# Chemistry

## Oscillating chemical waves process images

Computerized image processing typically involves assigning numerical values to each of an image's variously bright or colored points and then manipulating those values to enhance the contrast, change or add colors, fill in gaps, or perform other graphical transformations.

Can a thin liquid layer of chemicals in a petri dish behave like an image processing computer? Maybe, according to a report in the Jan. 19 NATURE. Most computers sequentially process each point of an image. But some chemical systems such as the Belousov-Zhabotinskii (BZ) reaction, which slowly oscillates between blue and orange states, work on every point at once. This chemical layer seems to temporarily store images, enhance contours and smooth "partially degraded pictures."

The BZ reaction is actually a series of reactions involving bromine-containing chemicals, acidic organic molecules such as malonic acid, and a catalyst. One set of reactions (orange) predominates at low bromide ion concentrations; another (blue) at higher ion levels. The system oscillates between the two sets of reactions because the first reaction set paves the way for the second by consuming bromide ions. But the products of the latter reactions promote the catalytically driven liberation of bromide ions. The return of the free ions resets the stage for the first reaction set and a new cycle.

The researchers made a light-sensitive version of the BZ reaction by using a ruthenium metal catalyst, whose bromide-liberating behavior changes when it absorbs light. Exposing the chemical layer in the petri dish with a half-tone image initiates a pattern of oscillating reaction zones that together appear as alternating positive and negative exposures of the image. At first, the exposed zones remain blue because light both increases local bromide concentrations and delays the onset of the orange-producing reaction set. Unexposed zones turn orange sooner. The two types of zones, now oscillating out of phase with each other, periodically exchange colors in the now nonhomogeneous layer.

The researchers — Lothar Kuhnert of the Max Planck Institute for Nutritional Physiology in Dortmund, West Germany, and K.I. Agladze and V.I. Krinsky of the Institute of Biophysics in Pushchino, USSR — suggest their chemical system may be more than a laboratory curiosity. "My aim was to construct a light-sensitive system, but I was surprised by how it works as an image processor," Kuhnert told SCIENCE NEWS. Still, the layer can "store" images only temporarily, so its fleeting information must be captured on film, he concedes.

## Short-circuiting spinach with platinum

In the daytime, intracellular assemblies of plant pigments and proteins gather the light energy that fuels photosynthesis, the production of biologically important molecules. Within superthin "thylakoid" membranes that are stacked inside chloroplasts (the cells' photosynthetic factories), these assemblies convert light energy into excited electrons. The electrons travel from one side of the membrane to the other along a string of molecules called the "electron transport chain."

According to Elias Greenbaum, a biophysicist at the chemical technology division of the Oak Ridge (Tenn.) National Laboratory, this property makes the cellular complexes candidates as "bioelectronic" material for, say, a future generation of tiny optical switches or "photobioelectrochemical" cells. In an upcoming BIOELECTROCHEMISTRY AND BIOENERGETICS, Greenbaum will report a technique for making electrical contact with the electron transport chain by depositing platinum particles onto thylakoid membranes that had been isolated from spinach cells and trapped on fiberglass filter paper. He can tap into and detect tiny electrical currents, but only when light shines on the platinized membranes.

# Environment

## Debate on forest fire policy

As forest fires left their mark on over 5 million acres of U.S. land last year, several groups called for a return to the pre-1972 policy of totally suppressing all forest fires in parks and wilderness areas. This worried ecologists who believe naturally lit fires can often benefit an ecosystem. However, judging from testimony before Congress last week, the nation will not revert to total fire suppression in the wilderness.

In their testimony before a joint hearing of the House Interior Subcommittee on National Parks and Public Lands and the Agriculture Subcommittee on Forests, Family Farms and Energy, several different forestry organizations and wilderness groups supported the main tenets of the current national fire program, although they added that the policy needs revision. Some groups also questioned whether park and wilderness area managers have been correctly implementing the "prescribed natural burn" policy. This policy allows managers of wilderness areas and natural parks to permit certain naturally lit fires to burn, as long as those fires do not endanger people, property or natural and cultural features. The policy also authorizes managers to set intentional fires to decrease the risk of uncontrollable future wildfires (SN: 11/12/88, p.316).

In general, the groups supported the findings of an interagency Fire Management Review Team that submitted its report late last year. Among its conclusions, the team suggested that agencies reaffirm and strengthen their prescribed natural fire policies. This assessment did not receive good marks from all, however. The National Forest Products Association, a group of forest land owners and forest product manufacturers, criticized the findings of the review team, saying it ignored the limitations imposed by the effort to decrease the federal deficit. A staffer with the National Parks subcommittee said this hearing will affect how Congress decides to allocate money for firefighting efforts in the 1990 budget.

## Potential replacement for ozone killer

An international treaty taking effect this July 1 will require the United States and 31 other ratifying countries to freeze their production and consumption of certain ozone-destroying chemicals at 1986 levels — a first step in a process that will cut use of these chemicals, called chlorofluorocarbons (CFCs), in half by the year 1999. Last week, the world's largest producer of CFCs, E.I. du Pont de Nemours & Company, announced its development of chemical blends that may easily replace the most widely used CFC.

Chemists at Du Pont have mixed together a newly developed compound called HCFC-124 along with two already available chemicals, HCFC-22 and HFC-152a. These mixtures are designed to replace CFC-12, a common coolant in air conditioners and refrigerators. Although these new blends pose some threat to ozone, Du Pont says, they are 97 percent less damaging to stratospheric ozone than CFC-12.

Du Pont and others have already developed alternate replacements for CFC-12, but the leading replacement candidate does not rival CFC-12 in energy efficiency (SN: 4/9/88, p.234). Based on laboratory work, Du Pont claims the new blends can perform as well as CFC-12, and that they might work in existing equipment with little change in design — a characteristic that would make the switchover less costly.

Other CFCs are used for blowing foam insulation and cushioning and for cleaning printed circuit boards.

It will take several years of testing by the industries using CFC-12 to tell whether the new blends can actually fill in for the older product. Moreover, the EPA must approve HCFC-124 for sale, a process that could take four years, says Tony McCain, alternatives development manager for Du Pont's Freon Products Division in Wilmington, Del.