SCIENCE

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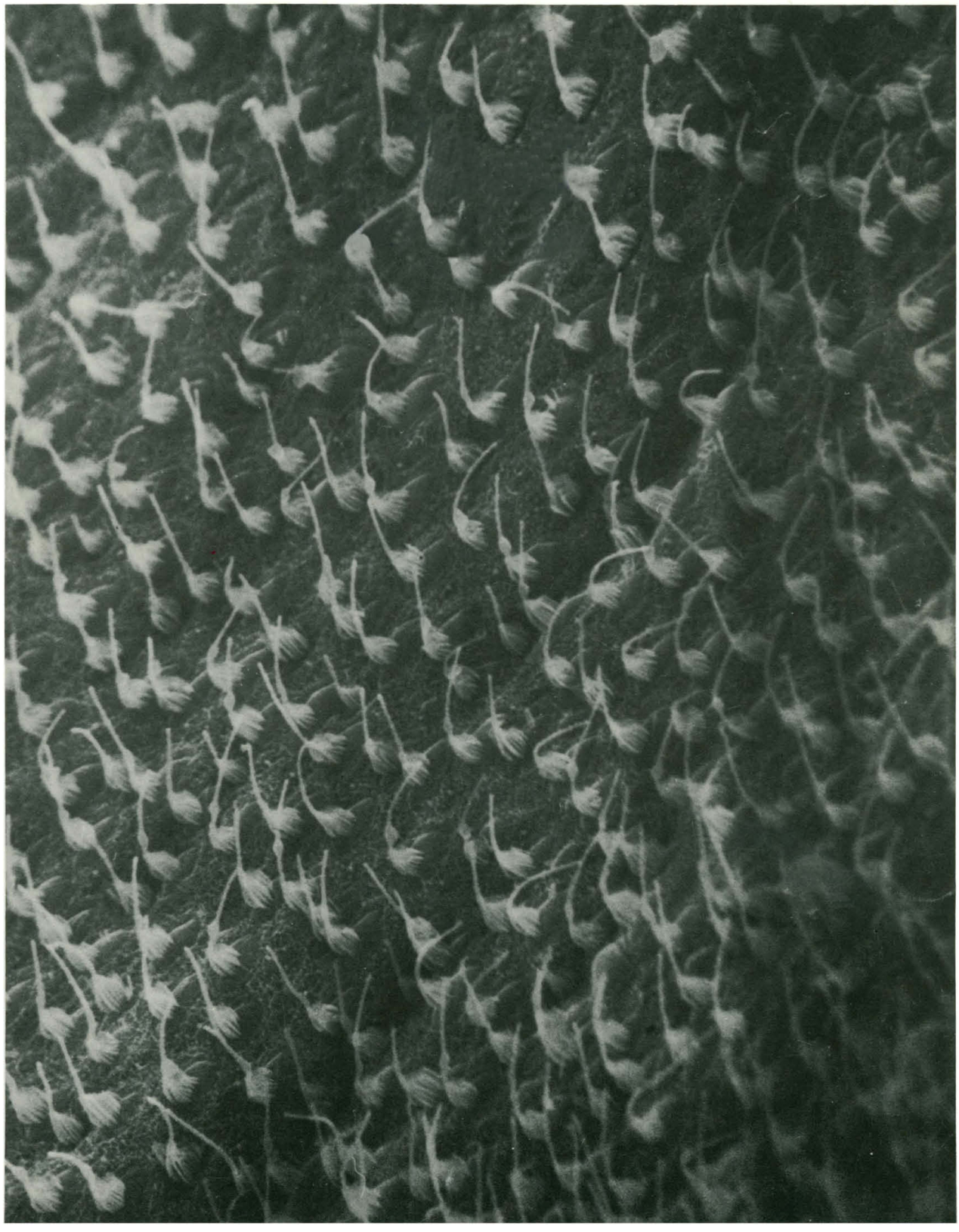
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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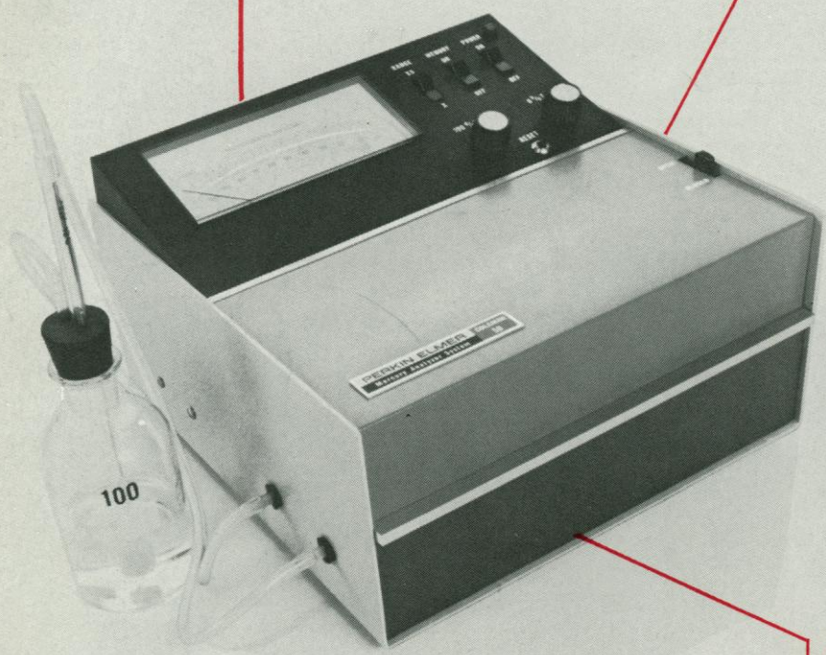

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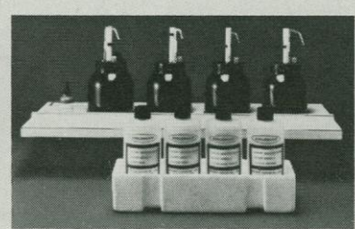

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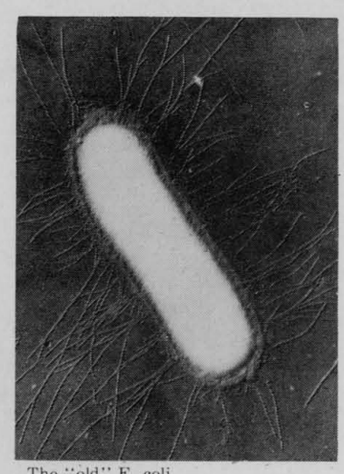
COVER

Ciliary tufts which protrude from the sensory surface of vestibular receptor cells are minute mechanical units. The ability of each tuft to deform the surface membrane of its receptor cell indicates a mechanism for transduction (× 7000). See page 416. [D. E. Hillman, University of Iowa; E. R. Lewis, University of California, Berkeley.]

