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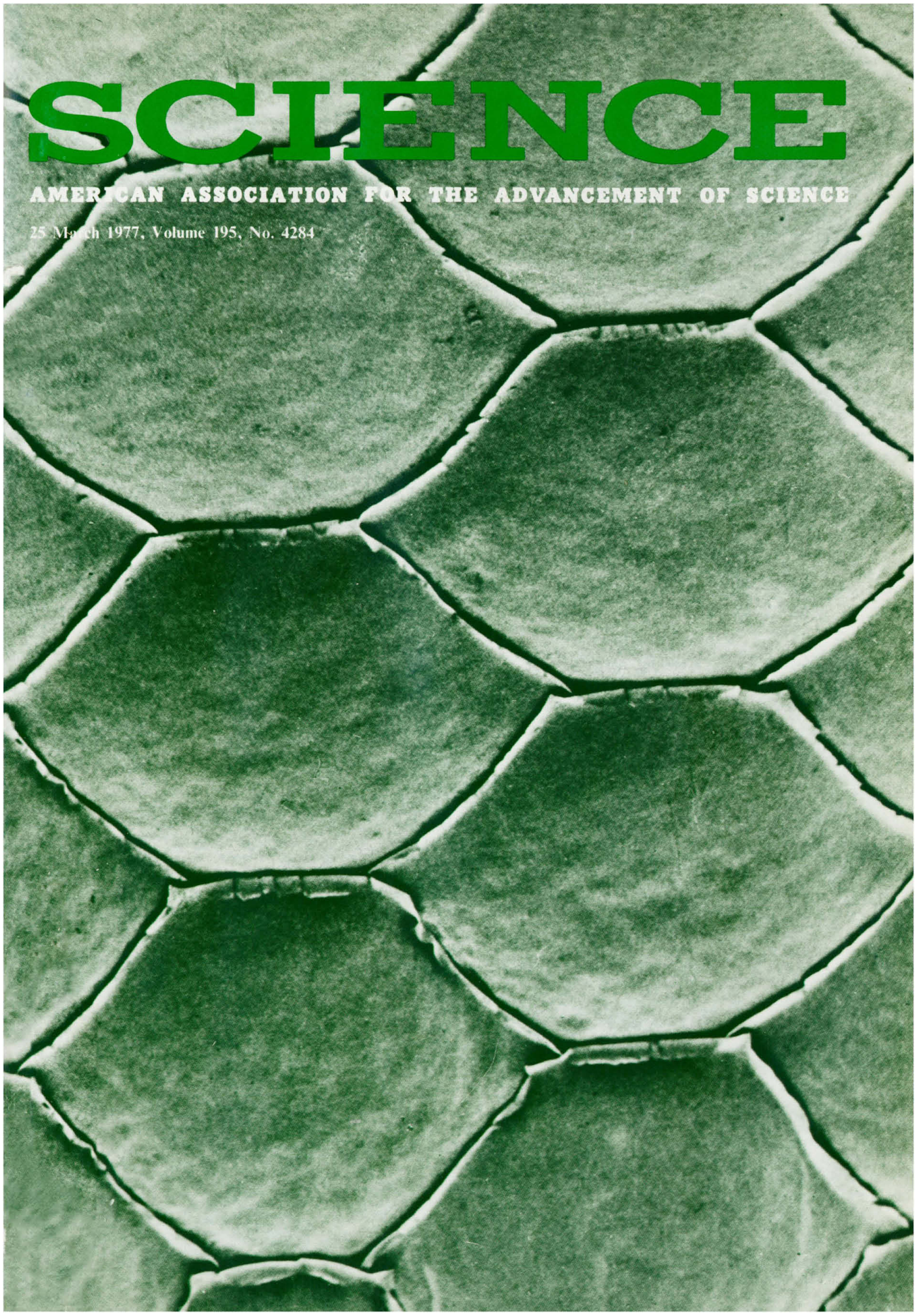
25 March 1977, Volume 195, No. 4284



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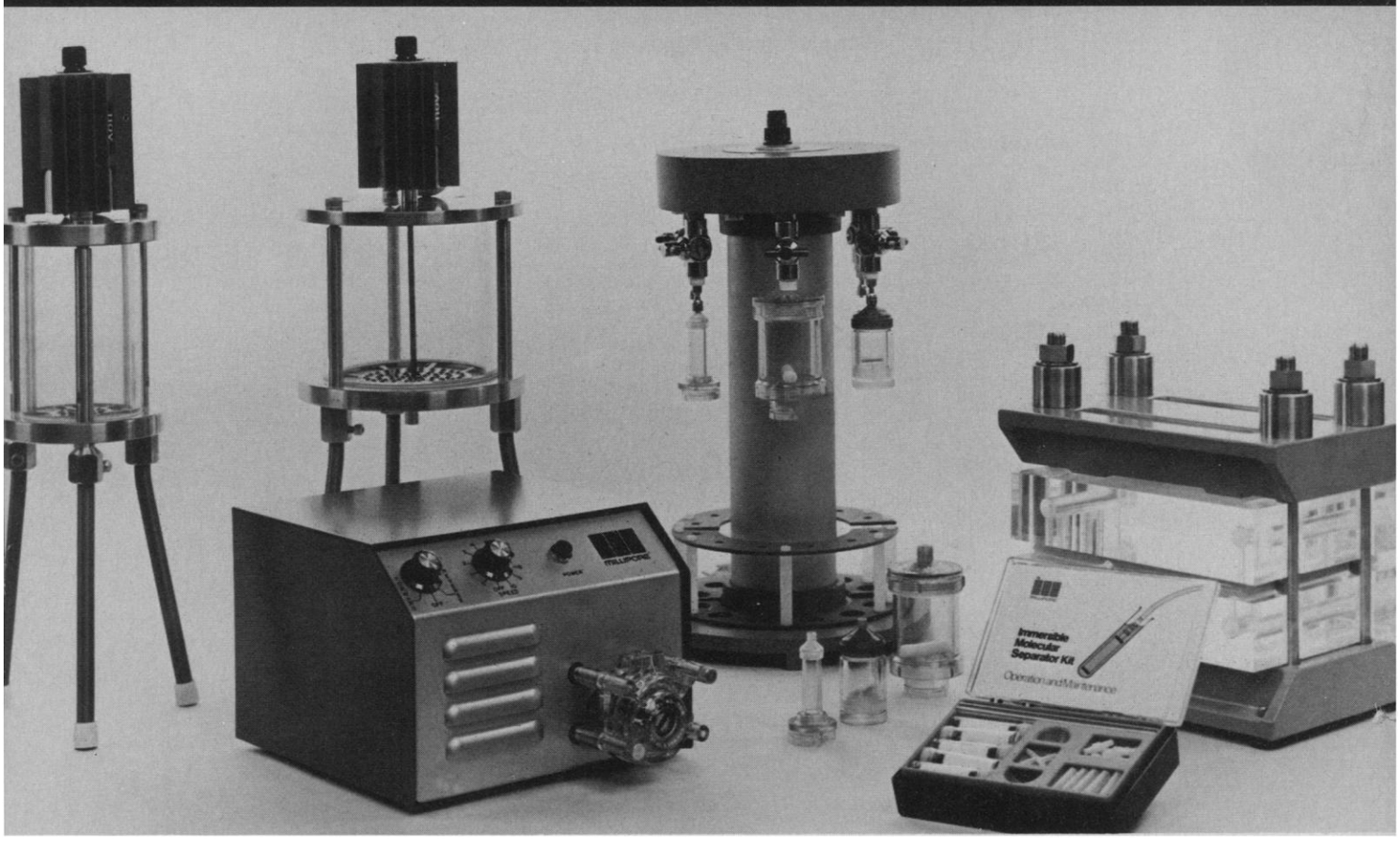

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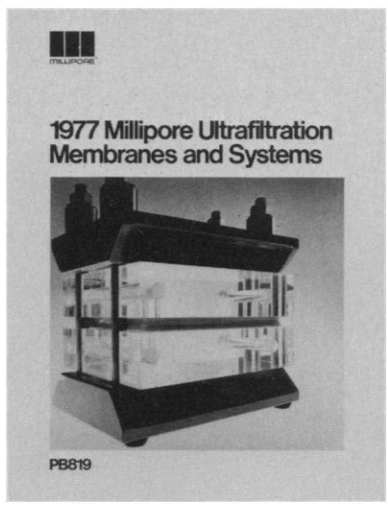

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25 March 1977

Volume 195, No. 4284

SCIENCE

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COVER

Dorsal surface of *Rhinophis drummond-hayi* from Namumukula, Sri Lanka. The smoothly irridescent scales of the burrowing uropeltid snakes have a wide, freely overlapping surface formed of a β-keratin grid. Its regular ridges near 2500 angstroms apparently reduce its free surface energy, keep dirt from sticking to the surface, and keep friction low. Consequently these animals may move along their soil tunnels with minimum effort (about $\times$ 70). See page 1348 [C. Gans and D. Baic, University of Michigan, Ann Arbor]

