SCIENCE

24 June 1977

Volume 196, No. 4297

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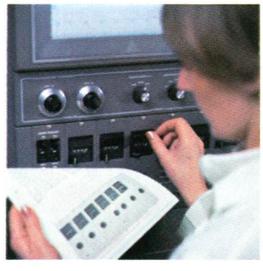

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24 June 1977

Volume 196, No. 4297

SCIENCE

SCIENCE is published weekly, except the last week in December, but with an extra issue on the fourth Tuesday in November, by the American Association for the Advancement of Science, 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Now combined with **The Scientific Monthly®**. Second-class postage paid at Washington, D.C., and additional entry. Member rates on request. Annual subscriptions $60; foreign postage: Canada $10; other surface $13; air-surface via Amsterdam $30. Single copies $2 (back issues $3) except **Guide to Scientific Instruments** $6. School year subscriptions: 9 months $45; 10 months $50. Provide 6 weeks' notice for change of address, giving new and old addresses and postal codes. Send a recent address label, including your 7-digit account number. **Postmaster: Send Form 3579 to *Science*, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005.** ***Science*** is indexed in the **Reader's Guide to Periodical Literature.**

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COVER

Micropyle on surface of egg of non-diapausing strain of the gypsy moth (*Lymantria dispar* L.). It looks like that on the normal eggs (about × 2800). See page 1462. [Kathleen Stone Shields, Northeastern Forest Experiment Station, U.S. Forest Service, Hamden, Connecticut]

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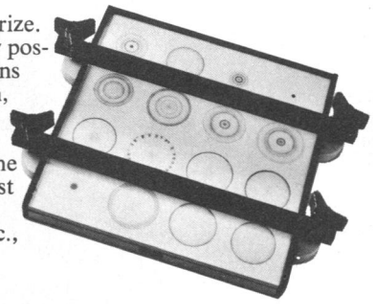

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LETTERS

Energy: The "Soft Path"

May I clarify a few points raised in Allen Hammond's stimulating account (News and Comment, 27 May, p. 959) of the reaction to my October 1976 *Foreign Affairs* article?

First the thermodynamically appropriate uses of electricity which, according to my article, make up about 8 percent of all U.S. (or European) end-use enthalpy, include not only those cited by Hammond—lights, motors, and electronic equipment—but also electrometallurgy, electrochemistry, and all other applications except electric heating and cooling.

Second, I did not propose making fuel alcohols by expanding the beer and wine industry but rather used an analogy with that industry's physical scale (volume of *fluid* output per year) to illustrate how big a bioconversion industry need be. Pyrolysis and enzymatic processes would be among its main methods, methanol probably its main product. The 12- to 17-fold discrepancy between my estimate and Daniel Kane's of the amount of alcohol required appears to arise from his misreading fluid output as alcohol output, despite my caveats.

Third, President Carter's speechwriters may have taken the incorrect cogeneration figure for West Germany from the same source I did (*1*). I am grateful to R. H. Williams for pointing out that 29 percent of German electricity is produced by industry but that only about 12 percent represents true cogeneration (the rest comes mainly from condensing stations).

Fourth, the fullest version of my work, combining and greatly augmenting the substance of my *Foreign Affairs* article and of its Oak Ridge companion piece, is a just-published book (*2*).

Finally, reports of my death are exaggerated. The many published critiques and my responses are collected in a U.S. Senate hearing record (*3*) in which I meet all the points raised. It thus seems premature to conclude that the soft-path thesis "seems certain to be discredited" by technical flaws. I tried to make my analysis explicit and fully documented, but I still await a critique that does the same and hence can show whether the analysis has merit. Encouragingly, after extensive correspondence summarizing data from my references, Hans Bethe has accepted my solar seasonal heat storage calculations, which he originally thought were wrong by an order of magnitude. A similar reconciliation, I believe, can occur with other critics if they will kindly verify my references.