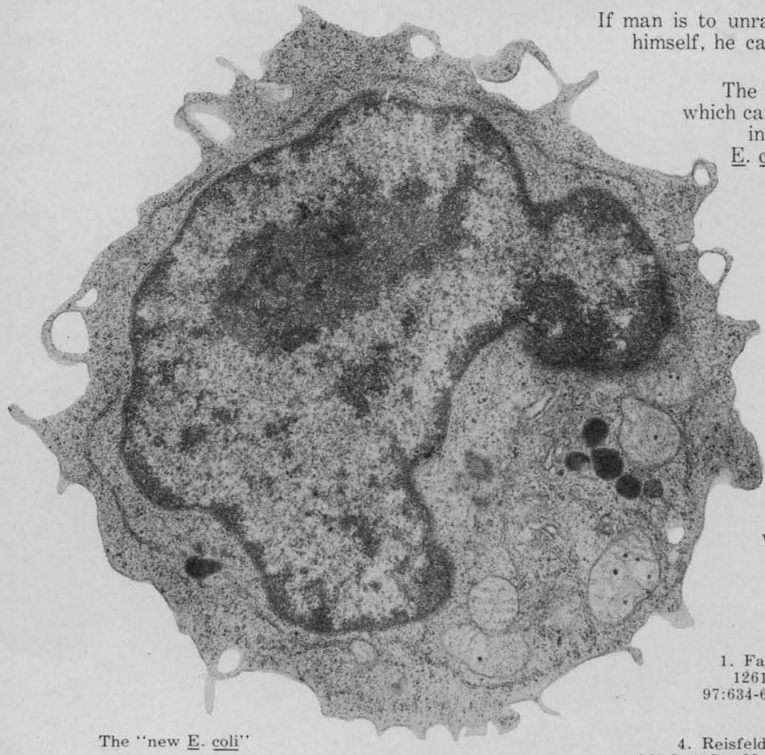


Courtesy of Dr. C. Brinton

The "old" E. coli

This helped answer a lot of questions.

The "new E. coli" will help answer the new ones.



The "new E. coli"

If man is to unravel the structural and regulatory genetic functions of himself, he can no longer base molecular biological research on the "old" E. coli. Human cells are necessary.

The "new E. coli" is a diploid, cultured human lymphoid cell which can be cloned or grown in suspension culture and provided in kilogram quantities. As a result of work with the "new E. coli," mutant lines and gene markers are being reported regularly. A certain number of markers have already been described; Immunoglobulins (1), Complement-C'-3 (2), Interferon (3), Transplantation (HL-A) antigens of the cell surface (4), DNA viruses (5), RNA viruses (6) and Reverse transcriptase - RNA - dependent DNA polymerase (7).

Cultured lymphocyte lines can be derived from patients with genetic deficiency diseases and inborn errors of metabolism with a high degree of success (8).

Recent investigations indicate it will be possible to hybridize cultured lymphocytes with both human and mouse cultured cells or cells taken from blood or other organs (9).

If you are interested in the "New" molecular biology, we would be pleased to share our research with you and provide you with a bibliography of current references.

Start answering the new questions. Write, call or visit ABS for information on the "new E. coli."

