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## COVER

Tropical deciduous forest tree, *Cochlospermum vitifolium* (Cochlospermaceae), flowering in leafless condition in the dry season (Guanacaste Province, Costa Rica). See page 1299. [Stephen P. Hubbell, University of Iowa, Iowa City]

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

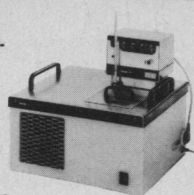




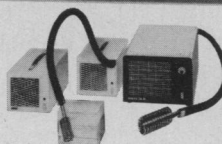
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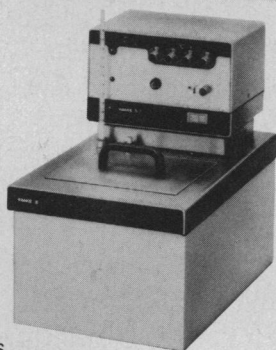


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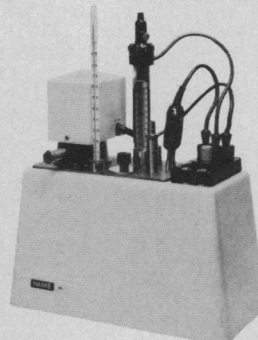
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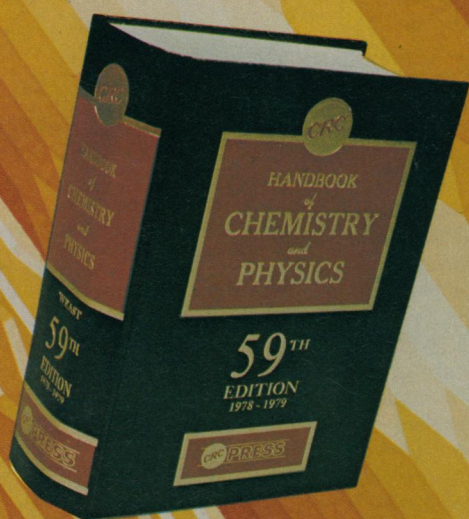
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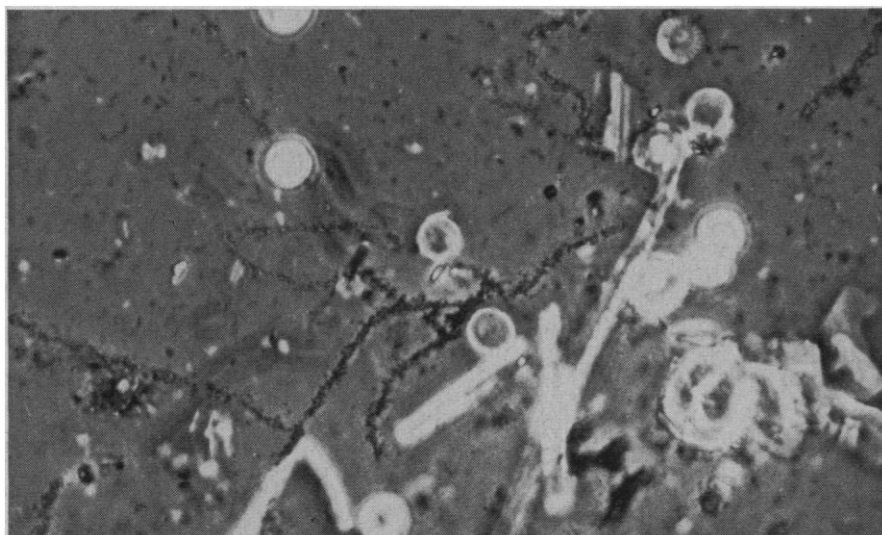
# Is dissolved organic carbon involved in eutrophication?

Possibly so. Possibly phosphates or nitrates are not alone to blame. But Hans W. Paerl's studies with Kodak nuclear track emulsions suggest that algae seldom use glucose or acetate from fresh or salt water. CO<sub>2</sub> seems to provide all the carbon they need, at least during daylight.

Dr. Paerl takes water from various depths in lakes of various kinds as well as the open ocean. He adds tritiated glucose and acetate to his samples and incubates. Then he kills all the microorganisms. Following preservation he filters out everything particulate, gets rid of salts that could crystallize, and

dries. A quick pass through acetone vapor makes his filters transparent.