My analysis is exploratory and undoubtedly imperfect. After long adversarial review, I published it so that it could be improved. But so far, regrettably, substantive criticism and refinement have scarcely begun. The jury will be out for a long time.

AMORY B. LOVINS
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The Smithsonian Under Scrutiny

Art Buchwald once wrote an article in which he noted that nothing succeeds like failure in Washington, D.C. The Buchwald thesis should now be elevated from hypothesis to theory, if not law. The ascendancy of bookkeepers within the Washington hierarchy has caused greater and greater emphasis to be placed on form, not substance. It is now the successful programs that suffer. The contributory programs of first the National Science Foundation, and then the Smithsonian Institution (News and Comment, 20 May, p. 857), have been subject to scrutiny for the wrong reasons. The bottom line is no longer success or failure or achievement of goals or contributions; instead it is adherence to bureaucratic procedures. It appears that bureaucrats would have Andrew Wyeth painting by the numbers and Salk busier taking inventory than proceeding with the polio vaccine. To be concerned with the hours a person works or the life-style pursued while ignoring the contributions made is bureaucratic badgering designed to ensure a mean of mediocrity.

Senator Proxmire (D–Wis.) gathers front-page publicity by holding up to ridicule what he considers to be absurd research projects. Even when he is right (and "right" and "wrong" are not absolutely determined), he is attending to projects that account for very little of the government's expenditures. One is reminded of the police department that bragged it had cited all drivers going 27 miles per hour in a 25-mile-per-hour zone, while it glossed over the increase in major crimes.

The Golden Fleece may not so much be awarded as pulled over our eyes. Diligent pursuit of minor derelictions gives the impression of protecting the public purse. However, if it becomes a substitute for dealing with major malfeasance, the results may be neither positive nor neutral, but doubly negative, as accomplishment is rebuked and malefactors rewarded.

Evidently what is needed for wholehearted government support is monstrous failure, accomplished "by the numbers" for bookkeeping purposes. No matter what the cost overruns or management ineffectivenesses may be, the Lockheed Aircraft Corporation, the Penn Central railroad, and the Social Security system, among others, receive massive infusions of government money with the only expressed desire that they try to use it more effectively. In Washington, gross failures seem to be either swept under the rug or alleviated by more money. In the meantime, projects that are infinitely less costly, and often quite successful, are made targets of ridicule and censure by these guardians of the public trust.

My hat is off to S. Dillon Ripley, who can build a National Air and Space Museum without having the contents ruined by a leaky roof such as the one at Kennedy Center. What Washington needs is more Ripleys and others like him who can get the job done, and fewer Proxmires. It is about time that bureaucratic spleen be spent on Washington-sponsored failures rather than on its sometimes eccentric successes. It is difficult to imagine that Buchwald's law is reversible, but one can always hope.

WILLIAM V. MAYER

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Forecasting Climatic Fluctuations: The Winter of 1976–77

The highly abnormal winter of 1976–77, characterized by severe cold over the central and eastern part of the nation and drought over the West, has brought into prominence the subject of short-period climatic fluctuations and raised the question of whether such events might be foreshadowed. Evidence suggests that there was some consensus among people who have worked on seasonal forecasting problems for many years, so that the dramatic change of temperature pattern relative to the mild conditions observed in the East during the past five winters was foreseen.

Around 1 December 1976, I was furnished with copies of three independently made forecasts for the forthcoming winter (December, January, and February) by the National Weather Service; by Robert R. Dickson, a visiting scientist at the Scripps Institution of Oceanography on leave from Lowestoft Laboratories, England; and by Joseph Chase of the Woods Hole Oceanographic Institution. These predictions were compared with forecasts made by me at Scripps. The methods used in preparing these forecasts, while differing with respect to the weights given to certain parameters, include some common factors, particularly atmospheric behavior in antecedent months along with the month-to-month behavior of sea-surface temperature patterns over the North Pacific. A more detailed account of the methodology was given in an earlier report of a 5-year experiment (*1*) and more recently at a 1976 American Geophysical Union symposium held in San Francisco (*2*).