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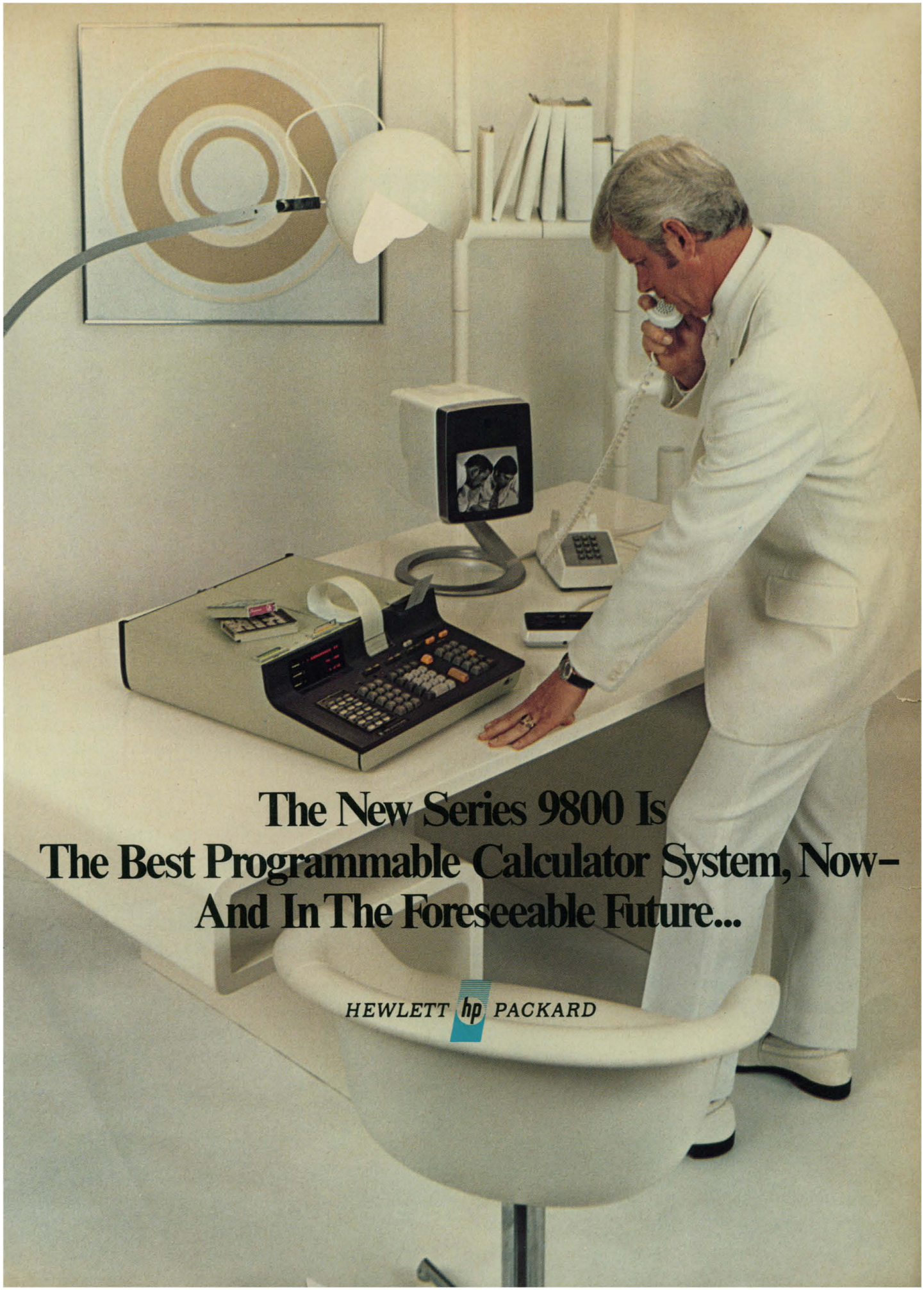
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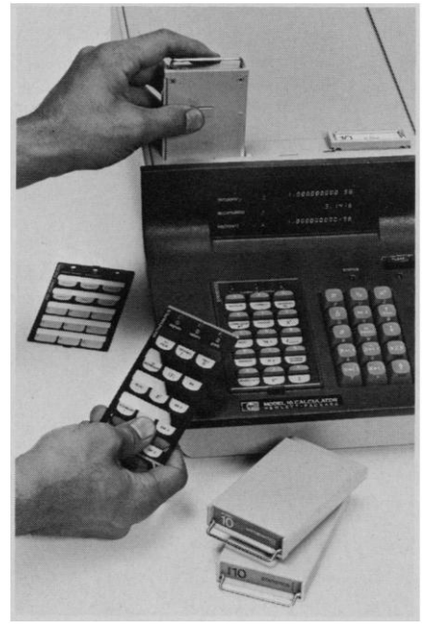

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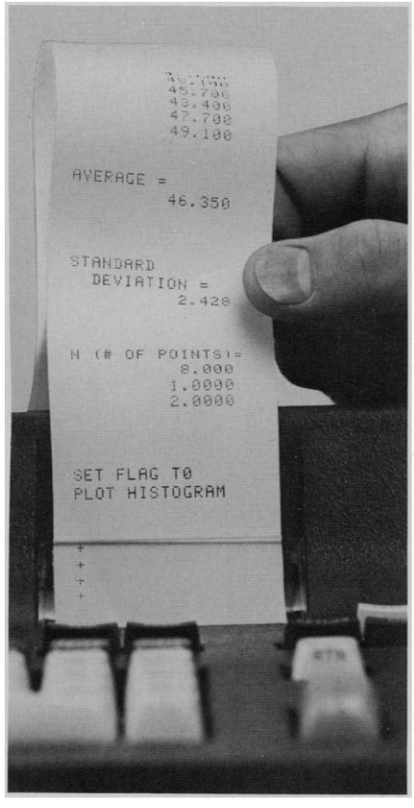
Only HP Gives You Simple Programming and Editing.

Symbolic addressing, indirect and register arithmetic, added subroutine capability, special editing keys for software debugging, true "Do-Loop" ability—when you get your hands on the Model 10 you'll quickly see that the mechanics of problem solving need no longer stand between you and your great ideas. You can store often used programs on handy magnetic cards for instant entry into your Model 10. These cards may be linked for automatic call by the calculator so there is no limit to the size or complexity of the problems the Model 10 will solve.



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...right on the printer tape. Standard equipment on the Model 10 is the bright, three register LED display. For hard copy you can add (with a modular plug-in) the quiet, low-cost strip printer. For the ultimate in operating simplicity, add the *exclusive Printer Alpha ROM* and you can automatically generate labels, program instructions, and messages—complete with symbols and punctuation—right on the printer tape.

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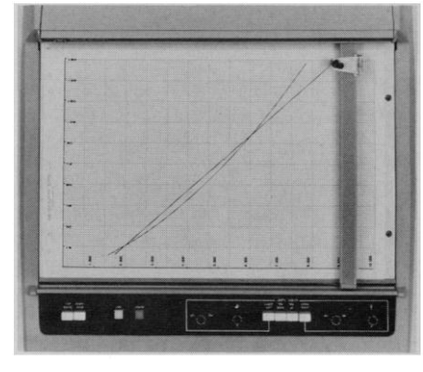
...to build a system suited to your procedures. The integral I/O bus of the Model 10 lets you plug in such work saving Series 9800 peripherals as a Marked Card Reader, Paper Tape Reader, Digitizer, Typewriter, or the exclusive HP X-Y Plotter that plots linear, log-log, semi-log, or polar plots—and writes alphanumerics.



Price. Performance. Simplicity. The Series 9800 is the best desktop computing system now, and in the foreseeable future. But don't take our word for it; ask our competitors. Or write for more information or a "hands-on" demonstration. Hewlett-Packard, P.O. Box 301, Loveland, Colo. 80537. In Europe: 1217 Meyrin-Geneva, Switzerland.