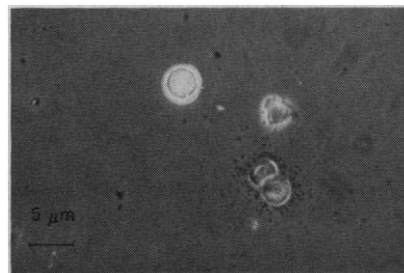
In the dark he melts Kodak nuclear track emulsion, either Type NTB-2 or NTB-3, at 40°C, dilutes it 1:1 with distilled water, dips in slides bearing his cleared filters, pulls them out after about 5 seconds, lets them dry on edge for about 15 minutes, then packs them away for two weeks in a lighttight box containing desiccant. After Kodak developer D-19 has done its work, he fixes and washes in deionized water. Then he looks in the microscope at  $\times 1000$  for black silver grains that show where the tritium was incorporated.



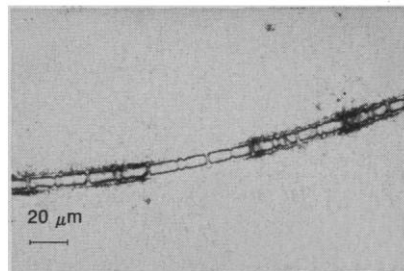
In scenes like this the black dots form over filamentous and coccoid bacteria attached to detritus. Only bacteria and fungal hyphae—both free-living and attached—give such evidence of having extracted the dissolved organic carbon. Algae do not.

In working with algae such as diatoms and dinoflagellates it has been hard to tell those that were alive when the sample was taken from dead siliceous skeletons that abound in natural waters. Dr. Paerl solves that with microautoradiography too, as seen at right.

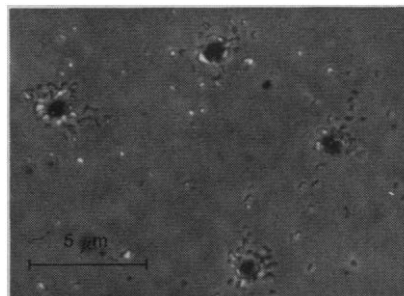
His address is Institute of Marine Sciences, University of North Carolina, Morehead City, N.C. 28557, phone 919-726-6841. The person to talk to about acquiring some Kodak nuclear track emulsion can be reached at 716-724-4633. Or Publication P-64 will give product and ordering information—drop a postcard to Dept. 55S, Kodak, Rochester, N.Y. 14650.



Living vs non-living cells of the diatom genus *Cyclotella*. Cells which have actively incorporated <sup>14</sup>CO<sub>2</sub> through photosynthesis are capable of exposing Kodak nuclear track emulsions. The emulsion was placed over a filtered plankton sample after the sample was incubated with <sup>14</sup>CO<sub>2</sub> under sunlight. Non-living *Cyclotella* (bright unlabeled cell) fail to expose this emulsion.



Living vs non-living cells present in a filamentous diatom, a species of *Melosira*. A majority of individual cells in the filament are capable of photosynthesis as determined by autoradiography. Photosynthetic <sup>14</sup>C-labeled cells are surrounded by clusters of exposed silver grains in Kodak NTB-2 nuclear track emulsion.



The detection of ultraplankton (0.7  $\mu$ m diameter) by microautoradiography. Photosynthetically-active cells are surrounded by groups of exposed silver grains in Kodak NTB-3 nuclear track emulsion. Such cells escape detection during routine microscopic enumeration.



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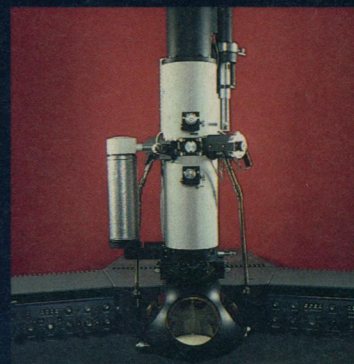
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Electron Diffraction pattern of CdS from a single grain in a solar cell. Courtesy of Dr. J.W. Edington, Dept. of Aeronautical Engineering, Univ. of Del.