These forecasts have been verified by comparing them in three equally likely classes: below, near, and above normal temperatures for 99 equally spaced points over the contiguous United States. The ranges of temperature which define these categories (terciles) were determined from a 30-year climatic record.

There was reasonably good agreement among all four forecasters. For example, my forecast agreed with the National Weather Service's predictions at 50 of the 99 points, with Dickson's at 84 points, and with Chase's at 82 points. Chance agreement would be 33 points.

As for the temperature predictions, the National Weather Service's forecast was correct at 44 of the 99 points, Dickson's at 63, Chase's at 63, and mine at 59. The corresponding large errors of two classes (that is, when above normal was forecast and below was observed, or vice versa), were four in the National Weather Service's predictions, six in Dickson's, two in Chase's, and four in mine.

All forecasts correctly anticipated the switch to cold weather in the East relative to the past five warm winters. The major region of disagreement was at the boundaries between the warm West and the cold East. Agreement between all forecasts and observed temperatures occurred at 27 points of the 99 points. Chance agreement among the forecasters with observed temperatures would be at about 1 point [actually $(1/3)^4$]. The major regions of agreement occurred in the northwest and southeast quadrants of the United States.

The scores for temperature prediction cited above are in general higher than those obtained from the past record of a dozen experimental seasonal forecasts I have made, where the number of correct points averaged 42 and the number of two-class errors averaged 13. These past forecasts were significantly more accurate than climatological probability alone (33 correct and 26 two-class errors). The point I would like to stress is that, *at times*, premonitory "signals" may be sufficiently loud that moderately successful forecasts can be made by different individuals using objective methods as a base (*3*).

JEROME NAMIAS
Scripps Institution of Oceanography, University of California, San Diego, La Jolla 92093

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Low-Level Radiation: Predicting the Effects

In my letter to *Science* of 29 October 1976 (p. 478), I questioned predictions of cancer incidence based on the linear theory used by the American Physical Society in their reactor safety study (*1*), by the Environmental Protection Agency (*2*), and by others. Despite the arguments given in the letters from von Hippel (29 Oct. 1976, p. 479), Morgan (28 Jan., p. 344), and Brown (28 Jan., p. 348), no meaningful evidence of the validity of the linear theory is presented.

Von Hippel and Morgan cite an article by Modan *et al.* (*3*), on thyroid cancers produced in Israeli immigrants exposed to a thyroid dose of 6.5 rads during x-ray therapy for ringworm. Neither author notes that the 6.5-rad thyroid dose was the result of a cumulative scalp exposure of 350 to 400 rads. Evans (*4*), on the basis of personal communication with Modan, points out that the confounding effect of the concomitant irradiation of the pituitary, as well as the large statistical uncertainties, make use of the thyroid data questionable.

Morgan refers to an article by Stewart and Kneale (*5*) that is discussed in the BIER report (*6*, p. 165). That report points out that the linear relationship inferred by Stewart and Kneale is inconsistent with effects on 1250 children exposed to atomic bomb radiation in Japan.

The data of Stewart and Kneale would predict 18 extra cancer deaths, whereas none were observed.

Morgan's article (*7*), referenced by both von Hippel and Morgan in support of the linear theory, contains no new data which would add to the verification of the linear theory.

The theoretical discussion by Brown which focuses on high linear energy transfer (LET) radiation is interesting, but its conclusions are at variance with extensive data available on high LET effects. Evans (*4*, *8*) reports on cancer incidence as a function of the bone dose of radiation received by those who worked on radium watch dials and by others who received medical treatment with radium-226 solutions (as was practiced before 1930). In a population of some 600 subjects, the 500 who received less than a cumulative bone dose of about 1000 rads were free of cancers. Of the 100 people who received between 1000 and 50,000 rads, there was a mean cancer incidence of 28 percent that was found to be essentially independent of dosage. I leave it to the reader to draw this step function distribution and to try to find a good fit of the linear theory that would be a straight line going through the origin. Evans points out (*4*) that additional data, gathered since publication of his work, now extends to 1700 people; again there were no cancers among people who received low doses. A similar threshold apparently exists for radium-224 (*6*, p. 126) and for radon inhalation (*9*). All of the above refer to high LET radiation.