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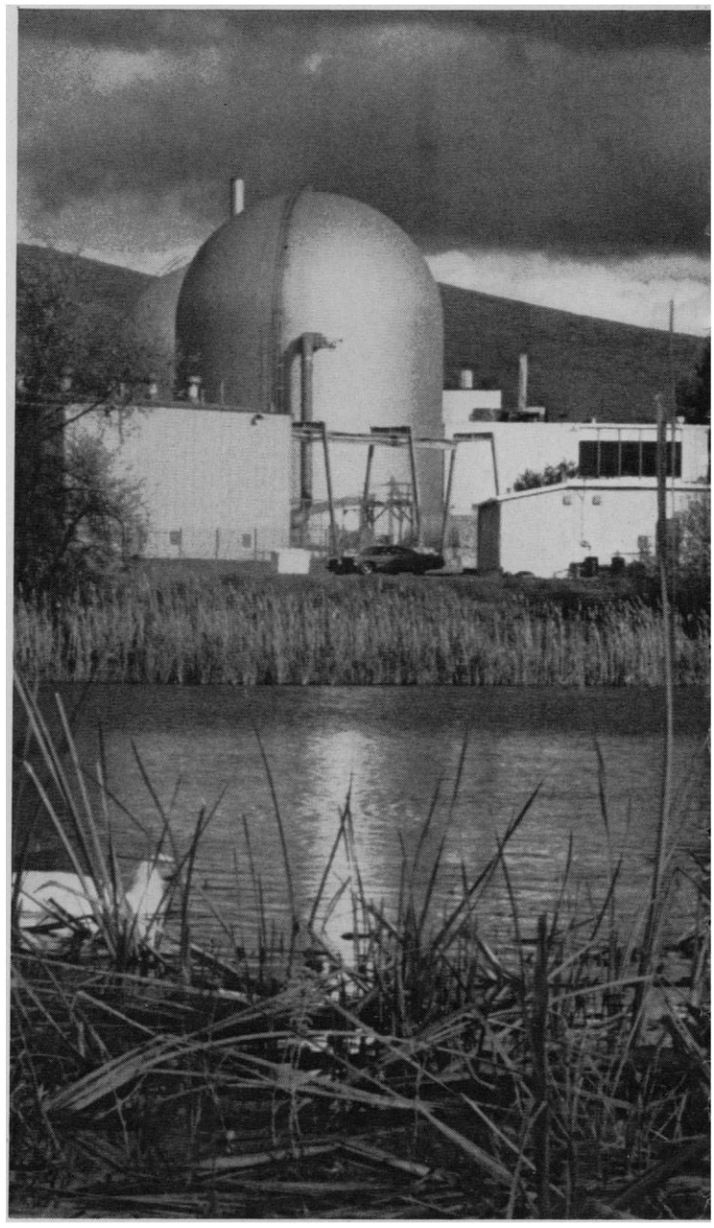
Nuclear waste assayed automatically for isotope inventories.

Of all industrial waste products, none requires more care than radioactive materials. And the assay of radioactive wastes is uncommonly time consuming and expensive.

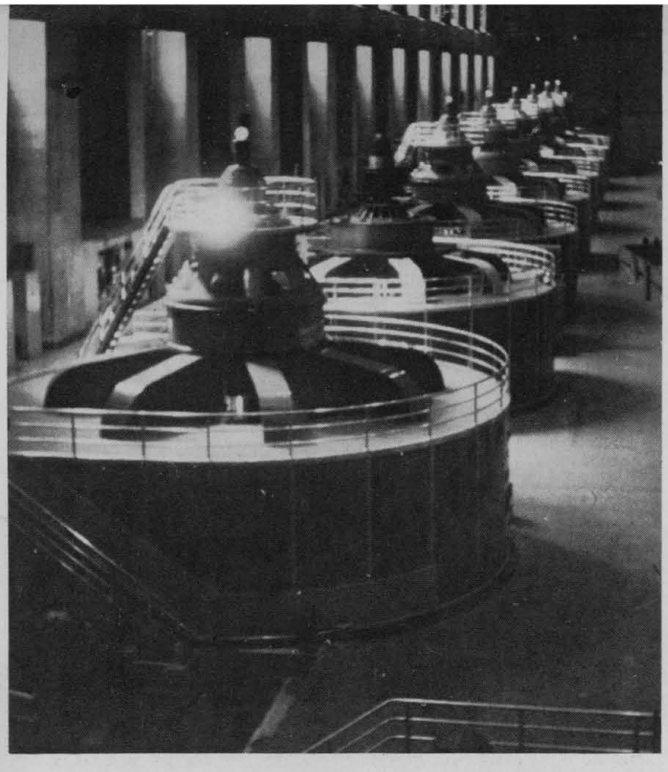
In a significant simplification of this problem, Gulf Energy and Environmental Systems, Inc. has developed a mobile automatic assay system with the help of Hewlett-Packard computerized nuclear instrumentation. Briefly, the system produces a penetrating beam of nuclear particles to induce gamma rays and measures the radioactivity without removing the material from its container. The computer analyzes the measurment, compares it with the known characteristics of nuclear materials, and automatically determines the types and quantity of isotopes present.

The Gulf system is better than previous techniques on at least two scores. Because it computerizes the intricate analysis, the system is easily operated by technicians. Results are immediate and accurate to 1%.

Similar HP nuclear measurement systems, beginning at $30,000, continuously monitor atomic power plant effluents and print out the type and amount of radioactivity. Detailed information is yours for the asking.



Pollution-free nuclear power generating plants now have added assurance they will stay that way. A Hewlett-Packard computerized measurement system helps by making a careful accounting of nuclear waste materials.



Keeping power generating equipment operating at capacity, especially during periods of peak demand, is vital. To insure against downtime, a new tool from HP can "look inside" key machinery and predict when it will need service or maintenance.

"Transformation Machine" converts fuzzy signals into sharp answers for power systems.

One user of the HP 5450 Fourier Analyzer acquired it after spending 18 frustrating months on a central computer trying to develop a method for the identification of load and machine characteristics in a power system. In his own words: "The 5450 makes practical the use of mathmatics to do things that scientists and engineers have wanted to do for 20 years. Using a central computer isn't satisfactory. It takes too long and you cannot see the results during your experiment. With the 5450 you can 'play' with the measurement signal to find out what's really going on. One session with the 5450 is worth 3 to 4 months on the central computer."

