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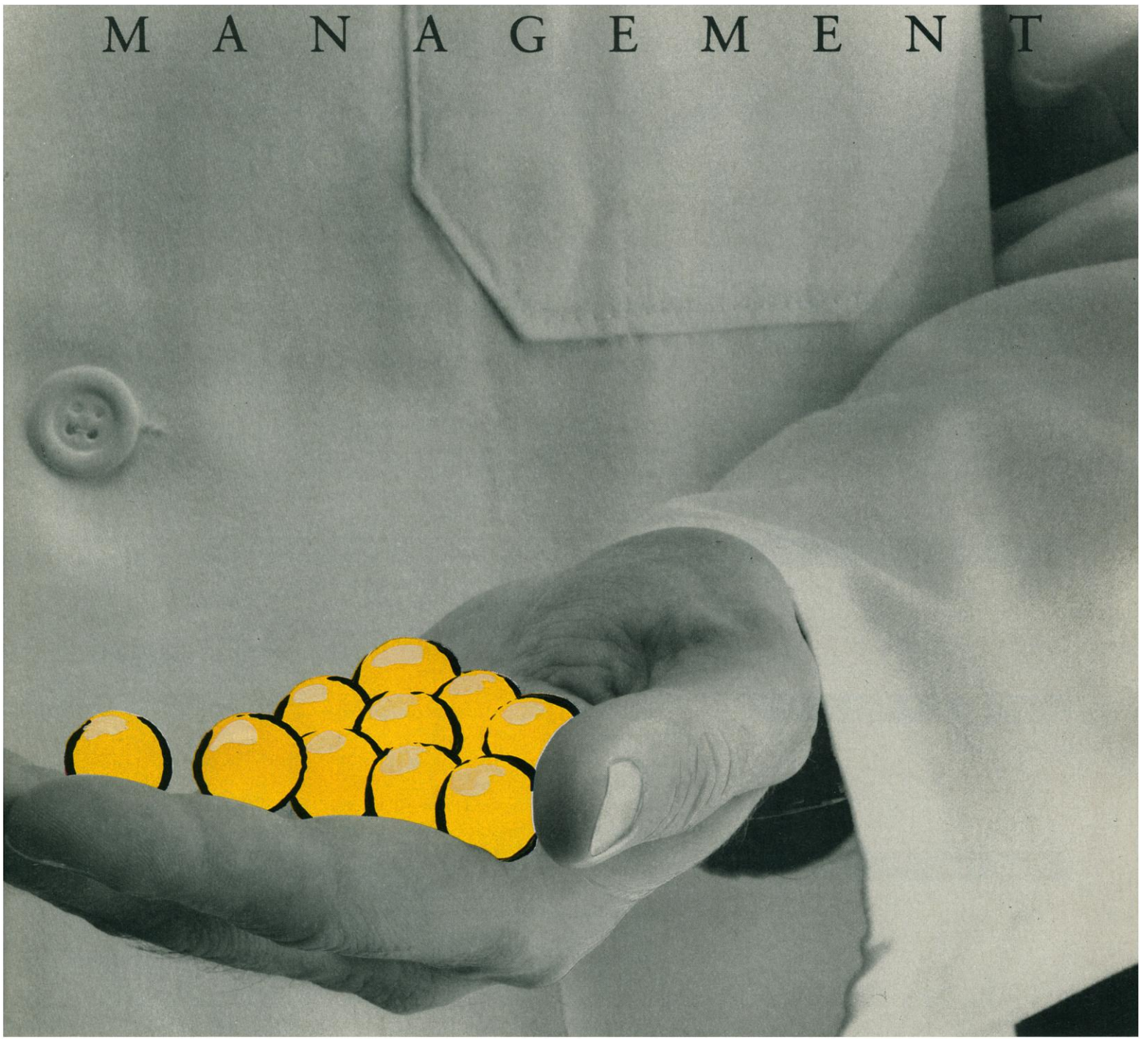


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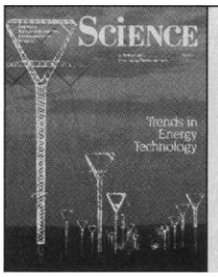


COVER The energy carried by these power lines may flow from diverse technologies. This special issue of *Science* contains articles that survey trends in several areas of energy generation and use. These include photovoltaic solar cells, natural gas, energy efficiency in manufacturing, and nuclear power. See Editorial, page 273. [Photograph by Joe Bator, copyright 1987]