In the case of the radium exposures, Evans notes that there is an inverse logarithmic relationship between dose and latent period before cancers show up. A similar relationship was found by Bair (*10*) in experiments on beagles inhaling plutonium and by Jee (*11*) in experiments where plutonium solutions were injected. The effect is also reported for uranium miners (*9*). A similar trend was noted by Jones and Grendon (*12*) after they reviewed data on exposure of animals to x-rays and studies of leukemia incidence among Japanese atomic bomb victims. As pointed out by Evans (*4*, *8*), by Jones and Grendon, and others, the increase of latent period with decreased radiation exposure implies a practical threshold where the latent period is longer than the lifespan. Jones and Grendon provide a theoretical explanation of this effect. This theory and its supporting evidence is at variance with the linear theory as used by those cited in my original letter.

Morgan suggests that experimental data might be obtained by low-level irradiation of those who are not sure that

beneficial effects are precluded from millirem per year dose rates. Such tests are, in fact, already in progress; both Morgan and I are participating. Background radiation varies by more than a factor of 2 in this country. Frigerio *et al.* (*13*) performed a comprehensive analysis of more than 40 geographical, social medical, meteorological, economic, radiological, educational, ethnic, and pollution parameters. He also analyzed mortality rates from malignancies for various age and geographic groups and for each of 56 separate malignant types. The study concludes: "Observations of the populations at risk showed not only no increment in malignant mortality with increasing background (radiation) but a consistent and continuous decrement." The linear theory as used in the BIER report predicts that a background radiation exposure of 170 millirems per year would cause an increase of 2 percent in the cancer death rate. In fact, the data of Frigerio *et al.* show a decrease in cancer mortality of about 20 percent from this exposure.

With present knowledge, no responsible person proposes the needless irradiation of people or opposes prudent standards to limit radiation exposures. My plea is merely for common sense in setting radiation standards and adherence to reasonable standards of scholarship and objectivity in public predictions of low-level radiation health effects.

BERTRAM WOLFE

Fuel Recovery and Irradiation Products Department, General Electric Company, San Jose, California 95125

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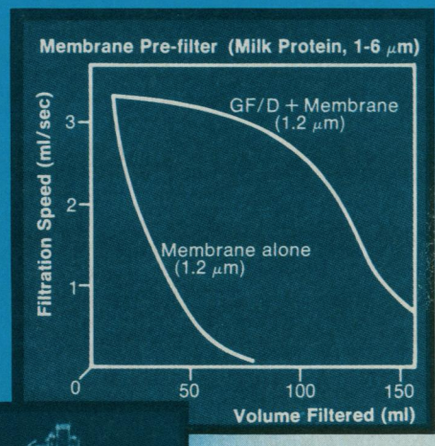

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24 June 1977, Volume 196, Number 4297 **SCIENCE**

Office of Technology Assessment

The importance of science and especially its technological applications to human affairs continues to increase. But most individuals are poorly informed about science and technology and are therefore fearful that these will be used without adequate thought and safeguards. These attitudes are not new; they were visible in the 1960's and were recognized then as important long-term threats to the health of society.

Among those who sensed that a major problem was developing was Emilio Daddario (D–Conn.), who was then serving as chairman of the Subcommittee on Science of the House Committee on Science and Astronautics. Daddario consulted many colleagues, including the senior minority member on the subcommittee, Charles A. Mosher (R–Ohio). It became apparent that other congressmen were also uneasy about unexpected adverse effects of technology. Accordingly, in 1969 Daddario introduced legislation calling for an Office of Technology Assessment designed to attempt to foresee major problems and to serve and be responsive to Congress. In the initial bill, policies for the office were to be established by a board, half of whose members were to be congressmen and the remainder distinguished scientists and engineers.