Scientists in many other fields have been confronted by measurement signals so complex that they look as useless as noise. Until recently, the best solution was to use the complex mathematics of the Fourier transform and program a computer to do the complex signal analysis computations off-line.

With the HP 5450 Fourier Analyzer, any scientist can perform these complex mathematical operations rapidly, while he's conducting his experiment. A computerized system that makes fundamental measurements of complex waveforms, the 5450 transforms signals from time to frequency domain and measures transfer function, coherence function, power spectrum and cross-power spectrum...at the touch of a keyboard. It unscrambles the waveforms into their individual frequency components and identifies the phase and amplitude of each component. The theory and use of the 5450 are described in the June 1970 issue of the HP Journal.

A design-your-own calculator: plug-in solutions to particular problems.

A user in virtually any discipline now can customize a powerful new programmable calculator to his specific computational needs.

An engineer at a utility company, for example, can use the Model 10 to design a transmission line or do a complete rate analysis. A broad spectrum of complex and tedious calculations common to the power industry now can be performed quickly and easily — often by simply entering the raw data and hitting a single key. Similarly, a chromatographer can obtain per cent concentration and relative retention time of each component on his chromatogram . . . at a single keystroke. A physicist completes a sequence of acceleration, velocity, force and work . . . and a clinical pathologist computes a full blood gas analysis . . . at a single keystroke. Et cetera.

Whatever your job, here's a calculator that speaks your language. You can customize its keyboard, memory size, display, programs and peripherals to suit your number-crunching tasks.

This is possible because the new Model 10 calculator has interchangeable function blocks which can define its keyboard to meet varying needs. One standard plug-in block emphasizes powerful statistical computations, another gives higher mathematics capability, and the third is completely user-definable. This block provides single keystroke solutions to multiple-step calculations commonly encountered by the user. Once programmed, each key performs its customized function whenever he strikes it.

For more on tailoring the $2,975 Model 10 to your particular profession (full alphanumeric printing capability, expandable memory, a wide line of peripherals, etc.) write for our brochure.

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LETTERS

Use of Energy

In his editorial, "Continuing increase in use of energy" (21 May, p. 795), Abelson notes five fundamental problems of our present economic system. The system will have to be redesigned to solve these problems if the aims of his editorial are to be realized.

1) Present incentives (profits, corporate growth, and so forth) operate to encourage high consumption, such as product proliferation, product inflation, rapid obsolescence, high turnover, and high waste. The incentives are weak that operate to satisfy needs with maximum efficiency, minimum inputs of labor and materials, and lowest real or long-term cost.

2) Progress in the direction indicated implies institutional restructuring that would displace many people from their present jobs. Can the system adapt smoothly without widespread disruption, maldistribution, unemployment, and economic depression?

3) How can the system handle the situations where the logic of "Tragedy of the Commons" or "tyranny of small decisions" operates? For example, my private decision to turn off unnecessary lights in my house is hardly influenced at all by the thought of the few cents saved. Yet the actions of millions of people thinking that way add up to a ponderable result. Electricity would have to cost much more to make me act differently; it is likely to cost less. And if it is deliberately made to cost much more, who gains? Similarly, when I decide to drive my car to work or hitch a ride with a friend, I do not take into account that my decision is helping to destroy a public transit system or a railroad that some other day I may want to use. It is widely believed that the system of private choice in the marketplace handles all these situations. The fact is that in many of them it breaks down. What kind of redesign will fix it?

4) The market system does not arrive at the best allocations if the relative prices of goods do not reflect their total real costs. Furthermore, study of many pollution cases shows that even a proportional distribution of the "total social cost" into the selling price or an industry's taxes will not accomplish the desired result, because of the presence of decision-making processes of the type previously discussed.

5) The system excessively discounts the future. This problem is implicit in Abelson's concern about rapid consumption "at ridiculously low prices" of nonrenewable resources. The "discounted present value" criterion for the use of capital resources, at high interest rates, leads to some patently bad decisions, which can impose escalating costs of another kind on our descendants.

R. W. JACKSON
Science Council of Canada,
Ottawa 4, Ontario

A switch to low-sulfur natural gas and fuel oil would have implications for agriculture, since a considerable amount of the sulfur needed by crops comes from atmospheric sources. Soil and plant analyses and field experiments in many areas of the world show that sulfur is a limiting nutrient element in crop production, particularly in nonindustrialized regions. There has also been a significant decrease in the sulfur content of fertilizers in recent years (*1*). Direct absorption of atmospheric sulfur dioxide by crops and plants has contributed significantly to the sulfur nutrition of crops.

In cleaning up the air, due allowances will need to be made for the removal of one unsought bonus of air pollution—the millions of tons of sulfur that are released annually into the atmosphere.