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*This Week in*
# SCIENCE

## Growth of continental crust

GRANULITES are rocks that formed under conditions of high pressures and temperatures; they are considered representative of the nature of the lower part of the continental crust. Samples of granulite include xenoliths, which are chunks of the earth's crust that are brought to the surface in erupting magmas, and granulite terranes that are exposed in a few places around the world. Granulite terranes and xenoliths were once thought to have had the same (lower crust) origin, but estimates by Bohlen and Mezger based on the pressures in terranes and xenoliths—which are indications of the depths at which rock metamorphism occurred—suggest that granulite xenoliths come from deeper sources in the earth than do granulite terranes (page 326). The bulk compositions of terranes and xenoliths are also consistent with this distinction. The formation of each, however, may have been induced by the same event—the thickening of the crust (an episodic event) as hot magmas entered and crystallized at the boundary of the crust and the underlying mantle. Most of the granulite xenoliths may be pieces of the crystallized magma; the heat from these magmas would have led to the metamorphism of the overlying crust, forming the granulite terranes.

## Leaky gene expression

TISSUE-specific gene expression is in fact not truly tissue-specific: small amounts of messenger RNA molecules for "tissue-specific" genes are produced by cells that are unrelated to the tissue that is normally associated with a given gene activity (page 331). Using a technique called RNA amplification with transcript sequencing (RAWTS), Sarkar and Sommer show that several types of cells (white blood cells, embryonic chorionic villus cells, liver cells, and erythroleukemia cells) all can make small amounts of messenger RNA for four "tissue-specific" proteins—blue pigment (a retina-specific protein), factor IX and phenylalanine hydroxylase (liver-specific proteins), and tyrosine hydroxylase (specific to brain and adrenal glands). This observation raises the possibility that diagnostic information can be obtained without intrusive biopsies, because tissue-specific messenger RNA molecules can be evaluated directly in readily accessible cells. In addition, because the proteins or segments of proteins specified by the amplified messenger RNA molecules can be produced in vitro, variations in protein structure and function can be observed. Finally, by modifications of the conditions of RAWTS, sequence information can be obtained for homologous proteins in different species and, from this, protein evolution may be better understood.

## IgE receptors expressed: nothing to sneeze at

THE binding of a foreign substance—an allergen—to immunoglobulin E (IgE), which is itself bound to a receptor on the surface of a basophil or mast cell, leads to the release of mediators and to the eventual production of an allergic response. The receptors for IgE have been difficult to study for several reasons: the body has a paucity of mast cells and basophils, the cells are difficult to purify, and there are currently no cultured cell lines of either cell type. Miller *et al.* transferred cloned human and rat genes for the four subunits of the receptors—each receptor has one $\alpha$ subunit, one $\beta$ subunit, and two $\gamma$ subunits—into cells that were growing in tissue culture; a chimeric rat-human receptor for IgE, which had binding characteristics of normal human IgE receptors, was expressed on the cells (page 334). Access to these receptors should facilitate inquiries into subunit interactions, into how the IgE molecules bind to the $\alpha$ subunits of the receptors, and into the mechanism by which the ensuing immune cascade is triggered. It will be a boon to allergy sufferers if drugs can be identified or designed that inhibit binding of IgE to the receptors or that block triggering after binding has taken place.

## Hepatitis C virus

A breakthrough has been made in the identification of the elusive agent(s) of non-A, non-B hepatitis (NANBH); more than 90% of transfusion-associated cases of hepatitis in the United States are of this type. Choo *et al.* proceeded on the assumption that very low amounts of viral antigens are present in infected plasmas; thus, to detect antigens, amplifications would be needed. Plasma from an infected chimpanzee was used as starting material from which antigen amplification was carried out (page 359). Serum from a patient with chronic NANBH (presumed to be a source of antibodies to viral antigens) was used for identifying clones producing NANBH-associated antigens; it was then possible to go back and identify in individual clones the NANBH-associated genetic material—single-stranded RNA. Larger amounts of viral antigen were subsequently produced and a clinical test, based on the antigen, developed for detecting circulating antibodies. Kuo *et al.* report that the virus appears to be a major cause of NANBH in the United States, Italy, and Japan, and, therefore, probably throughout the world (page 362). The availability of an assay for screening blood for "hepatitis C" should make it possible to eliminate this virus from the blood supply. The technique probably can be adapted for cloning genetic material from other poorly characterized viruses and other kinds of infectious agents.