Three years passed before final action was taken. In the meantime, Daddario left Congress and provisions of the bill were modified. The composition of the cognizant technical assessment board was altered so that today it is made up of senators and representatives. The guidelines for the office were also modified. Section 3(c) of the act stated, "The basic function of the office shall be to provide early indications of the probable beneficial and adverse effects of the applications of technology and to develop other coordinate information which may assist the Congress." Under section 3(c-8) the "coordinate information" was further amplified as "such additional associated activities as the appropriate authorities [for instance, the board] . . . may direct." Thus, OTA was authorized and directed to do both long-term assessments and anything else that its governing board might require. It is human nature to be much more interested in an immediate crisis than one that may occur some years hence. This is particularly true of politicians, who love the media attention that goes with the tempest of the moment. In consequence, there have been many congressional demands on OTA for quick responses to such developments as the saccharin problem.

When OTA was finally established in 1973, Daddario was its first director. The choice was a good one, for he enjoyed the confidence of members of Congress and the esteem of scientists and engineers. He had need of these assets in creating a new organization that could function usefully dealing both with highly technical long-term matters and with the heat of the political cauldron.

As might be expected in such a situation, Daddario has received mixed notices—critical and complimentary. However, in departing from OTA, he leaves a record of solid accomplishments. A small OTA staff has interacted well with congressional staff and members of the Executive Branch, while drawing on the talents of about a thousand of the country's leading scientists and engineers. Inputs from the public have been sought and considered. The OTA staff has managed to be highly useful and influential in short-term matters while carrying out many long-term studies that have led to substantive documents. The scope of the activities has been broad. In addition to 46 reports that have been issued, projects under way include energy (6), food (3), health (5), materials (7), oceans (4), transportation (3), and research and development (3).

Today, OTA is the most effective mechanism for inserting factual, technical material into the political process. There is an easy short path between advisers and Congress. Mr. Daddario can take pride in his central role in the creation of an important tool for society.

—PHILLIP H. ABELSON

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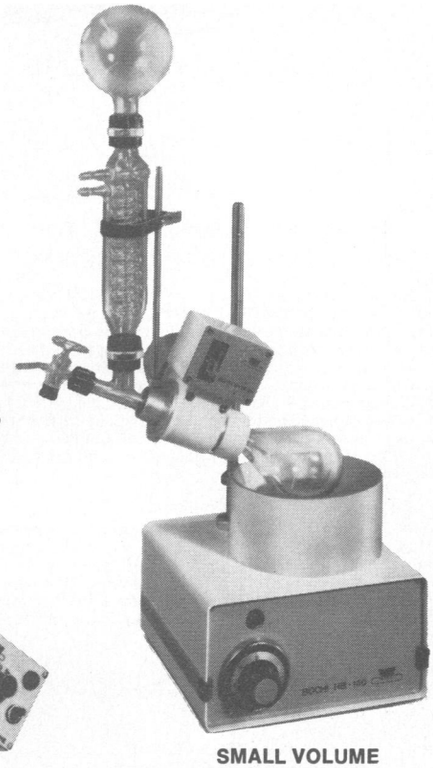