P. K. HANLEY
Soils Division,
Agricultural Institute,
Johnstown Castle Agricultural College,
Wexford, Ireland

Reference

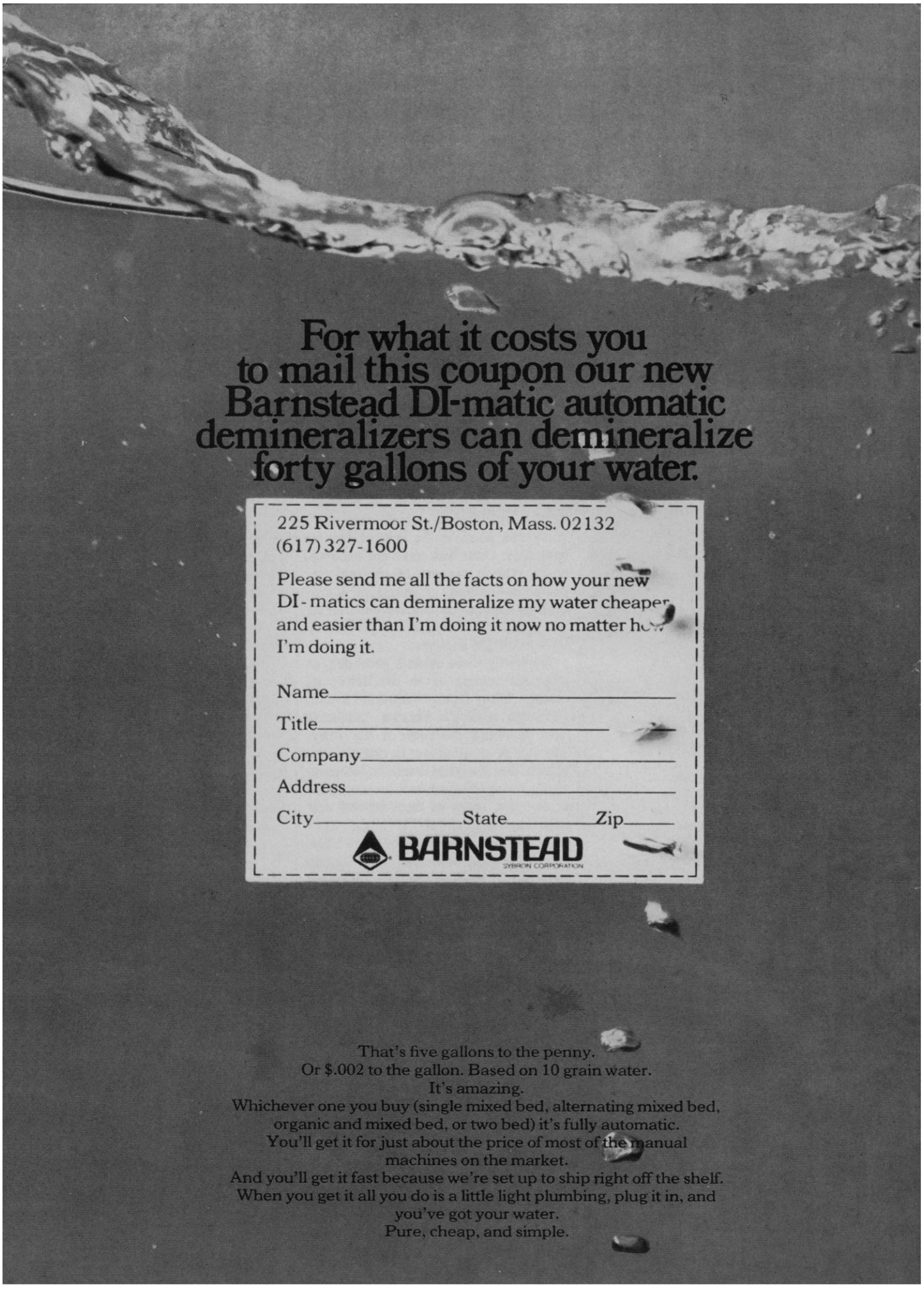
1. *Sulfur in Agriculture* (Proceedings of a symposium at Johnstown Castle, Johnstown Castle Agricultural College, Wexford, Ireland, 1970).

Ecology

"There are no such people as ecologists. I don't know what ecology is. Ecology is a word; it isn't a science. It is the sum of all the sciences that must be brought to bear on the totality of the biosphere, so I am told.

"When I looked around at ecology a few years ago, the best that the ecologist, so-called, could hope to do was to understand the processes in what he called the 'terrarium' . . . or perhaps a goldfish bowl . . . and suddenly they wish to make extrapolations to Lake Erie or the totality of the grass lands of the United States."

Accompanying these remarks, along



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with a reference to "hortatory hyperbole" on the part of environmentalists, was the assurance that our present concern stems from esthetic offense rather than evidence of physical or biological danger.

These statements might pass without notice had they not been delivered to an intelligent lay audience by a distinguished scientist in a position of unusual influence. Since I respect his professional achievements and cherish his friendship, I take the liberty of being no more specific than this. My concern is not personal, but with ideas. Polemics is not my dish.

To begin with, and leaving aside the relegation of more than 4000 members of the Ecological Society of America to nonperson status, the speaker underestimates a respectable amount of serious study of inland waters. Likewise he ignores many years of productive work on grasslands.

He also minimizes the value of esthetic judgments as clues to environmental disturbance, which they certainly are. Even in the field of human pathology, Osler was noted for his diagnostic skill in the use of external appearance—backed, of course by a prodigious amount of clinical experience, comparable to the field and laboratory training of the ecologist.

Obviously there exists a good deal of misunderstanding as to the nature of ecology. Many factors contribute to this. Although ecology became inevitable with Darwin's evidence of the selective role of environment in organic evolution, the discipline itself is comparatively young. Its problems are immensely complex, many of them beyond neat experimental control. It must draw heavily upon other fields of knowledge, including those that deal with human behavior. It has also suffered from what is best called "a bandwagon effect," due to sudden awareness by the public of critical environmental problems.

These problems, notably depletion and disruption, have been identified and described in print by ecologists for several decades. But circumstances, not without a measure of vested interest and academic snobbery, have muted their influence on educational programs. This is changing, thanks to public opinion, but also thanks to instances of enlightened administrative leadership, such as that of Samuel Dana at the University of Michigan some 20 years ago.

I have in the past encountered two very different but both honestly meant criticisms of ecology. The first, that it

is merely a formal attempt to emphasize the obvious; the second, that it is a legitimate enterprise but must be deferred until we know a lot more than we do. I cannot help being reminded of Pepys' account of Charles II scoffing at the men of Gresham College wasting their time trying to weigh air. This chimerical business, we should note, led to the discovery of oxygen, the founding of modern chemistry, and plant and animal physiology a century later.

It may clear matters somewhat to modify the usual definition of ecology as the science of interrelation between life and environment. Actually it is a way of approaching this vast field of experience by drawing upon the *best information available* from whatever source it may come, with precise experimental control where possible, of course, as in the superb watershed studies of Herbert Bormann and his associates. But one cannot, for example, interpret the ecology of a deciduous forest, an urban complex, or the East African plains, while ignoring their history, despite the imperfections of the record. Geology, too, has had to face this problem and survive skepticism, which is confined today to the Fundamentalists.