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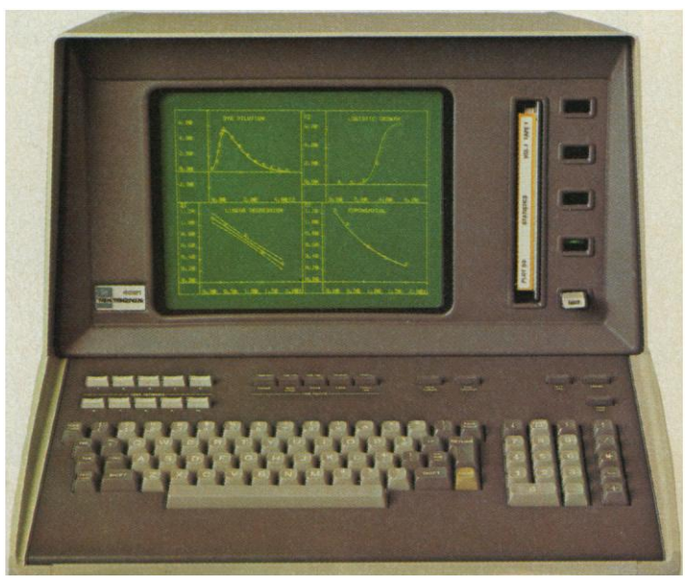

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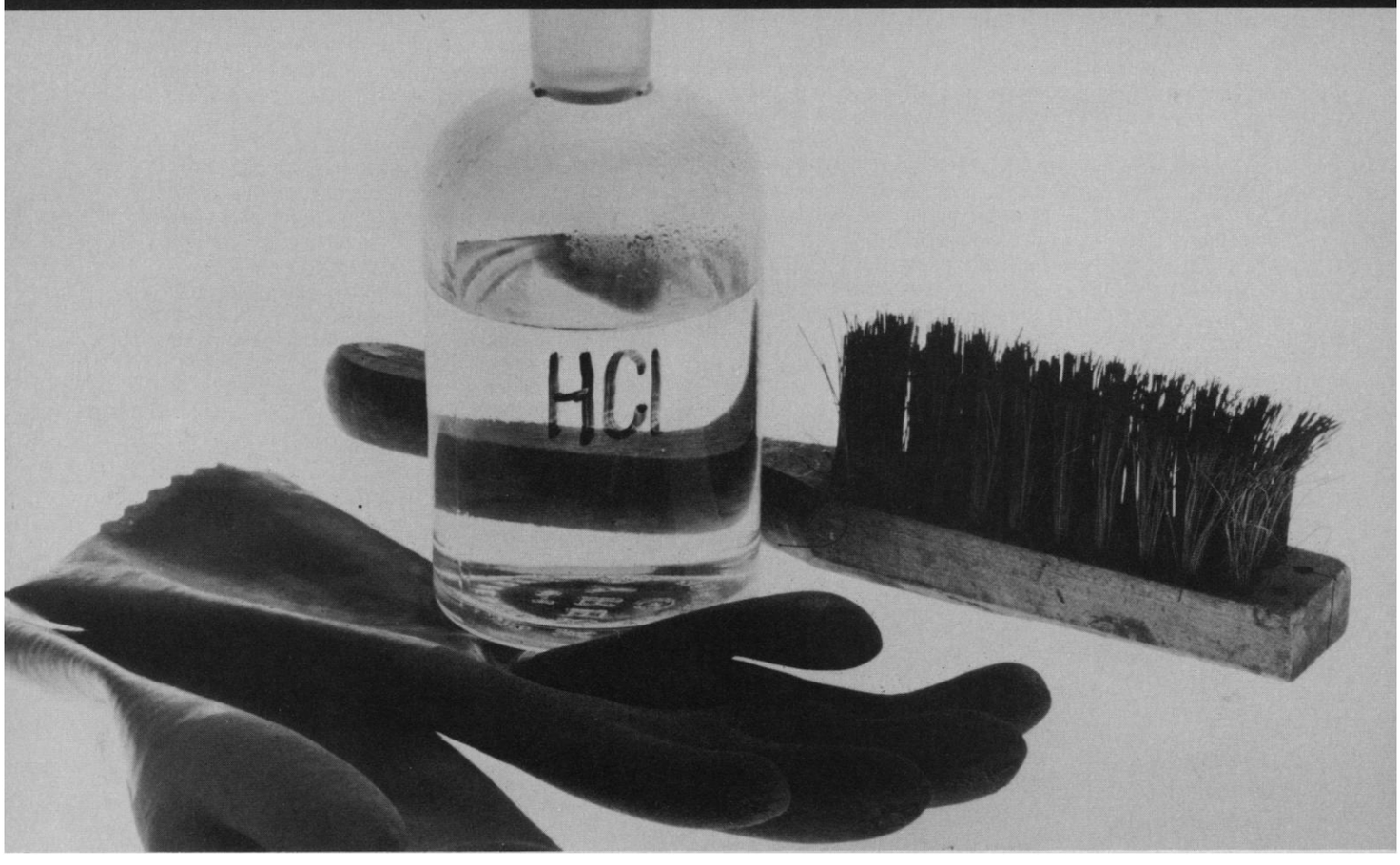

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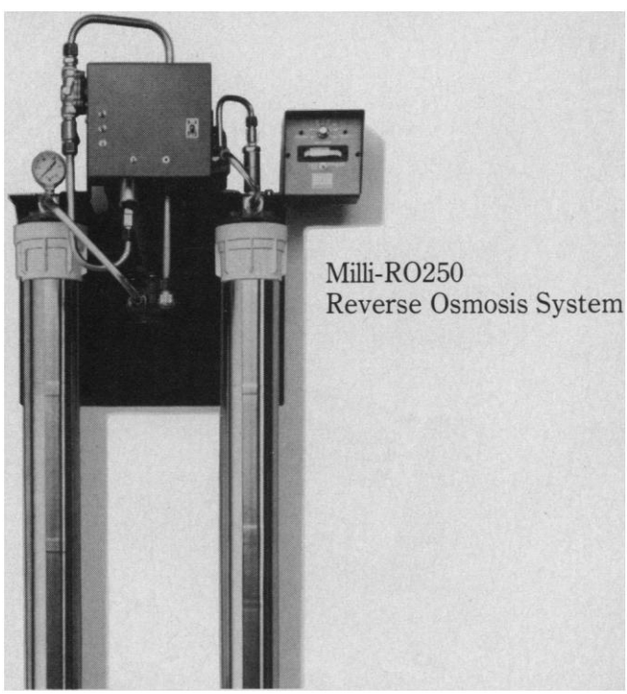