### Energy

As it burns, which fuel—gasoline, natural gas, or coal—releases the smallest amount of the greenhouse gas $CO_2$ into the atmosphere? How has solar energy been beneficial to vaccine delivery? Why were the take-home lessons of the accidents at Three Mile Island and Chernobyl different? This issue of *Science* provides answers to these questions and much much more (pages 273, 297, 305, 311, and 318).

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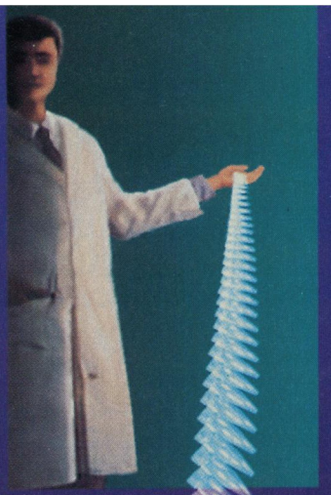

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# Progress in Energy R&D

Our present pattern of energy utilization will someday be substantially altered. Impetus for change will arise from our inability to sustain continued increases in oil imports, or to mounting concerns about the greenhouse effect, acid rain, or urban pollution. Four articles in this issue of *Science* describe progress in developing technologies that may be helpful in responding to the next energy crisis.

Hubbard describes dramatic improvements in photovoltaic (PV) technology. Scores of new PV materials and many new designs have been explored. As a result, the cost of PV electricity has dropped from $15 per kilowatt-hour to about $0.30 per kilowatt-hour. To be competitive with future electric generations options, PV modules must exhibit solar energy efficiencies in excess of 15% at costs somewhere between $0.06 and $0.12 per kilowatt-hour. Recent striking improvements in efficiency of conversion of solar energy to electricity and continued improvements in methods of manufacture indicate that this goal may be attained by the mid-1990s. A competitive solar cell industry has emerged, and substantial research is being conducted in a number of countries.

Burnett and Ban describe ways in which prospects for natural gas have improved. The energy content of natural gas production in the lower 48 states is already substantially greater than that of oil, and research and development have shown that methane occurs and is recoverable in many places in which oil is not present. Examples include coal seams, shales, and deep formations. A recent U.S. Department of Energy reassessment of the resource base concluded that technically recoverable natural gas in the lower 48 states is 1059 trillion cubic feet—a greater than 50-year supply at today's usage.

Natural gas is a clean fuel that gives rise to much less pollution than either coal or oil. In applications for cogeneration of electricity and heat, thermal efficiencies of 60% to 80% are achieved. The authors describe other new applications that guarantee an increasing role for natural gas in the U.S. energy mix. For example, the use of small amounts of gas in coal-fired and waste-burning furnaces can lead to substantially decreased emission of pollutants. Improvements in furnaces for home heating have made gas highly competitive with oil or electricity.

Ross discusses energy efficiency in industry. He points out that largely in response to the energy shocks of the 1970s, U.S. manufacturers reduced their real fossil fuel intensity ratio of energy use to production by 50%. In the past decade there have been only sporadic improvements, and Ross states that the cost-effective opportunity now available is very large. In addition to potential financial advantages, the technology of efficient energy use is improving rapidly. Manufacturing is being revolutionized by introduction of new sensors coupled with electronic processing of information, followed by automatic control of processes. For example, equipment being installed in steel mills increases yields by controlling thicknesses during the rolling process. Another development in industry is use of electricity in new applications where special advantages are achieved. That is, electric heating processes can achieve extremely high energy densities. In arc plasmas temperatures of 10,000°C are routine. In almost every sector of industry pioneering methods of obtaining increased efficiency and energy savings are being implemented. If an energy crunch comes, these demonstrations will find energy-saving replications.