The fact that a great deal of ecologically indispensable work is being done by those who do not call themselves ecologists does not validate an indictment of the profession as incompetent to deal with anything more significant than goldfish bowls.

It is the special responsibility of the ecologist to discover, assemble, and interpret whatever is pertinent and sound. Often, as by Frederic Clements, Sir Arthur Tansley, Patrick Geddes, and Charles C. Adams, this charge has been powerfully and effectively met.

PAUL B. SEARS

Las Milpas,
Taos, New Mexico 87571

Linear Algebra Problem

With respect to Bosch's article "Redwoods: A population model" (23 Apr., p. 345), I wish to inform Bosch, the editors of *Science*, and its referees that they have all just failed elementary linear algebra (see Technical Comments, p. 435).

MITCHELL TAIBLESON

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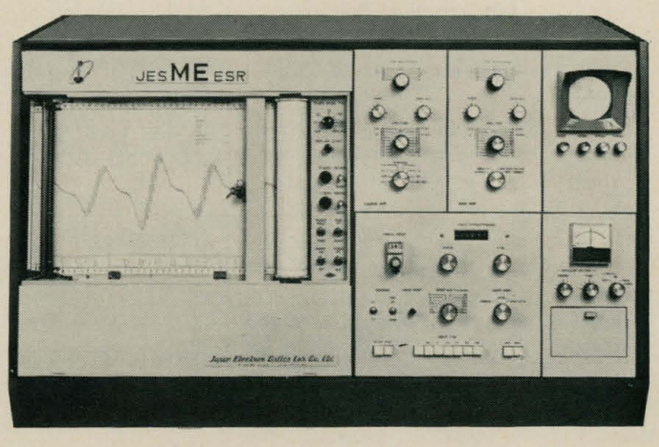

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22 October 1971, Volume 174, Number 4007 **SCIENCE**

Mass Transfer and Urban Problems

Geophysicists are understandably excited because they have clearly detected continental drift. This finding comes as no surprise to the public official, who has already observed that the island of Jamaica, a huge exporter of bauxite, is gradually drifting—in the form of a unicellular layer of aluminum beer cans—onto the United States and covering us.

Indeed, one way of looking at the problem of the urban environment is from this mass-transfer point of view. An urban society is characterized by the continuing transfer of substantial amounts of matter from remote, uninhabited sites to urban centers. Thus, fuel, ore, and timber, as well as food, are extracted or harvested in distant, rural locations and ultimately transported to urban areas. There, after physical and chemical transformation, they are deposited within the urban environment as solid, liquid, and gaseous wastes, and our cities stagger under the resulting burden of polluted air and water and mounting piles of solid refuse.

Yet, as a matter of public policy, our society perversely encourages and subsidizes this process of mass transfer. We grant generous depletion allowances instead of levying prohibitive depletion penalties. A pound of iron as ore is less costly to transport than a pound of iron as scrap, a rate preference enshrined in federally prescribed interstate tariffs. Thus, although recycling presents itself as a way of reducing the overload on our environment, our system discourages recycling and rewards profligate consumption. The required national changes are obvious, but the political will is generally lacking. One hopeful sign is the recent legislation in New York City which discriminates in favor of manufacturers who use recycled material in paper products purchased by the city government.

At the municipal level, a refuse-collection service that is paid for exclusively by real estate taxes offers no incentive to reduce the amount of refuse that is generated; whether one produces a lot of refuse or a little makes no difference, for it is removed "free of charge." The result, again, is that we encourage indiscriminate production of waste in our "effluent society" at the same time that we are running out of land for waste disposal. To repair this portion of our malfunctioning system, we ought to either impose a disposal tax—collected at the manufacturing source—on all inedible products (with the tax proportional to the difficulty of disposal), or else charge the consumer directly, by the pound, for the waste he nonchalantly bequeaths to his municipality.

The challenge before us is to design and implement the right kind of regulatory feedback mechanisms, through enlightened tax and transport policies, so that we can reduce the rate of depletion of our resources, increase recycling, reduce the amount of material that has to be handled in the cycle, and improve the quality of our urban environment.—E. S. SAVAS, *First Deputy City Administrator, Office of the Mayor, 250 Broadway, New York 10007*