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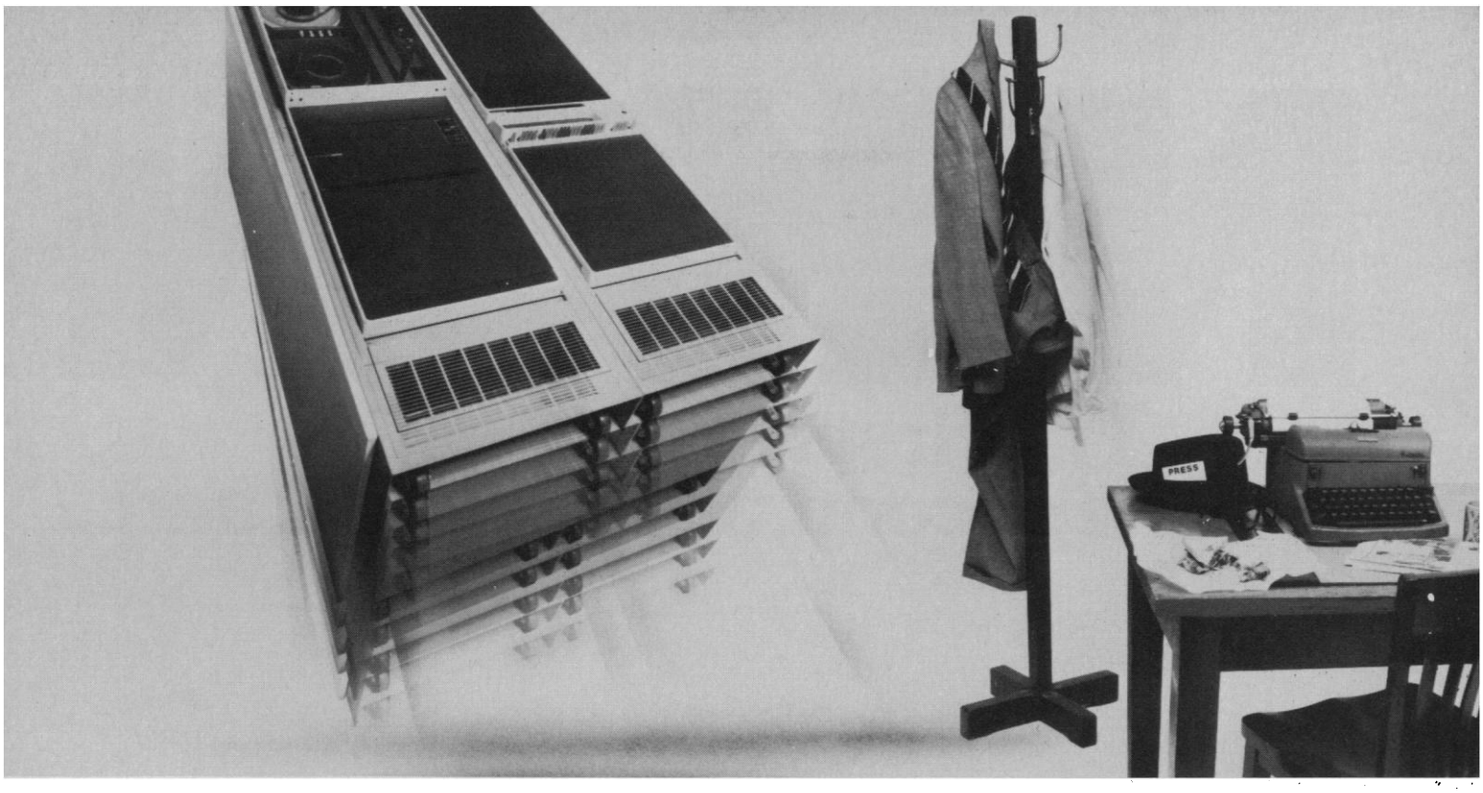

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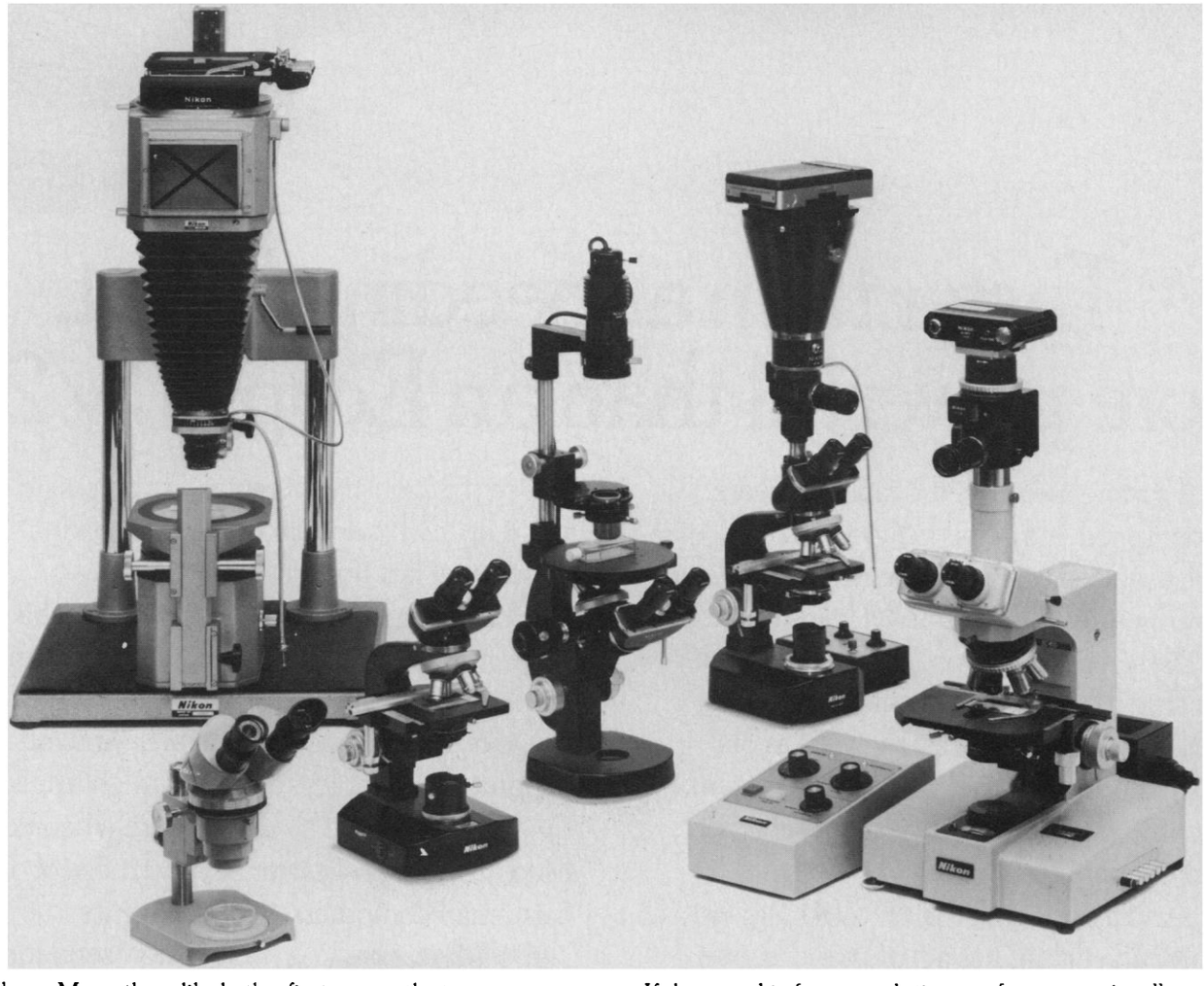

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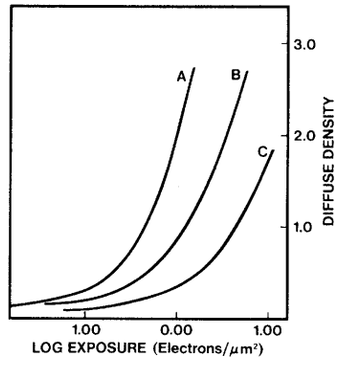

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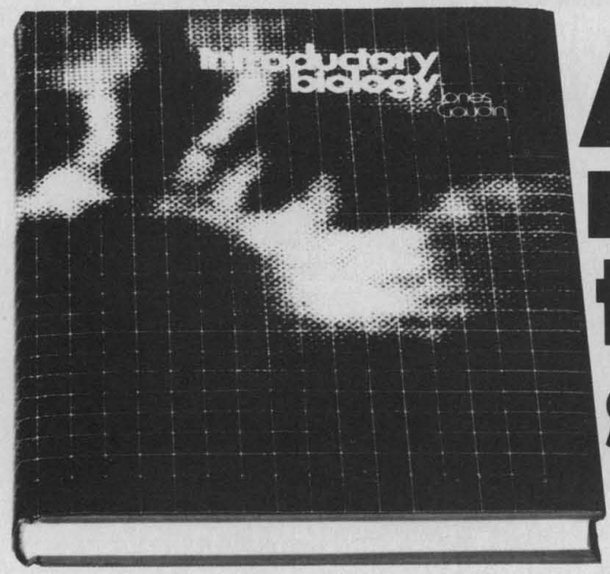

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Contents:

Introduction
1. The Study of Life
2. The Living World

Matter, Energy, and Cells
3. Chemical and Physical Basis of Life
4. Cells: Structure and Organization
5. Cellular Use of Energy

Whole Organisms
6. The World of Microbes
7. Plant Form and Function
8. Animal Form and Function
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Homeostasis: Coordination and Control
10. Hormones
11. Nerves and Muscles
12. The Role of the Nervous System
13. Behavior
14. Health and Disease

Reproduction and Heredity
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16. Human Reproduction
17. The Mendelian Basis of Inheritance
18. The Molecular Basis of Inheritance
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Ecology
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22. Human Activity on the Environment
23. Management of Our Resources

Evolution
24. Variation and Natural Selection
25. Adaptation and Speciation
26. Life as It Evolved • Glossary • Index

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What's so special about Jones/Gaudin? In addition to covering all the widely accepted areas of biology, this text gives you a wealth of teaching aids to make your job easier *and* more effective. (See sample pages opposite.)

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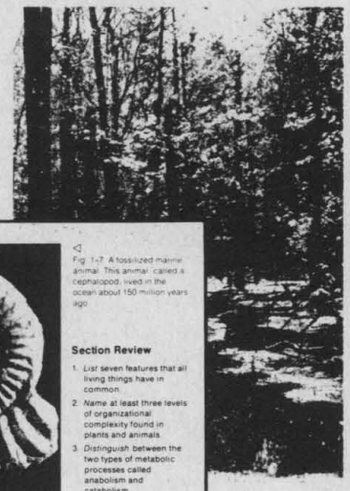
And that's not all!