The history of nuclear energy in the United States is a striking illustration of how a great nation can flub a major technological development. Taylor states that the average capacity factor in the United States is about 60% as compared to 75% to 85% in some countries. In addition, U.S. operations and maintenance costs are averaging roughly twice what other countries spend. The U.S. utilities have now set goals to bring their average performance and cost effectiveness to a world competitive level while devoting top priority to safety. Designs of three different reactor systems are moving ahead with five goals in mind: (i) assured safety with features that minimize consequences of human error, (ii) a significantly simpler design, (iii) high reliability throughout a lifetime of on the order of 60 years, (iv) reduction in capital and other costs and a construction time of 3 to 5 years, and (v) a standard design that is predictably licensable.—PHILIP H. ABELSON

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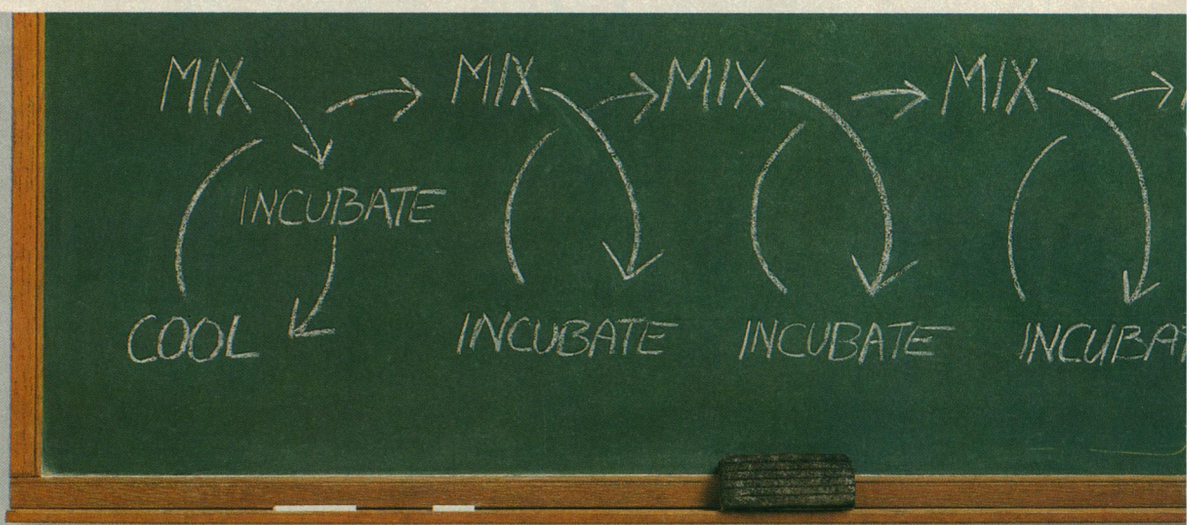


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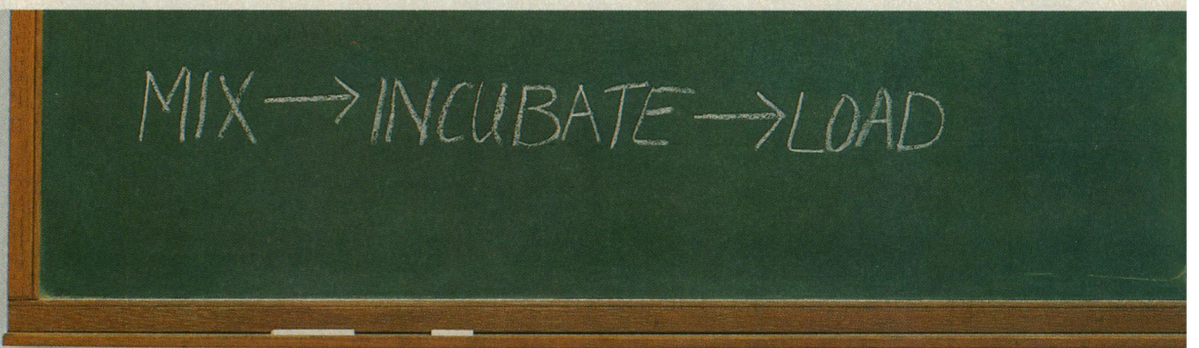


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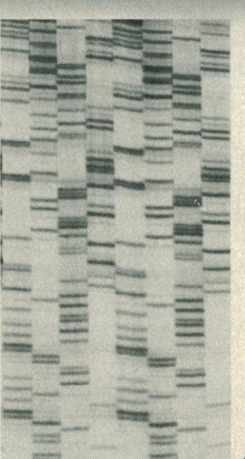

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least a tradition of altruism, would be greatly exacerbated in committees formed under the auspices of the very entities which they are supposed to be regulating.