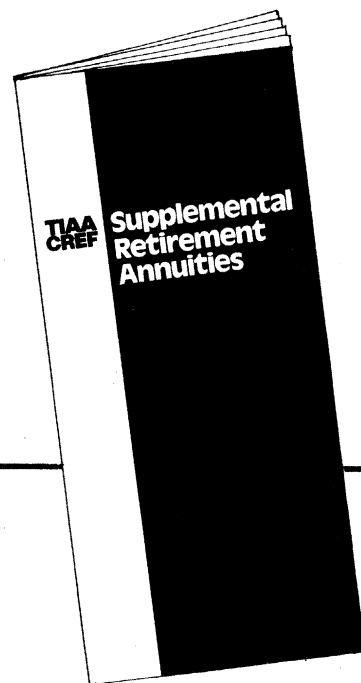
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Györgyi's theory] in the scientific literature other than one or two papers in the *Proceedings of the National Academy of Sciences*.<sup>1</sup> Some 30 years ago Szent-Györgyi published in *Nature* his prediction that proteins are semiconductors (1). Since then, a number of papers published in scientific journals indicate that charge transfer reactions occur in biological systems. Semiconductor properties have been demonstrated for collagen (2), deoxyribonucleic acid (3), and certain metalloproteins (4). Bone and tendon have been shown to exhibit photoconductivity, reflecting their electronic properties (5). Moreover, amide bond, the backbone of proteins, is a transmitter of electronic effect (6). Finally, most biopolymers, including proteins, nucleic acids, and mucopolysaccharides, are capable of mechanoelectrical transduction (piezoelectricity) (7).

In view of these facts indicating the potential importance of bioelectricity for controlling the growth of cells, to state that "... there are no data indicating that it [Szent-Györgyi's theory] might have validity" seems difficult to justify.

BOGUSLAW LIPINSKI

St. Elizabeth's Hospital,  
Tufts University School of Medicine,  
Boston, Massachusetts 02135

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Constance Holden's article on Albert Szent-Györgyi contains almost as an aside a statement of much that is wrong with American science. She says, "scientists connected with the NFCR [National Foundation for Cancer Research] agree with others that this is not a theory that is exactly ripe for government support. It is exceedingly unconventional, a leap into the unknown."

I could not disagree with these sentiments more strongly. Great discoveries in all fields from the sciences to the humanities have nearly always been the result of imaginative and innovative approaches to old problems. In the process of becoming the principal source of research funding, the federal government has exercised a subtle but pervasive control over the kinds of research that are performed. As one member of a funding agency remarked to me, "We admire innovation, but we don't trust it. And we fund what we trust."

American preeminence in science has historically been based on the willingness of past researchers to take imaginative leaps. Today, support for this kind of thinking is extraordinarily difficult to come by, even for persons with strong reputations (witness Linus Pauling and Albert Szent-Györgyi). For those with equally fertile imaginations but of less repute, the truly creative art of scientific research is an unreachable dream. Federal funding agencies would do well to mark out a portion of their budgets specifically for the researching of a few wild ideas. Otherwise, we may find ourselves lagging progressively farther behind those places "further East" which Holden says are more in sympathy with fantastic ideas.

THOMAS M. VOGT

Health Services Research Center,  
Kaiser Foundation Hospitals,  
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## Cancer Incidence

Luther J. Carter, in his excellent article on cancer policy (News and Comment, 9 Feb., p. 525), misses an important consequence of assuming a proportional relationship between cancer incidence and dose—that the total number of cancers tend to stay constant if the pollutant is spread more widely in the population. Carter says, "With the current popularity of self-service pumps at gasoline stations, exposure to this chemical [the additive ethylene dibromide] is presumed to have been increasing." This is probably wrong.

Replacement of gas station attendants by self-service pumps will increase the number of persons exposed, but if the exposure per car filling remains the same, so will the total exposure—it is merely spread over more persons. There will be fewer cancers among the attendants but more among the customers. The decrease in one will be matched by an increase in the other to within statistical error.

If, as some people believe, there is a threshold exposure below which no cancer appears, then the customer may get no cancers at all, and the total number of cancers will go down.

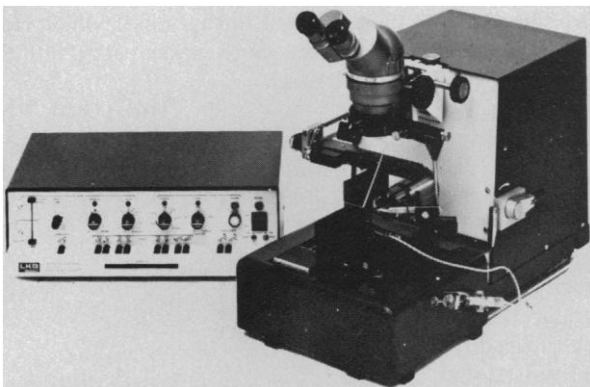
RICHARD WILSON

Energy and Environmental Policy  
Center, Harvard University,  
Cambridge, Massachusetts 02138

*Erratum:* Because of a printer's error, a line was dropped from the letter by Robert W. Berliner (16 Mar., p. 1066). The third sentence in the third paragraph should have read, "Schools of medicine have large fixed costs that do not vary with the number of students. . . ."

