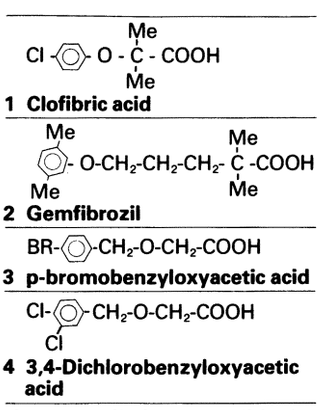
Chemistry

From the American Chemical Society meeting in Kansas City, Mo.

Closer to sickle cell drugs

The defective hemoglobin molecules associated with sickle cell anemia — an inherited disease that is found predominantly among blacks — unload the oxygen they carry to body tissues and then start sticking to each other. This in turn causes the red blood cells, which carry these hemoglobin compounds, to bend into firm sickle shapes that plug up tiny blood vessels. Severe pain, high fever, jaundice, skin ulcerations, heart problems and strokes are associated with this crisis period.

(Me = CH_3)



While many chemicals have been studied as possible inhibitors of the initial crisis event, hemoglobin fusing (gelling), no such agent has proved sufficiently effective and safe to be approved for widespread use. Now, Donald J. Abraham of the University of Pittsburgh and colleagues report progress in developing just such a drug.

In research that is described in the September JOURNAL OF MEDICINAL CHEMISTRY (and that also will be reported in an upcoming PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES), Abraham and cohorts began their search for drug candidates with clues from a simple chemical called "toluene," a methyl group (CH_3) attached to a six carbon-membered ring. First, the researchers noted that in previous studies, the ringed structure toluene has been used to cause hemoglobin molecules to crystallize (a certain analytical technique called "X-ray crystallography" requires crystallized molecules). They next realized that other ringed structures have been shown to possess some anti-hemoglobin-gelling activity. Perhaps, they theorized, toluene and certain other ringed chemicals bind to the same spot in hemoglobin to cause the crystallizing or anti-gelling effect. If such were the case, a rational approach in the search for effective sickle cell anemia drugs would be to find the toluene-binding site and then to develop and test more ringed structures that would be expected to bind to that same spot.

This approach eventually led Abraham and associates to four chemicals that show anti-gelling activity in test-tube experiments: clofibric acid (1), a breakdown product of a drug now used to treat high blood levels of lipid (fat); gemfibrozil (2), another antilipidemia drug; p-bromobenzyloxyacetic acid (3); and 3,4-dichlorobenzyloxyacetic acid (4). Of these latest sickle cell drug candidates, compounds 3 and 4 are "most promising" and 4 is definitely the "hottest," Abraham says. In fact, compound 4 could be ready for clinical trials in three to five years. Says Abraham, "We have really opened up the test-tube phase of solving [the sickle cell anemia] problem."

Toward a winter coat for crops

Elizabeth A. Allegretto, now a first-year graduate student at the University of Arizona at Tucson, has developed several synthetic compounds that eventually could lead to a polymer that protects crops from frost damage, a natural disaster that causes $1.5 billion in U.S. agricultural losses each year. Allegretto studied a protein that previously was shown to protect antarctic fish from freezing. She then set out to duplicate the fish's antifreeze system with various combinations of methyl acrylate, methyl methacrylate and N-vinylpyrrolidone. In laboratory tests, certain of these polymers successfully inhibit bacteria that are associated with crops from producing crystals around which ice can form — the first step in frost formation.

Technology

Holograms for concentrating sunlight

In their search for cheaper solar collectors, researchers are taking a closer look at holograms. Jacques E. Ludman of Photics, Inc., in Westford, Mass., reports in the Sept. 1 APPLIED OPTICS, "It appears possible to make a holographic concentrator that has no moving parts and is able to track the daily movement of the sun and concentrate the sun's rays onto an absorber." Although holographic concentration has so far met with only limited success, Ludman describes a design that avoids several of the problems encountered in earlier efforts.

A hologram, a pattern of light and dark areas on a thin film, behaves like a diffraction grating, which bends light. Thus, an appropriate pattern can be used to focus light. A hologram works best when incoming light is restricted to a narrow band of wavelengths and to a small angular range. A solar concentrator, however, must deal with a broad spectrum, from the ultraviolet to the infrared, and be able to handle a large angular range if it does not track the sun. Non-holographic concentrators that meet these requirements are available, but they tend to be expensive and complicated. Ludman says it is possible to find holographic configurations that "have substantial angular dispersion and high efficiency at the same time as broadband wavelength operation."

In Ludman's design, different parts of the same hologram are in operation throughout the day. As the sun's angle changes, different regions deflect the light to the absorber. A complete system that efficiently diffracts the entire visible spectrum requires several holograms arranged in a stack. Previous designs, however, failed because a lower layer tended to undo the work of the previous one. Ludman proposes that the focused beams from each different layer of the concentrator reach different locations on the absorber so that no cancellation occurs.

Ludman says, "It is easy to complete the design of a three-level holographic system that effectively concentrates the visible spectrum over a 100° daily angular variation and for an annual 40° variation." Ludman has applied for a patent on his design.

Using computers to improve education

After sifting through hundreds of applications, the National Science Foundation has selected 58 research teams to conduct experimental projects aimed at improving science and engineering education at high school and early college levels. Computer equipment (valued at almost $1 million) needed for the projects was donated by five computer companies (SN: 7/17/82, p. 41). NSF will provide about $850,000. Institutions awarded grants had to provide at least a quarter of the project cost, and many were able to obtain additional donations from local industries.

Funded projects covered a variety of topics including computer simulations of the research process in astronomy, demographic and economic forecasting for high school students, computer-based instruction to improve problem-solving skills, robotics and computer games for teaching modern physics.

Faster film and personal processing

The Eastman Kodak Co. last week at an international photographic show in Cologne, West Germany, announced the development of a new high-speed color negative film that allows the use of higher shutter speeds for photographing sports or fast-action subjects and offers good pictures even by candlelight. The film uses flat, tablet-shaped silver halide crystals that are more regular and sensitive than the pebble-like grains found in conventional film. The new grains maximize the absorption of incoming light. Kodacolor VR 1000 film will be available in 1983.

At the same show, the Polaroid Corp. unveiled a new instant 35 mm slide film and processor. The kit produces color and black and white slides in three minutes.

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