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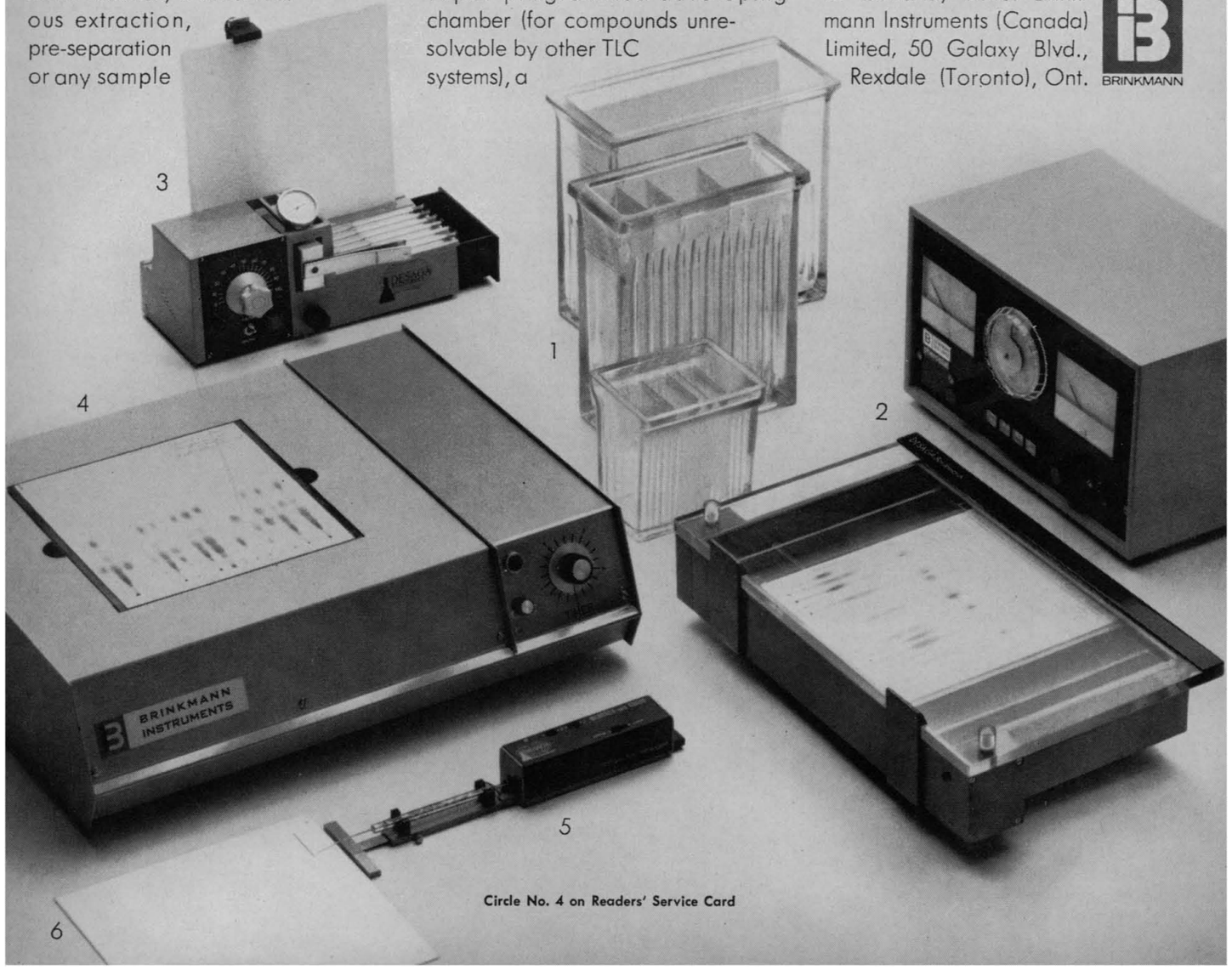

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BOOKS RECEIVED

(Continued from page 399)

New York, 1971. xiv, 602 pp., illus. $29.50.

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Bonds between Atoms. Alan Holden. Oxford University Press, New York, 1971. xii, 108 pp., illus. Paper, $2.95.

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Grundriss der Vogelzugskunde. Ernst Schüz with the collaboration of Peter Berthold, Eberhard Gwinner, and Hans Oelke. Parey, Berlin, ed. 2, 1971. x, 392 pp., illus. DM 88.

Handbook of Fluorescence Spectra of Aromatic Molecules. Isadore B. Berlman. Academic Press, New York, ed. 2, 1971. xiv, 474 pp., illus. $19.

Homotopy Theory. George W. Whitehead. Compiled by Robert J. Aumann. M.I.T. Press, Cambridge, Mass., 1971. x, 124 pp., illus. Paper, $1.95. Reprint of the 1966 edition.

Hour of the Beaver. Hope Sawyer Buyukmihci. Rand McNally, Chicago, 1971. 176 pp., illus. $5.95.

In the Matter of J. Robert Oppenheimer. Transcript of Hearing before Personnel Security Board and Texts of Principal Documents and Letters. U.S. Atomic Energy Commission. M.I.T. Press, Cambridge, Mass., 1971. xii, 1084 pp. Cloth, $17.50; paper, $5.95. Reprint, with additions of the 1954 editions.

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Introduction to Phase Transitions and Critical Phenomena. H. Eugene Stanley. Oxford University Press, New York, 1971. xx, 308 pp., illus. $9.50.

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Proceedings of the Symposium on Submillimeter Waves. New York, March 1970. Jerome Fox, Ed. Polytechnic Press, Brooklyn, N.Y., 1971. xlviii, 726 pp., illus. $25. Polytechnic Institute of Brooklyn Symposia Series.

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Risk-Taking Behavior. Concepts, Methods, and Applications to Smoking and Drug Abuse. Richard E. Carney, Ed. Thomas, Springfield, Ill., 1971. xii, 212 pp. $13.75.

The Rust Fungi of Cereals, Grasses, and Bamboos. George Baker Cummins. Springer-Verlag, New York, 1971. xvi, 570 pp., illus. $19.50.

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Studies of Fossiliferous Amber Arthropods of Chiapas, Mexico. Part 2. Contributions by Alexander Petrunkevitch and others. University of California Press, Berkeley, 1971. vi, 106 pp. + plates. Paper, $4.50. University of California Publications in Entomology, vol. 63.

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Thin-Layer Chromatography. Cumulative Bibliography II, 1967–1969. Dieter Jänchen, Ed. Camag, New Berlin, Wis., 1971. 224 pp. Paper, $9.75.

Topics in Stereochemistry. Vol. 6. Norman L. Allinger and Ernest L. Eliel, Eds. Wiley-Interscience, New York, 1971. xii, 296 pp., illus. $19.95.

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What You Should Know About Blood Types, Transfusions, Rh, and Heredity. Addine G. Erskine. Altamont, Berkeley, Calif., 1970. xii, 156 pp., illus. Paper.

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Cell Biologist, Ph.D. (Berkeley 1968), 29, broad university teaching experience (freshman biology through specialized graduate courses), interesting published research. Desires a new teaching position. Box 373, SCIENCE. X

Chemical Oceanography—analytical/inorganic chemistry. Experience in spectrochemical, radiochemical, and electrochemical techniques. Ph.D. 1968 in analytical chemistry. Postdoctorals and publications. Currently employed in teaching and research position. Desires faculty appointment in chemistry and/or chemical oceanography. Box 374, SCIENCE. X

Physiologist-Lipid Biochemist, Ph.D., 1968. Three years of postdoctoral experience. Desires position in university or pharmaceutical industry. Broad background in lipid metabolism, methodology, and use of isotopes. Capable of working in multidisciplinary program. Box 371, SCIENCE X

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