and biological worlds in unexpected ways and the connections often seem strange and abstruse. Look at DDT and egg shells, for example. Another such bizarre connection has been reported. The widely used chlorinated pesticide toxaphene causes bone degeneration and broken backs in fish. Paul M. Mehrle and Foster Mayer of the U.S. Department of Interior Fish-Pesticide Research Laboratory in Columbia, Mo., suspect that the pesticide causes vitamin C deficiency leading to a decrease in bone protein (collagen). This can leave a fish's backbone so brittle it can bend or break during growth. Perhaps three to five percent of fish in the South are so affected, including many raised on catfish farms.