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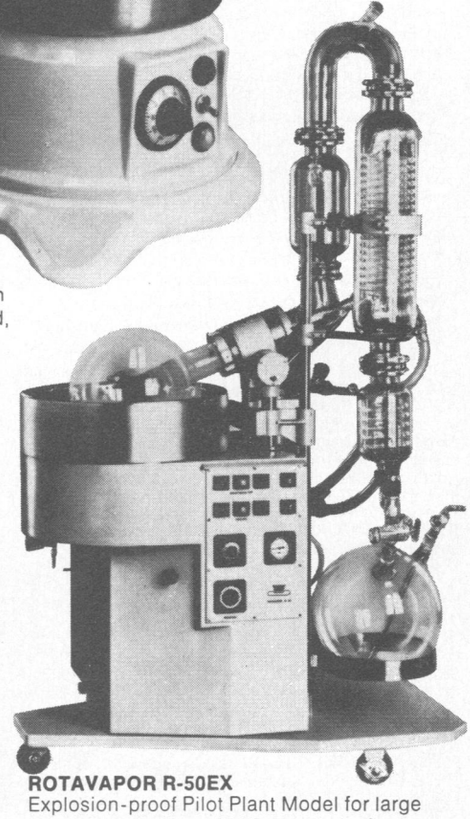

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Explosion-proof Pilot Plant Model for large volume extractions. 50 liter capacity flasks, high throughput of solvent. Variable speed motor. For batch or continuous-feed operations.

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An implantable cutaneous valve is made of Lexan. It permits long-term sampling of blood or other fluids, injecting, and taking pressure readings. The valve anchors firmly in the connective tissue upon healing in situ. The device is reusable after gas sterilization. JAT Scientific. Circle 711.

Spectrofluorometer

Model SFR100 employs single monochromators for excitation and emission. A reference channel monitors the excitation at the sample. The double-beam system determines the ratio of the output of the reference and signal channels and compensates for spectral variation in excitation intensity. The device features digital readout, choice of fixed bandwidths from 1 to 32 nanometers with 0.5-nanometer reproducibility. Baird-Atomic. Circle 712.

Analytical Balance

Model TB160-S has a weighing range of 160 grams, an extended taring range of 48 grams, readability to 0.05 gram, and precision of ±0.03 milligram. This balance has electronic features and digital output for interface with data processing equipment. Weight measurement is a function of the torque applied to alloy bands. The TB160-S uses a null indicator, a seven-segment LED display, and the digital output is parallel BCD, 8421 code, and TTL-compatible. Taring is additive and does not subtract from the full working range of the balance. Torsion Balance. Circle 713.

Newly offered instrumentation, apparatus, and laboratory materials of interest to researchers in all disciplines in academic, industrial, and government organizations are featured in this space. Emphasis is given to purpose, chief characteristics, and availability of products and materials. Endorsement by *Science* or AAAS is not implied. Additional information may be obtained from the manufacturers or suppliers named by circling the appropriate number on the Readers' Service Card (on pages 1392A and 1468A) and placing it in the mailbox. Postage is free.

—RICHARD G. SOMMER

Hematology System

The JTB700 is a microprocessor-directed device that counts blood cells, corrects for coincidence, calculates ratios, and monitors the measurement process. Each sample is counted twice. If the results vary, the count is repeated. Seven standard blood parameters are measured and results are displayed on a screen and printed out. The monitor instructs the operator and indicates the state of the instrument and the progress of the measurement. J. T. Baker Instruments. Circle 714.

X-ray Analyzer

The Spectrace 440B features high sensitivity to lighter elements from sodium through chlorine. In a 1000-second test with NBS orchard leaves, the 440B exhibited the following sensitivities: to magnesium, 120 parts per million (ppm); to phosphorus, 10 ppm; to sulfur, 6 ppm; and to chlorine, 2.5 ppm. (The threshold of sensitivity is defined as a peak three standard deviations above background.) The x-ray source emits a continuous spectrum of Bremsstrahlung radiation. The side window on the x-ray tube is thin (5 mils). A silver target is used and the resulting radiation is at 2.98 kiloelectron volts. United Scientific, Nuclear Semiconductor Division. Circle 717.