Chapter Objectives

communicate clearly and concisely exactly what your students will learn, and list what they'll be able to do after completing the chapter. Take a look at the sample from the chapter on *Ecosystems and Habitats*—

20 Ecosystems And Habitats



Chapter Objectives

In this chapter you will see how plants, animals, and microorganisms form dynamic environmental relationships, utilizing energy and cycling matter through their bodies. You will also see how the interactions with light, temperature, moisture, minerals and energy determine which organisms will occupy any specific area.

After completing this chapter you should be able to:

1. Define the term ecosystem and name the major classes of organisms found in practically all ecosystems.
2. Distinguish between producers, consumers, and decomposers, and describe their functional role in an ecosystem.
3. Discuss the passage of energy through an ecosystem and indicate the relative efficiency of passage through different parts of an ecosystem.
4. Describe the cyclic passage of water, carbon, oxygen, and nitrogen through both living and nonliving parts of the environment.
5. Discuss the principal interactions between organisms in an ecosystem, including predation, parasitism, mutualism, and commensalism, and competition.
6. Describe typical food chains and food webs in terrestrial and aquatic environments.

Succession and Evolution

Another feature characteristic of living things is that they interact with other living things. Although these interactions are not necessary to define life in an individual, they are experienced by all organisms during their lifetime. Such interactions include competition for space, food, and water; avoidance of predators or the capturing of prey; and cooperation among individuals in establishing and maintaining a community of organisms (Fig. 1–6). Never reaching a completely balanced state, these interactions result in a sequence of changes in the community. In addition to the community changes that occur over a few months or years, we also see gradual long-term changes in the organisms themselves. The first of these processes is called ***succession*** and the second ***evolution***.

The process of evolution — change through time — is particularly characteristic of living things. Plants and animals exist in a fluctuating environment that places different demands on each group. This interaction between organisms and environments favors the survival and reproduction of certain individuals over others. The more successful ones survive to pass their characteristics on to future generations. Environmental factors thus influence the makeup of populations of plants and animals on the earth.

Charles Darwin was the first biologist to explain this concept in a convincing way and he provided a theoretical framework that gave new meaning to the study of life. Moreover, the recognition of the fact of evolution provided a logical connection between organisms alive today and those of the past whose fossils are found in the rocks that remain (Fig. 1–7).

Even though much can be recognized about the nature of living things through casual observation, the detailed knowledge that we possess today has resulted from a careful, systematic study of organisms. Biology, the study of life, is the science of observing living things and experimenting upon them.

◁ Fig. 1–7 A fossilized marine animal. This animal, called a cephalopod, lived in the ocean about 150 million years ago.

Section Review

1. *List* seven features that all living things have in common.
2. *Name* at least three levels of organizational complexity found in plants and animals.
3. *Distinguish* between the two types of metabolic processes called anabolism and catabolism.
4. *Define* the difference between asexual and sexual reproduction.
5. *Name* the process of dynamic equilibrium found in living things.
6. *Answer*: What theory or concept is offered by biologists to explain the existence of fossils.

Section Reviews

let students test themselves to make sure they have a firm grasp of the material they just went over, before they go on to a new section. See the sample from chapter one, *The Study of Life*—

Summary

1. Living organisms differ from nonliving ones in that plants, animals, and microorganisms are highly organized. They transform, store, and expend energy as they maintain a dynamic equilibrium between their requirements and resources.
2. Living things respond to both internal and external stimuli. They produce new individuals, they grow, specialize, and die.
3. Scientists use a standardized technique of inquiry — the scientific method — that tends to eliminate prejudice and prior bias in the solution of problems. This method involves carefully observing a problem, proposing possible answers, testing the answers under carefully controlled conditions, and drawing conclusions based on the results of the tests.
4. Science is limited in that scientists cannot apply the methods of science to solutions of moral, philosophical, or aesthetic problems. Such subjective ideas as beauty and goodness do not lend themselves to scientific analysis.
5. The application of scientific techniques to the solution of human problems has led to great advances in agriculture, animal husbandry, medicine, environmental protection, and industrial development.
6. Different biologists have approached the study of life from several different viewpoints, and they investigate different aspects of life. These fields of specialization include the study of structure, function, reproduction, growth, development, behavior, heredity, ecology, evolution and molecular biology.

key terms and concepts

characteristics of life
organizational complexity
systems
organs
tissues
metabolism
anabolism
catabolism
homeostasis
irritability
stimulus
response
asexual reproduction
sexual reproduction
death
succession
evolution
the scientific method
observation
hypothesis
controlled experiment
conclusions
limitations of science
technological applications of science
evolution
fossil
taxonomy
anatomy
physiology
genetics
development
growth
behavior
ecology
succession

Summaries

(at the end of each chapter)—enable students to see how each statement fits into the subject as a whole, and how all the statements taken together can help them meet chapter objectives. Examine page 19 from *The Study of Life* chapter—

Lists of Key Terms and Concepts

encourage students to make certain they grasp the specifics and understand how the specifics relate to the subject. (The lists also make excellent study aids for groups of students and stimulate questions and discussions.) Also from *The Study of Life* chapter, page 19.

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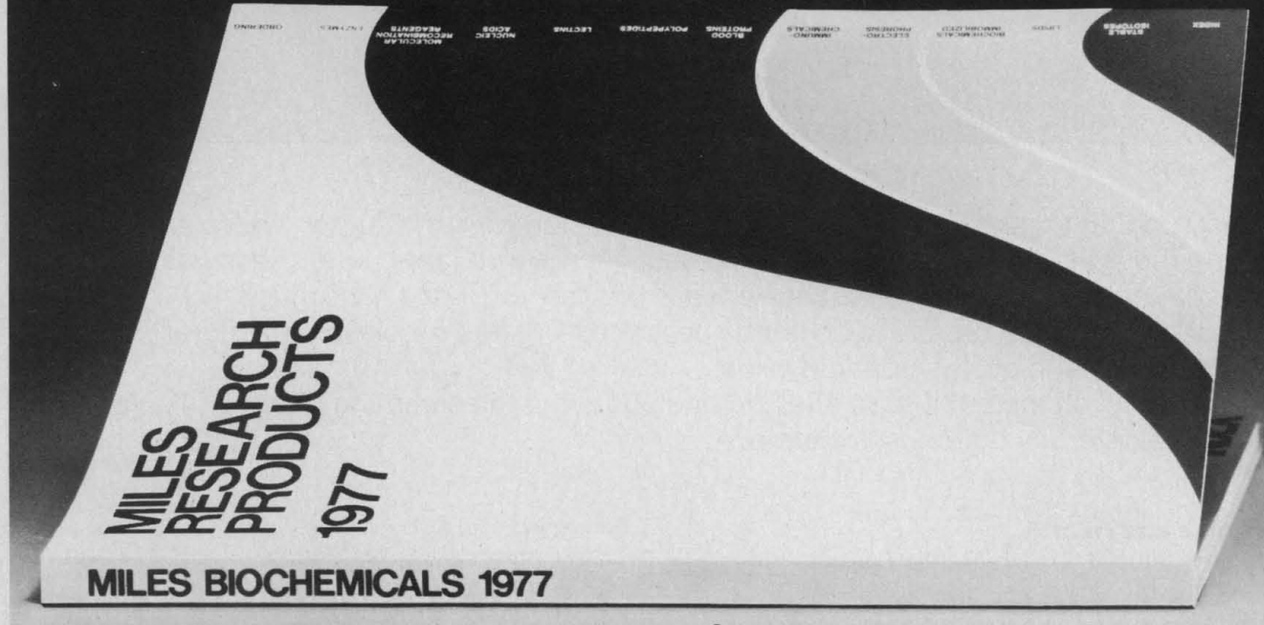