PHILIP L. BEREANO
*Technology and Public Policy, College of Engineering, University of Washington, Seattle, WA 98195*


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Documents recently made public by the Environmental Protection Agency (EPA) indicate that the Office of Management and Budget is refusing to release the EPA rules—in part, because of "fundamental scientific concerns" raised by the White House's Biotechnology Science Coordinating Committee (BSCC). According to the EPA documents, the BSCC maintains that the "proposed rules do not use scientifically determined likelihood of risk bases for categories of regulated microorganisms" (*1*).

A new report (*2*) from the Ecological Society of America (ESA) discredits this BSCC argument against the rules. The ESA report, while supporting the principle of regulation scaled according to risk, concludes that risk-based categories of transgenic organisms should be developed *after*, not before, experience is gained from field experiments and risk assessment research. In other words, it is too soon to develop risk-based categories.

The report also provides well-documented positions and ecological perspectives on other controversial matters that are central not only to the EPA rules but to other federal regulation of biotechnology. For example, it concludes that (i) small-scale releases deserve oversight; (ii) a safe record in traditional agricultural breeding should not exempt from review transgenic organisms that the traditional methods could not have produced; and (iii) techniques other than recombinant DNA produce transgenic organisms that should be subject to federal oversight.


JANE RISSLER
*National Biotechnology Policy Center, National Wildlife Federation, 1400 Sixteenth Street, NW, Washington, DC 20036-2266*


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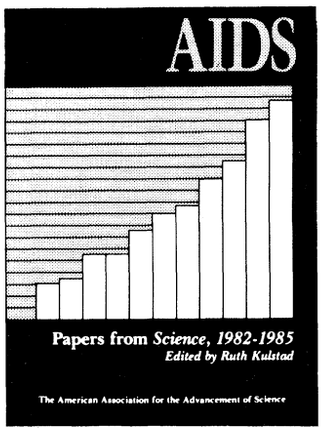


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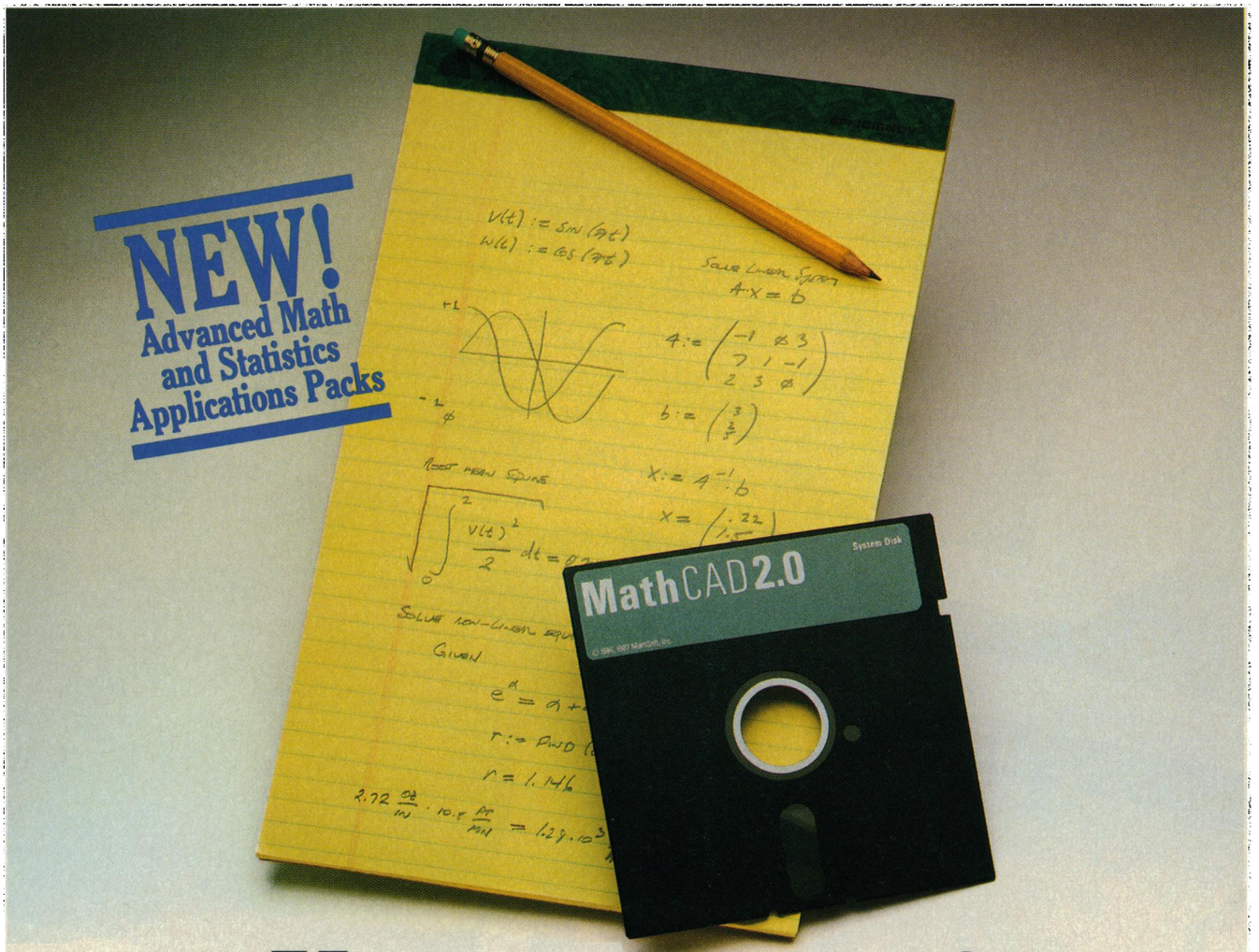