Nuclear Magnetic Resonance Spectrometer

The EM-390 spectrometer is a 90-megahertz system with resolution to 0.5 hertz (full line width at half maximum amplitude). The 21-kilogauss permanent magnet requires no cooling water. The EM-390 features a range of sweeps from 0.2 to 100 parts per million and a range of offsets from −200 to +200 ppm. The proton sensitivity is 50:1 (5-millimeter sample, 1 percent ethylbenzene test) with no compromise of resolution. This enables the operator to analyze samples of a milligram or less. The spin-rate of the sample is continuously monitored by a tachometer built into the probe. A variety of accessories enable the user to design his own analytic system. Varian Instrument Division. Circle 718.

Temperature Monitor

Model PTS-80A is accurate to within 0.025°C including the probe, signal conditioning, and output circuitry. Resolution is within 0.01°C. The system accommodates up to 30 sensors and a variety of interchangeable probes. Peripheral devices include printers, cassette storage systems, and interfaces. Environmental Systems. Circle 715.

Electron Microscope

The H-300 Universal Electron Microscope combines scanning and transmission electron microscopy in a single console. As a TEM, the instrument provides resolution of 4.5 angstroms, accelerating voltage of 75 kilovolts, and magnification from 250 to 100,000 power. As a SEM, it provides resolution of 100 angstroms, accelerating voltage of 20 kilovolts, and magnification from 50 to 100,000 power. Perkin-Elmer Scientific Instruments. Circle 716.

Literature

Guide to Funds and Volunteers for Field Research 1978–79 describes how qualified scientists may apply for funds and assistants to conduct research. Center for Field Research. Circle 719.

Aminco Laboratory News reports research activities of general interest to the scientific community. American Instrument. Circle 720.

Drug and Metabolite Analysis in Biological Samples describes the use of liquid chromatography to separate and quantitate drugs and metabolites. Waters Associates. Circle 721.

Spectrum Analyzer is devoted to the FFT 512/S narrow band real time spectrum analyzer. Rockland Systems. Circle 722.

Personal Computing System describes the PCS-II, a desk-top system. Wang Laboratories. Circle 724.

Carbon-14 and Tritium Labeled Compounds features nucleics and analogs, mycotoxins, *Vinca* alkaloids, synthetic precursors, and offers a custom-labeling service. Moravek Biochemicals. Circle 725.

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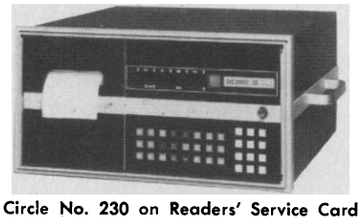

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RESEARCH NEWS

(Continued from page 1430)

duced by slime molds mediate the cellular aggregation that occurs during the development of these organisms. In the early stage of their life cycle, slime molds exist as amoeboid cells that, under appropriate conditions, aggregate to form a living slime that in turn forms fruiting bodies and spores. The Barondes group has shown that the cells produce both surface lectins and receptors for them when cohesiveness develops. They think that the lectins, which are species-specific, enable slime mold cells of the same species to recognize one another and aggregate.

Gilbert Ashwell of the National Institute of Arthritis, Metabolism, and Digestive Diseases, and Anatol Morell of Albert Einstein College of Medicine have been studying the removal of glycoproteins from the blood by the liver of several mammalian species. (Most blood proteins, with the exception of albumin, contain carbohydrates and are thus glycoproteins.) The carbohydrate chains of the glycoproteins normally terminate with sialic acid.

The investigators observed that when the terminal sialic acid residues were removed to expose the penultimate residue, galactose, the glycoproteins were taken up very quickly and destroyed by the liver. They subsequently identified a liver receptor that specifically recognizes and combines with the galactose of the glycoproteins. On further analysis, the liver receptor turned out to be a protein with all the properties of a lectin. Ashwell and Morell have indentified another lectin-like protein in chicken livers that recognizes a different sugar.

Ashwell suggests that the concept of a lectin be broadened to embrace all biological systems, not just plants. He would define lectins as proteins with the capacity to recognize subtle differences in cell surface carbohydrate sequences as a means of regulating a variety of normal physiological functions.