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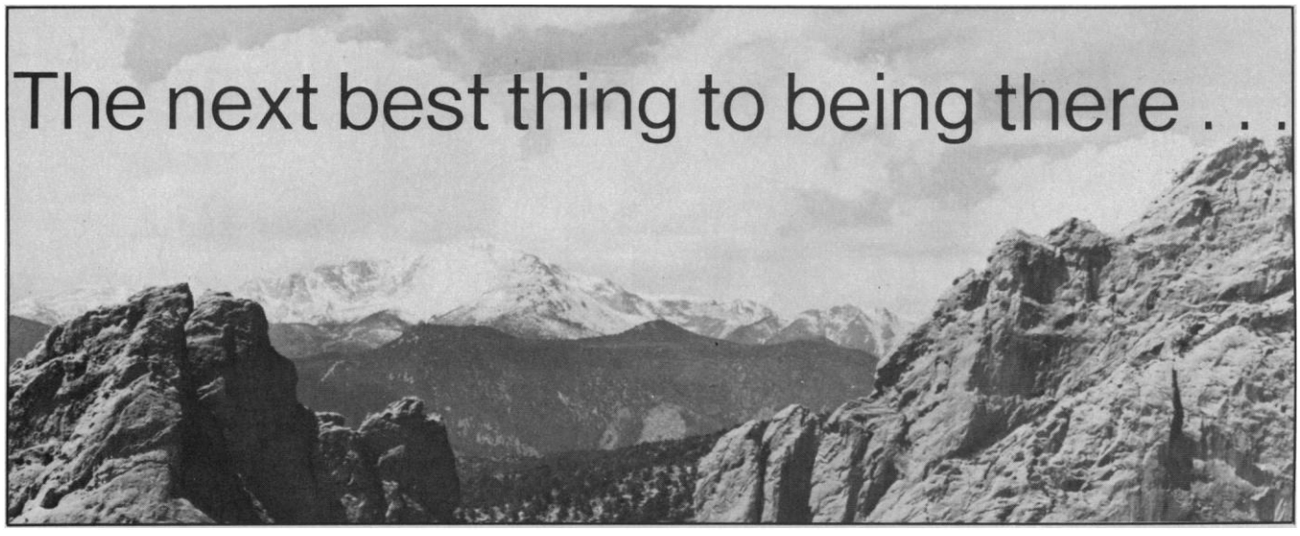

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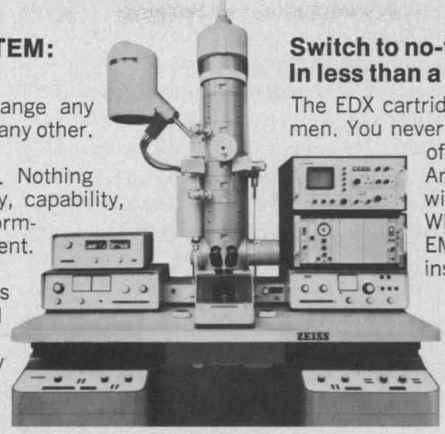

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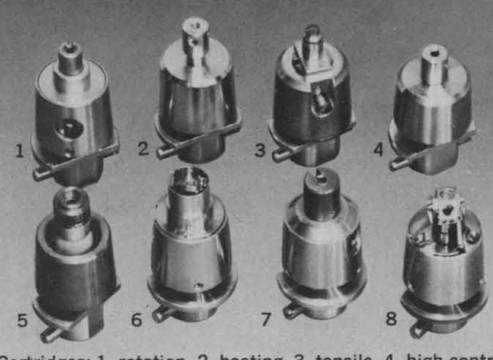

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The Fertilizer-Ozone Connection

Deborah Shapley's article (News and Comment, 18 Feb., p. 658) is not fair to some people and is 9 months late. The article is based on a paper I gave at the April 1976 meeting of the American Geophysical Union in Washington, D.C. Eight other papers on the same subject were presented at the symposium. Most of these papers consisted of original contributions, whereas mine was only a review of the work of others. Also, my paper is now one part of an undigested, unapproved, preliminary report being prepared by the Panel on Nitrates of the National Academy of Sciences–National Research Council, which apparently was "leaked" to Shapley. I think it is ludicrous that my 9-month-old review paper was rushed into print as if it were a hot news item.

Shapley's article appears to give me credit for discovering that nitrogen fertilizers (manufactured and managed legumes) may conspicuously reduce stratospheric ozone, but this is an injustice to the actual discoverers and developers of the case. That man-induced fixed nitrogen might reduce stratospheric ozone was implicit in 1971, after the publication of three papers (*1*) showing that nitric oxide is chemically formed in the stratosphere from soil-produced, inert nitrous oxide and two others (*2*) showing that nitric oxides catalytically reduce ozone. An illustration of how well this was recognized then is a quotation attributed to a spokesman for an aircraft company early in 1972: "Blame the farmers; don't blame us."

In 1971 so little was known about the natural amount and distribution of nitrogen oxides in the stratosphere that it was not timely to pursue the fertilizer problem. However, in the period 1972 to 1975, the Climatic Impact Assessment Program obtained enough measurements of stratospheric oxides and learned enough about the sensitivity of stratospheric ozone to nitrogen oxides that it became appropriate to consider the problem. Although it is difficult to assign priorities, it is my impression that Crutzen (*3*) first took up the subject again, and McElroy (*4*) was the first to deeply probe the complicated biological bases for the problem.

Shapley says the problem has been "hampered by vigorous disputes," but any "vigorous disputes" I know of are evidence of the vitality of the subject and have tended to speed up work on the problem and get new people (*5*) (including soil scientists) interested in it.

In the discussion of possible partial answers, Shapley apparently misunderstood what I said in a telephone interview. Although recycling of fixed nitrogen could reduce the amount of manufactured nitrogen fertilizer, organic farming in terms of cultivated legumes also represents added nitrogen fixation.

HAROLD S. JOHNSTON
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Radioactive Wastes

The article by Luther J. Carter on radioactive wastes (News and Comment, 18 Feb., p. 661) is full of numbers but devoid of information that gives an understanding of what they mean. It constantly mentions millions of gallons and tens of thousands of tons of waste from the entire nuclear industry over the next 25 years and creates the impression that we are being inundated by vast quantities of this waste. If that's the game, why not mention the trillion gallons (10 million tons) of carbon dioxide, the 10 billion gallons (150,000 tons) of sulfur dioxide, or the 100 million gallons (1 million tons) of solids produced by SO_2 scrubbers that are the wastes from a single coal-fired power plant in 1 year? An understandable figure for the high-level wastes is 2 cubic meters per year from a nuclear power plant, an amount that could be stored under a typical dining room table. The electric power produced by such a plant is worth $200 million per year, so one could spend $2 million in handling this small quantity before increasing the cost of electricity by as much as 1 percent.

Carter says this material must be isolated "for what, in the human perspective, must be forever," but after 500 years, the amount one would have to eat (after conversion to edible form) to give a good probability of injury is about a half-pound. (In the case of military

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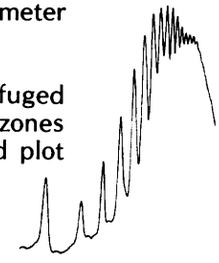

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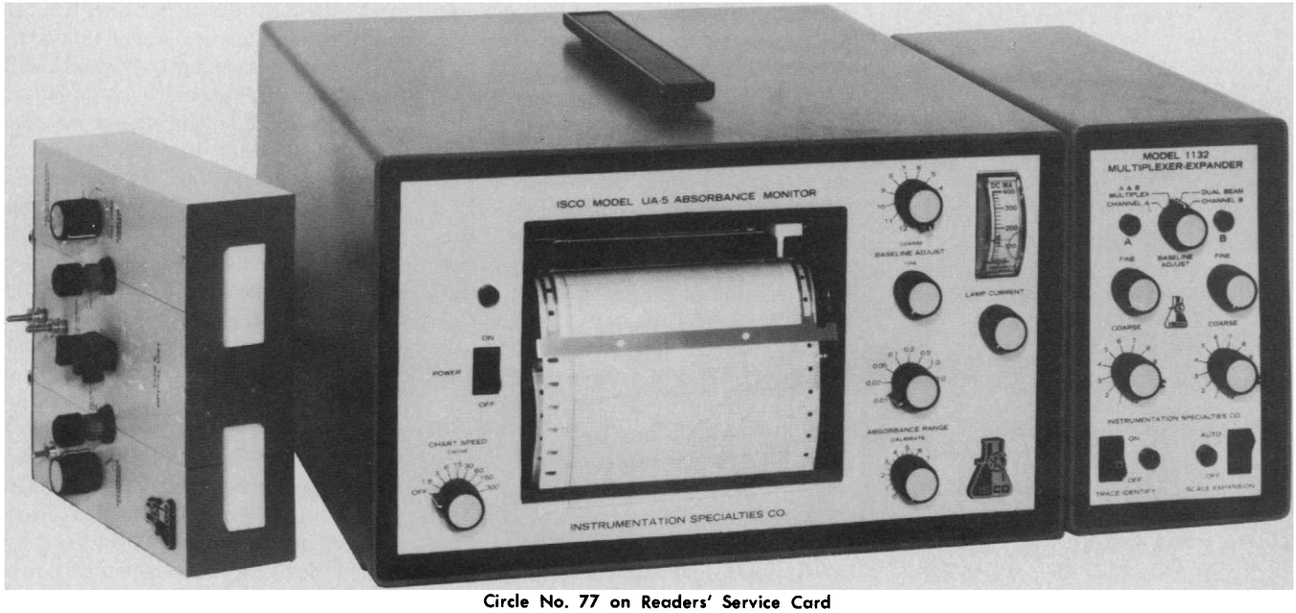

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waste, about which the above statement was made, one would have to eat 10 pounds.) That makes it less dangerous than many natural rocks (for example, cinnabar) and clearly less dangerous than pesticides and herbicides we keep in our homes and spread on the ground in farmland. Why don't they have to be isolated forever?