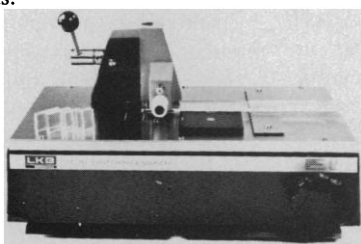


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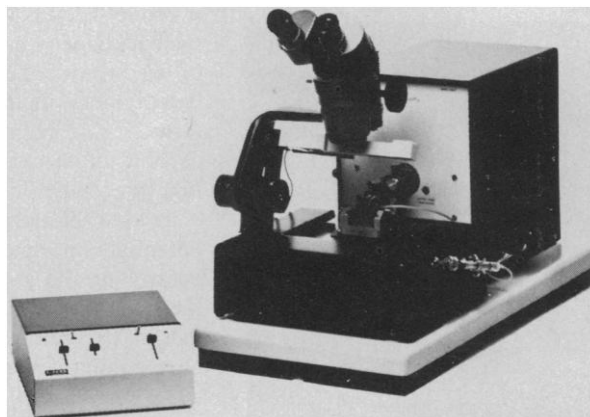
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**Immunoperoxidase:** Localization of neuraminidase in the crypt bases of polymorphs in the stroma of human small intestine. The tissue section was incubated with antineuraminidase, followed sequentially with second antibody and peroxidase antiperoxidase. Peroxidase was demonstrated with 3, 3', 5, 5' diaminobenzidine. (Courtesy of MJ O'Brien, G.I. Research Laboratory, Mallory Institute of Pathology, Boston.)

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## Dependence on Imports of Oil

Since 1973 the world has had a series of lessons about imports of oil. Unfortunately, the people of the United States seem to be slow learners. Had they been attentive they would have noted that the United States and the other oil consuming nations behave as if they were helpless. They are so eager for oil that they will pay almost any price for it. In 1973 a curtailment in Free World production of about 10 percent for 3 months led to a quadrupling of the price. Recently, a shortfall of about 5 percent has resulted in increases of spot prices by 50 percent or more. It is clear that if production were permanently diminished somewhat further, the producing countries could at least double their take.

The Russians are self-sufficient with respect to oil, and they profit from price increases. For reasons of power politics they have found it attractive to try to stir up trouble and encourage greed in oil producing countries. Their policies, which are implemented by many willing tools, have met with success and will be continued. Russian clandestine activities will not be stopped by sending an aircraft carrier to the Middle East. They could be curtailed only by a very high-risk nuclear confrontation.

For the short term the probabilities are that drastic troubles will not materialize, but prudence would dictate efforts to lessen increasing dependence on imports of oil. Despite the contribution of Alaskan oil, U.S. imports have increased by about 50 percent since 1973, and their cost this year will exceed \$50 billion.

When one considers long-term potential costs, both military and economic, the government's proposed actions are shortsighted. The tentative 1980 budget calls for a reduction in energy research and development dollars which translates into an overall reduction of activity of about 10 percent. But the picture with respect to synthetic liquid is more dismal. Taking into account inflation, efforts to obtain clean liquids from coal and efforts to get liquids from oil shale are to be reduced even more.

In its current approaches to meeting the shortages created by the revolution in Iran, the Administration is proceeding cautiously. The word "conservation" has excellent connotations, and talk of fostering conservation is good politics, but actually to do something about it is another matter. The nub of the problem is gasoline, which is by far the largest petroleum product. The public is dependent on and infatuated with the automobile; use of gasoline continues to increase. The public will not gladly tolerate interference with supplies. A government that fails in this matter could find itself thrown out of office.

At the very least, shortages of liquid fuels or extremely high prices for them must lead to demands for action, including greater efforts to increase domestic supplies. Typically, little will be done until public opinion suddenly forces a major heedless, unplanned crash program, costing great environmental damage and hundreds of billions of dollars.