Much of the evidence implicating lectins in recognition processes in plants is still circumstantial rather than definitive, and it is still too early to tell whether Ashwell's suggestion to broaden the definition of lectin will be accepted. Nevertheless, the current research is stimulating a new look at some familiar substances and, at the same time, providing a better understanding of several important biological processes, including the development of symbiotic relationships between legumes and nitrogen-fixing bacteria.—JEAN L. MARX

BOOKS RECEIVED AND BOOK ORDER SERVICE

(Continued from page 1433)

lag, New York, 1977. xiv, 314 pp., illus. $29.60. Advanced Series in Agricultural Sciences 4. *To order this book circle No. 548 on Readers' Service Card.*

Continuous Culture 6. Applications and New Fields. Papers from a symposium, Oxford, England, July 1975. A. C. R. Dean, D. C. Ellwood, C. G. T. Evans, and J. Melling, Eds. Published for the Society of Chemical Industry by Horwood, Chichester, England, 1977 (U.S. distributor, Halsted [Wiley], New York). xii, 364 pp., illus. $37.50. *To order this book circle No. 549 on Readers' Service Card.*

Coping and Defending. Processes of Self-Environment Organization. Norma Haan with contributions by Paul Joffe, Richard F. Morrissey, and Murray P. Naditch. Academic Press, New York, 1977. xiv, 346 pp. $17.50. *To order this book circle No. 550 on Reader's Service Card.*

Corixidae of the Western Hemisphere. H. B. Hungerford. Entomological Reprint Specialists, Los Angeles, 1977. viii, 828 pp., illus. $25. University of Kansas Science Bulletin, vol. 32. Reprint of the 1948 edition.

Crystal Form and Structure. Cecil J. Schneer, Ed. Dowden, Hutchinson and Ross, Stroudsburg, Pa., 1977 (distributor, Halsted [Wiley], New York). xiv, 370 pp., illus. $32. Benchmark Papers in Geology, vol. 34. *To order this book circle No. 551 on Readers' Service Card.*

Electrochemical Studies of Biological Systems. Papers from a symposium, San Francisco, Aug. 1976. Donald T. Sawyer, Ed. American Chemical Society, Washington, D.C., 1977. viii, 216 pp., illus. $15.50. ACS Symposium Series, 38. *To order this book circle No. 552 on Readers' Service Card.*

Electron Correlation in Small Molecules. A. C. Hurley. Academic Press, New York, 1976. viii, 276 pp., illus. $23. Theoretical Chemistry, vol. 6. *To order this book circle No. 553 on Readers' Service Card.*

Elements of Experimental Stress Analysis. SI Edition. A. W. Hendry. Pergamon, New York, 1977. viii, 194 pp., illus. Cloth, $10; paper, $5.50. Pergamon International Library. *To order this book circle No. 554 on Readers' Service Card.*

Experimental Embryogenesis in Vascular Plants. V. Raghavan. Academic Press, New York, 1976. x, 604 pp., illus. $45.65. Experimental Botany, vol. 10. *To order this book circle No. 555 on Readers' Service Card.*

Fish Remains in Archaeology and Paleo-environmental Studies. Richard W. Casteel. Academic Press, New York, 1976. x, 180 pp., illus. $14.75. Studies in Archaeological Science. *To order this book circle No. 556 on Readers' Service Card.*

La Flore et la Végétation de l'Afrique Tropicale. R. Schnell. Gauthier-Villars, Paris, 1977. Two parts. Part 1. x, 470 pp., illus. 295 F. Part 2. vi, 378 pp., illus. 265 F. Introduction à la Phytogéographie des Pays Tropicaux, vols. 3 and 4.

Forecasting Economic Time Series. C. W. J. Granger and Paul Newbold. Academic Press, New York, 1977. xii, 334 pp., illus. $22. Economic Theory and Mathematical Economics. *To order this book circle No. 557 on Readers' Service Card.*