The principal hazard scenario for the waste is that it may be contacted by groundwater, leached into solution, and eventually get into food and water supplies; but this process includes many inherent time delays which essentially guarantee that nothing will get out for at least 500 years (*1*). Also, the waste accumulated by a million years of all-nuclear power in the United States would cause less than one fatality per year (*1*). Compare this with the 10,000 fatalities per year from sulfur dioxide due to coal burning.

Carter states in one place and implies throughout that these wastes have a great potential danger, but he gives no indication that it is orders of magnitude less than the potential danger from many other poisonous substances our society constantly deals with (*1*). Also the radioactivity in the waste is many orders of magnitude less than natural radioactivity in the earth at depths shallower than that of the waste burial.

Carter implies that the low-level transuranic waste is also a serious problem, but it is really trivial, and even the most haphazard deep burial would surely suffice. The British simply dump it in the ocean with no ill effects. Until recently, the United States handled it with haphazard shallow burial, and any reasonable analysis shows that there are no ill effects. For example, if all the transuranics thus buried were to leak out and get into rivers, or to become distributed through soil uniformly between the surface and their burial depth, not a single fatality would ever be expected to result.

The statement about friction between the Atomic Energy Commission (AEC) and the National Academy of Sciences (NAS) committee on radioactive waste disposal is somewhat misleading. With the exception of a brief misunderstanding in 1966, the relations between the NAS committee and AEC-ERDA (the Energy Research and Development Administration) have been most cordial for over 20 years. Several thousand copies of the so-called "suppressed" report were distributed by AEC.

The statement that "there have been no known human casualties" from leaking waste storage tanks at ERDA's Savannah River and Hanford installations implies that there may well be some. The leaking material is 40 feet below the surface, which gives a gamma-ray attenuation of something like 10^{-50} for the approximately 10^{24} gamma rays that have been emitted, so there is only 1 chance in 10^{26} that a single gamma ray has ever reached the surface. Compare this with the thousands of gamma rays with which natural radiation bombards each of us every second.

BERNARD L. COHEN
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Cancer Data

Most death certificates do not reflect incontrovertible evidence of cancer when compared to evidence established by autopsy, biopsy, or surgical resection of a malignant tumor as an index of cancer epidemiology (*1*). Reliance upon mortality figures based on death certificates in which autopsy results are reported in establishing the epidemiology of cancer raises serious questions about the validity of subsequent lengthy and costly studies on environmental carcinogens by the Environmental Protection Agency (EPA) (Editorial, 4 Feb., p. 443) or by others.

As a practicing general pathologist I am well acquainted with the low autopsy rate in most hospitals in the United States, and particularly in rural counties. Knowing the frequency with which occult cancers may be encountered at autopsy, the difficulty in deciding whether cancer is the cause of, or even related to, death, and the casual way in which death certificates are filled out by many physicians whether or not an autopsy has been performed adds further skepticism about the epidemiologic value of cancer mortality figures based on death certificate data.

Far more reliable, albeit perhaps a harder initial task, would be a random sampling in every possible county of autopsy and surgical pathology records over a specific time period. Virtually all biopsied, resected, and occult cancers would be found, as well as the patient's age at the time cancer is recognized. Few cancers go unrecognized before death even though they may not cause death. Further, many cancers are successfully treated or recur after a latent period long enough so that death from other

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causes may supervene (for example, an elderly woman who has had a "successful" mastectomy, dies of cerebrovascular hemorrhage 3 years later, before clinical evidence of recurrence of the breast cancer has manifested itself).

The College of American Pathologists, in its Inspection and Accreditation Program, requires a cross-indexed surgical pathology and autopsy file of all diseases diagnosed, including cancer. Thus a readily available source of information can be easily tapped for a more comprehensive and reliable index of the incidence of cancer. When seeking to find the relationship of the environment to cancer, what is important is not cancer *mortality* but cancer *incidence*.

With cancer incidence data, EPA could plan a productive program with relevance. Without them, much money and time will be wasted and, worse, invalid conclusions might be reached.

Every county in the country might not be covered by this alternative approach to data gathering, but the data generated would provide opportunities to plan investigations on possible environmental carcinogens that would enthuse even the most pessimistic grantsperson in academia, or in state or federal agencies.

ROBERT W. CHRISTIE
Diagnostic Services Professional Association, Lancaster, New Hampshire 03584

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Nuclear Arsenals

Kearny and Wigner, in their letter concerning Soviet civil defense (21 Jan., p. 243), express alarm at the possibility of a Soviet "plan for evacuation" followed by nuclear blackmail threats. They state that, after such an evacuation, "we could destroy only a small fraction of [their population]" and that Wigner has estimated such Soviet losses to be between 2.75 and 4.5 percent.

They do not point out that these are immediate and short-term losses only. Just as in World War II, the majority of the losses would probably be long-term, resulting from lack of food, shelter, and medical care. There are over 30,000 warheads in the U.S. nuclear arsenal—certainly enough to destroy nearly all the housing, power plants, fuel refineries, storage depots, major factories, and transportation systems in the Soviet Union. Fuel, machinery, and fertilizer would not be available for modern agriculture, nor would there be means of transportation to distribute the food. Only a small fraction of the present population would be able to "live off the land" even in warm months. History has shown that modern man is incapable of surviving the Russian winter without housing, heavy clothing, food, and space heating.

Americans and Russians to whom I have talked about nuclear war have the concept of being "bombed into the Stone Age." Whether they die within 10 seconds or 10 months is not significant. These people find the enormous nuclear arsenals of the United States and the Soviet Union more than an adequate deterrent under any circumstances. I find it inconceivable that the leaders of the Soviet Union would allow their country to be "bombed into the Stone Age," even if the population is evacuated.

JAY OREAR
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Rocky Mountain Spotted Fever: Occurrence in Massachusetts

McEnroe's statement (Technical Comments, 4 Feb., p. 506) "Preliminary screening of *D[ermacentor] variabilis* from inland Massachusetts has indicated the presence of RMSF [Rocky Mountain spotted fever] rickettsiae . . ." needs clarification. To date, none of the rickettsial strains isolated by us from Massachusetts populations of *D. variabilis* ticks are referable to *Rickettsia rickettsii*, the causal agent of RMSF. Instead, all share a major antigenic component with *R. montana* (*1*). The latter, a distinct member of the spotted fever group, is characteristically an agent of low virulence for laboratory animals and of questionable clinical significance. Obviously, *R. rickettsii* does exist in Massachusetts (*2*). However, in our experience, its frequency of occurrence in *D. variabilis* is lower than that for the milder strains of the RMSF group.

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National Institute of Allergy and Infectious Diseases, Rocky Mountain Laboratory, Hamilton, Montana 59840

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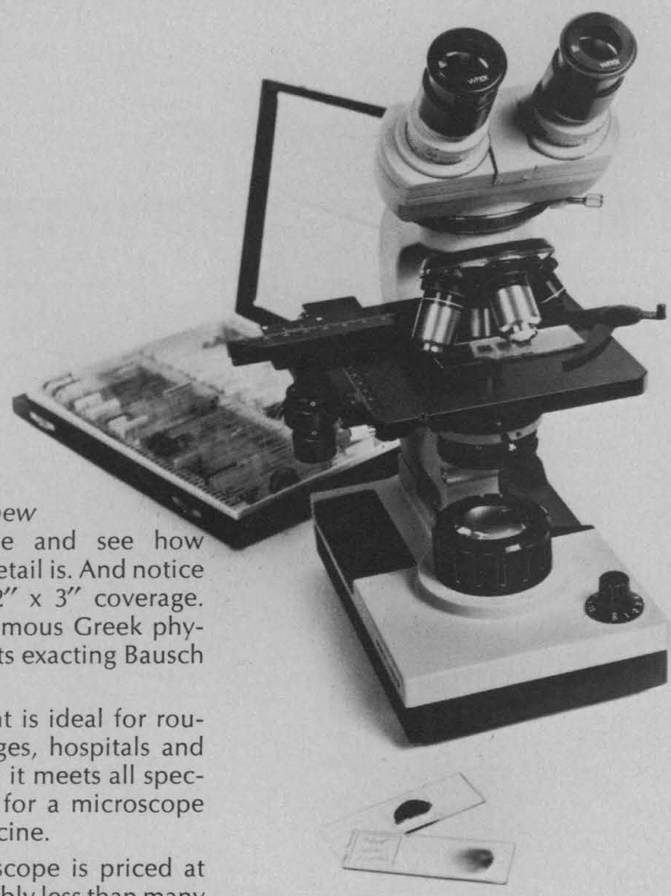