Such costs could be minimized by actions taken now. By building quickly and operating several full-scale plants, knowledge could be gained leading to improved designs and minimum damage to the environment.

Sufficient experience has been gained from intermediate-scale plants and pilot plants to establish the feasibility of production of shale oil or coal liquids. Cost estimates range from \$20 to \$35 a barrel. However, no full-scale plant will be built under present circumstances. There is too much uncertainty about government regulations related to the environment, prices for products, and interest rates. Principal components in the projected price of synthetic fuels are capital costs and interest charges arising from long delays. Estimated operating costs are about \$10 per barrel. The amounts of liquids that could be obtained from shale or coal are enormous in comparison with oil potentials. If the United States were to move decisively with even a few plants it would gain valuable experience, and the oil producing and exporting countries would perceive that there were limits to how far they could go in squeezing financial and political advantages from their oil.

—PHILIP H. ABELSON

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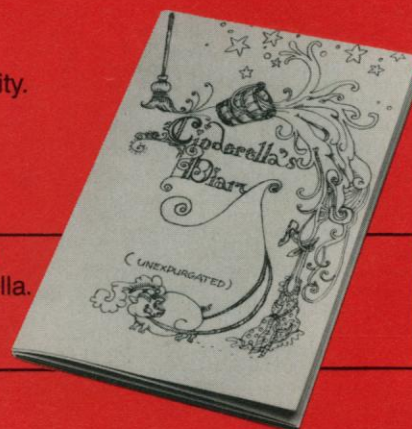


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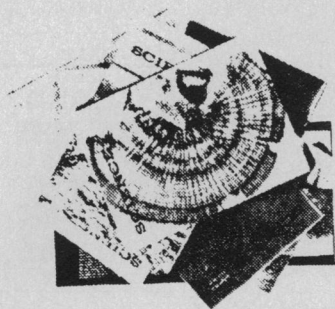
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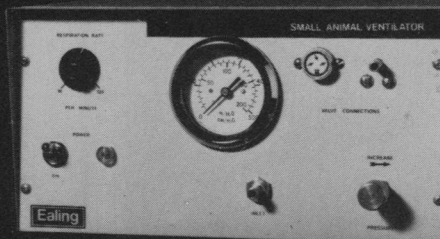
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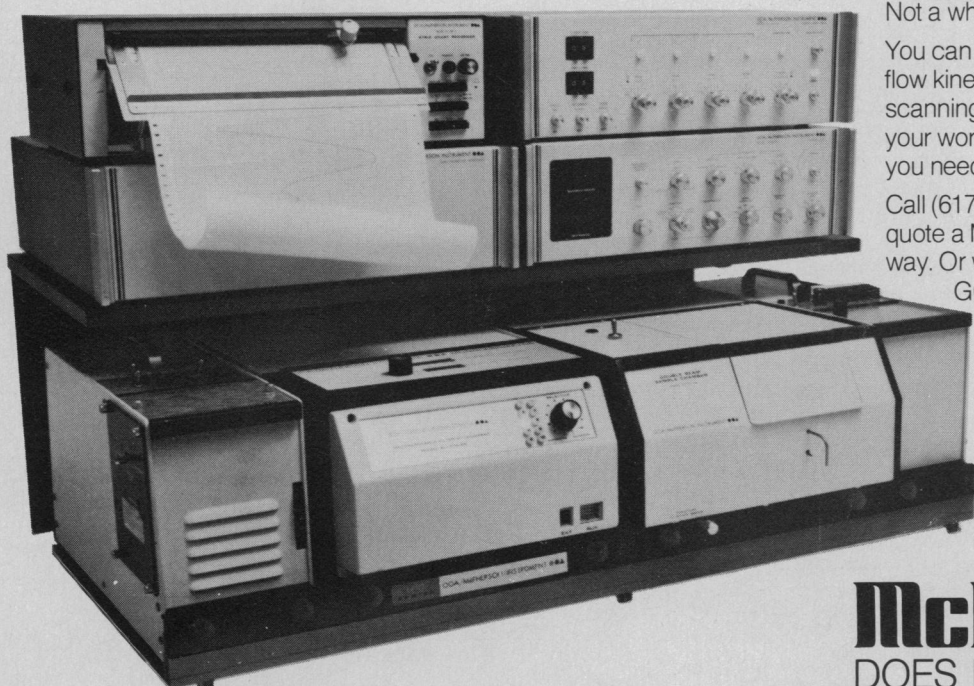
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