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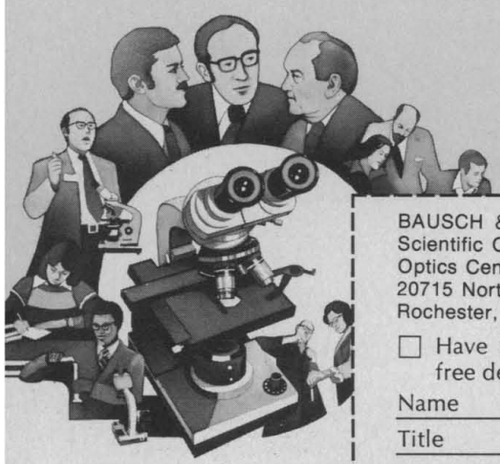

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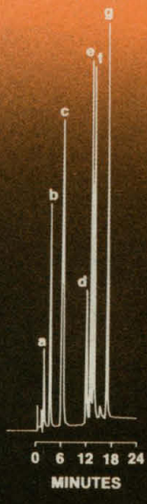

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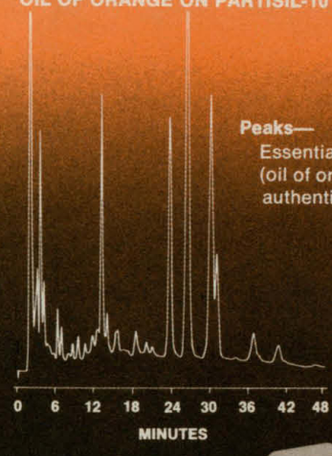

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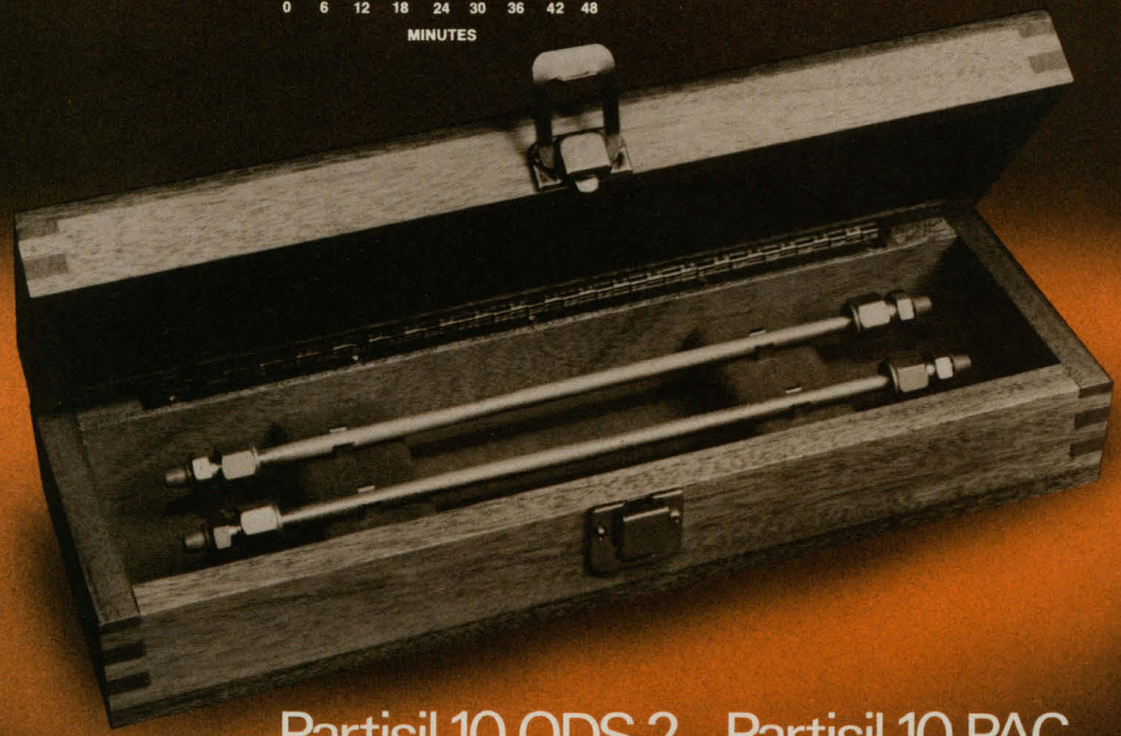

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25 March 1977, Volume 195, Number 4284 **SCIENCE**

Our Last Vaccine?

A writer in the *New York Times* termed the recent swine influenza immunization program a "sorry debacle." What happened, and what are the implications?

The new strain of swine flu isolated at Fort Dix represented a serious potential public health hazard. Virologists and public health officials responded rapidly and with expertise drawn from years of experience and research. Vaccine strains were developed with amazing speed and distributed to manufacturers. The government—perhaps in part politically motivated, but also mindful of the well-known difficulty of mass immunization by private means—made the startling and courageous decision to underwrite the cost of a mass immunization program.

The real problems which are common to all vaccines and to other biologics in the United States today, then began to surface. First, in a mass immunization effort, there are two very real hazards. One or more batches of vaccine may be imperfect and produce unexpected side effects. With current methods of detection and reporting, even infrequent side effects will be apparent. This hazard is minimal in the United States today because of the stringent controls required by the Bureau of Biologics of the Food and Drug Administration. Nevertheless, the possibility always exists. Second, and perhaps more troublesome, is the certainty that deaths and other complications will occur coincidentally with vaccine administration. In the litigious climate that exists in the United States, these events will inevitably result in lawsuits, each of which may result in a judgment as large as $1 million to $10 million.

Who properly should bear the risk of such suits, and the cost of their defense? After lengthy deliberation, the government made the momentous decision, in the case of influenza vaccine, to assume this responsibility. Otherwise, not a single dose of vaccine would have been released.

A major problem inherent in making vaccines, other biologics, and new drugs available in the United States is here put into sharp focus. The problem is liability. Until this problem is understood, faced, and solved, innovation in preventive medicine will slow down to an unacceptable crawl.

A manufacturer who proceeds with dedication, expertise, and courage to make a new vaccine available, investing time, effort, and money to satisfy the most stringent FDA requirements that both the safety and efficacy have been proved beyond reasonable doubt, still must face the realization that if the product is not widely used, he may never be able to recoup even a fraction of the cost of the development, validation, and licensing. In the case of vaccines, where widespread use is likely, he also will have to bear an intolerable risk of litigation for even coincidental adverse events.

As a result, an important segment of the biologics industry in the United States is moribund; effectively only one U.S. vaccine manufacturer remains willing to embark on the development of a new vaccine. Plants and research facilities lie empty, or are sold to foreign firms; research and development efforts are at a standstill. Exciting new vaccines are ready for development—hepatitis B, gonorrhea, syphilis, malaria, to name a few. They may never be available in the United States.

What is the solution? Two possibilities might be considered. One would have the government undertake to bear legal responsibility for all products that it has licensed (and therefore tested and approved) unless negligence in manufacture or administration can be proved. The second would have the government itself or nonprofit government-supported organizations take over the responsibility of manufacture and distribution of biologics. This approach has been widely used in many countries, such as Sweden and France, and in certain states, such as Massachusetts. Perhaps a combination of those approaches would permit America to return to the forefront of preventive and curative medicine.—ALFRED M. PRINCE, *New York Blood Center, 310 East 67 Street, New York 10021*

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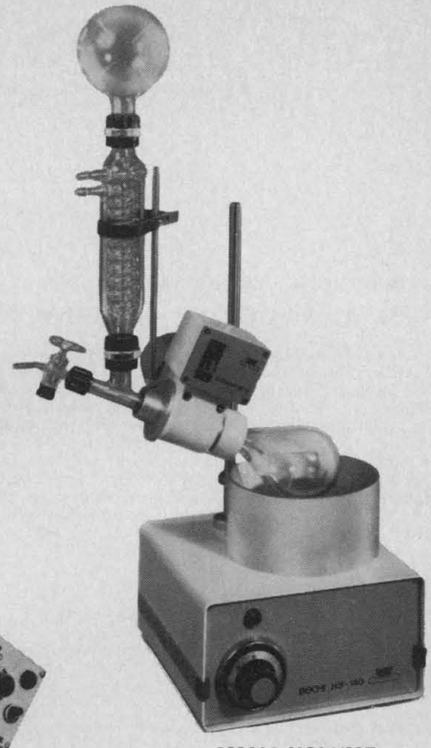

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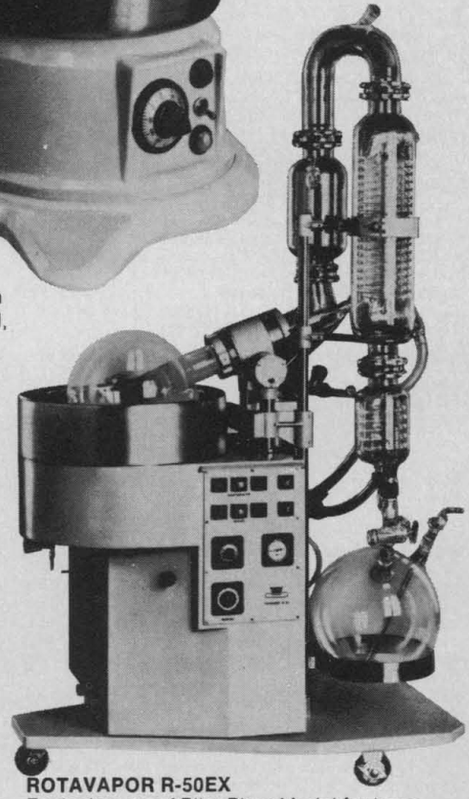

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The ESD-9000 renders an 85-decibel signal two times per second to warn of conditions hazardous to laboratory apparatus. Such conditions may be drops, surges, or cutoffs of electrical current, temperature changes, or pressure changes. These alarms are designed for interface with central computors, alarms, or event recorders for complete protection of sensitive laboratory apparatus. Wolsk Associates. Circle 681.

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—RICHARD G. SOMMER

Microcomputer Systems

Micropac Program Development Systems include a PROM programmer, dual floppy disk system, high-speed line printer, CRT terminal, and interface modules plus software. This system enables the microcomputer user to design, program, and install a system with relative, rather than absolute, addressing of program segments. Thus, only portions of program directly affected by software changes need be reassembled when any change is made. Different configurations of hardware and software are available to suit the user. All options are based on standalone microcomputer modules and minimum systems may be upgraded to allow for greater complexity. Process Computer Systems. Circle 678.

Water Quality Monitoring System

A system is now available for oceanographic or limnologic data acquisition. The underwater probe, model 513D, measures conductivity, salinity, temperature, depth, dissolved oxygen, *p*H, turbidity, oxidation-reduction potential, and concentrations of specific ions. Model 514D is a digital readout of the data acquired by the probe. The user may monitor the various parameters individually via continuous scanning of one he selects or all at once. The readout may be interfaced to any of several types of recorders. The system is complete with an electromechanical sea cable and a winch. InterOcean Systems. Circle 690.

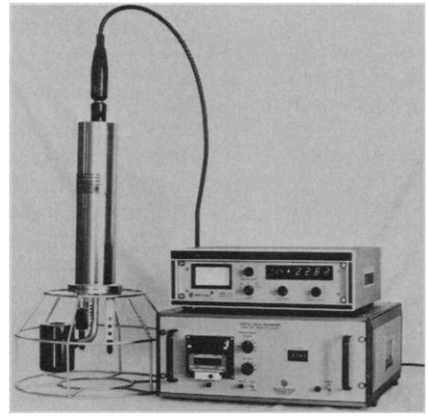

Fig. 1. Model 513D underwater probe and model 514D digital deck readout from InterOcean Systems.

8-Hour Lecture Recorder

Model RAD14 is a miniature tape recorder that will record for 4 hours, stop automatically, and emit a tone. The operator then turns the cassette and reactivates the device for another 4 hours. An optional switch allows the operator to interrupt the recording and continue at a later time. The device measures 5.5 by 3.25 by 1.25 inches. It is equipped with a cassette, a microphone, record/play control, review mechanism, auto-stop with alarm, pause button, three-digit counter with reset, battery-condition indicator, 4-hour battery set with holder, 2-hour rechargeable battery pack, a-c adaptor/recharger, carrying case, and an earphone. It weighs 1.1 pounds. Courterport. Circle 680.

Pocket Thermometers

The series 1500 thermometers are powered by C batteries. They are available in −55° to 999°F and −55° to 999°C models. They read in 1° increments. A variety of stainless steel penetration, immersion, and surface Type K thermocouple probes are available. All models come in leather cases. Extech International. Circle 693.

Laboratory Freezer

Model SE22-100 is designed for medical research and preservation of tissues, plasma, and blood cells. Temperature is adjustable from −18° to −73°C. The cabinet is steel and the lid is counterbalanced. Chamber dimensions are 67 by 19 by 30 inches. SE22-100 is also available with a recording thermometer and buzzer system. So-Low Environmental Equipment. Circle 692.

Scanning Electron Microscope

The System III-A offers a magnification range from 10 to 200,000 power. Features include television-scan mode, variable control of accelerating voltage at 2, 5, 10, 15, and 25 kilovolts, dual magnification and signal imaging, and an automatic vacuum system. The device pro-

vides zoom magnification, control of focusing, automatic filament saturation, gamma control, and automatic control of brightness and contrast. Externally selectable apertures are optional. There are four modes of operation including secondary electrons, backscattered electrons, external line profile with Y control, and spot mode with X–Y control. The universal stage accepts specimens up to 3 inches in diameter. Super III-A interfaces with energy-dispersive or wavelength x-ray spectrometers. International Scientific Instruments. Circle 691.

Animal Activity Monitor

Opto-Varimex measures animal activity in 16 by 16 inch cages and plots their movements on an X–Y chart. Operation is based on two arrays of infrared beams crossing each other at right angles 1 inch above the bottom of the measuring field. Patterns of movement and the effects of experimental conditions (administration of drugs, for example) on patterns may be studied. With the installation of vertical sensors, a third dimension of movement may also be measured. Columbus Instruments International. Circle 694.

Tape Recorder

Biotape 500 is a magnetic tape recorder that features audio and time/event input. Five channels may be recorded or played back simultaneously. This recorder may be used to activate remote devices through encoded event marks on the tape. Another application allows recording of information on one track about the data on a previously recorded track. All five channels may be displayed while being edited, dubbed, or recorded. EDCO Scientific. Circle 695.

Digital Voltmeter

Model 9577 is a 7.5-digit meter with a displayed scale length of 14 millions. It can measure direct current and alternating current (true root-mean-square) volts, ohms, and ratios of direct currents to one another or to alternating currents. With an external resistance thermometer, the 9577 can measure temperature. Whether the measurement made reflects hundreds of volts, millivolts, or microvolts, the reading is always in the same place; the decades are static. Digits are grouped in threes with a fixed decimal point always reading in volts (or kilo-ohms). Guildline Instruments. Circle 682.

Literature

Humidity Instrumentation lists a complete line including accessories and design specifications. General Eastern Instruments. Circle 696.

Cachalot-Brand Fatty Alcohols includes a complete listing of pure fatty alcohols in the eight- to eighteen-carbon range. M. Michel. Circle 697.

Vacutainer-Brand Evacuated Blood Collection System is a 44-page booklet that classifies tubes, needles, and holders and describes proper types for various applications. B-D Division, Becton, Dickinson. Circle 698.

Laboratory Regulation Manual is a two-volume set that treats legal aspects of laboratory operation. A free four-page brochure describes the set. Aspen Systems. Circle 699.

Automatic Gas Chromatograph describes the device that automates the entire process from sample injection and separation through peak measurement, calculation, and final report. Varian Instrument Division. Circle 700.

Column Survival Kit extends the useful life of columns for high-performance liquid chromatography. Whatman. Circle 701.

Dissecting Instruments is devoted to forceps, scalpels, scissors, needles, and other typical tools for a variety of biological disciplines. Carolina Biological Supply. Circle 702.

Infrared Laser Components includes zinc selenide, germanium, gallium arsenide, silicon, and calcium fluoride components from 0.5 to 4.0 inches. Laser Optics. Circle 683.

Scanning Electron Microscope depicts the Stereoscan 150 instrument, a modular system with many optional configurations. Cambridge Instrument. Circle 684.

Pyroelectric Detectors are described in a series of brochures. Also listed are radiometers and chopper accessories. Molectron. Circle 685.

Computer Power Center is devoted to a new peripheral and its application to computer systems design. Computer Power Systems. Circle 686.

Digital Signal Analyzer describes the NS-570A analyzer that performs a full complement of signal analyses. Tracor Northern. Circle 687.

Laboratory Tube Furnaces lists the models available in the 55000 series that incorporate the insulation/heating element composite called Moldatherm. Lindberg Division, Sola Basic Industries. Circle 688.

Semiconductor Reference Handbook lists more than 36,000 semiconductor substitutions. Radio Shack. Circle 703.