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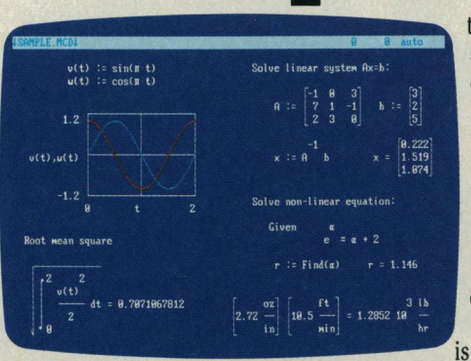


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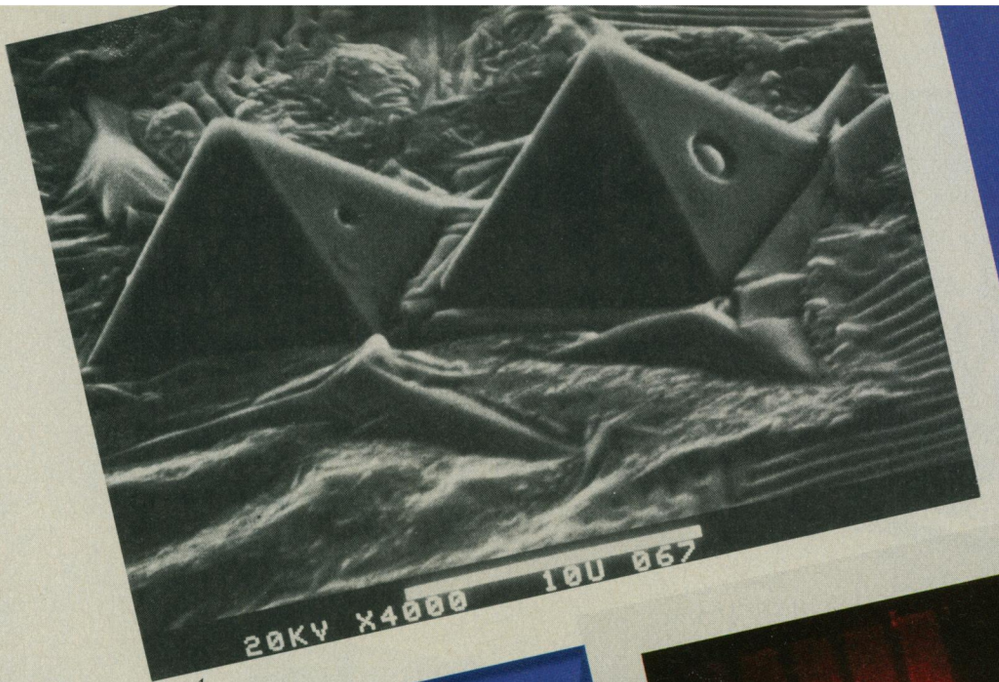
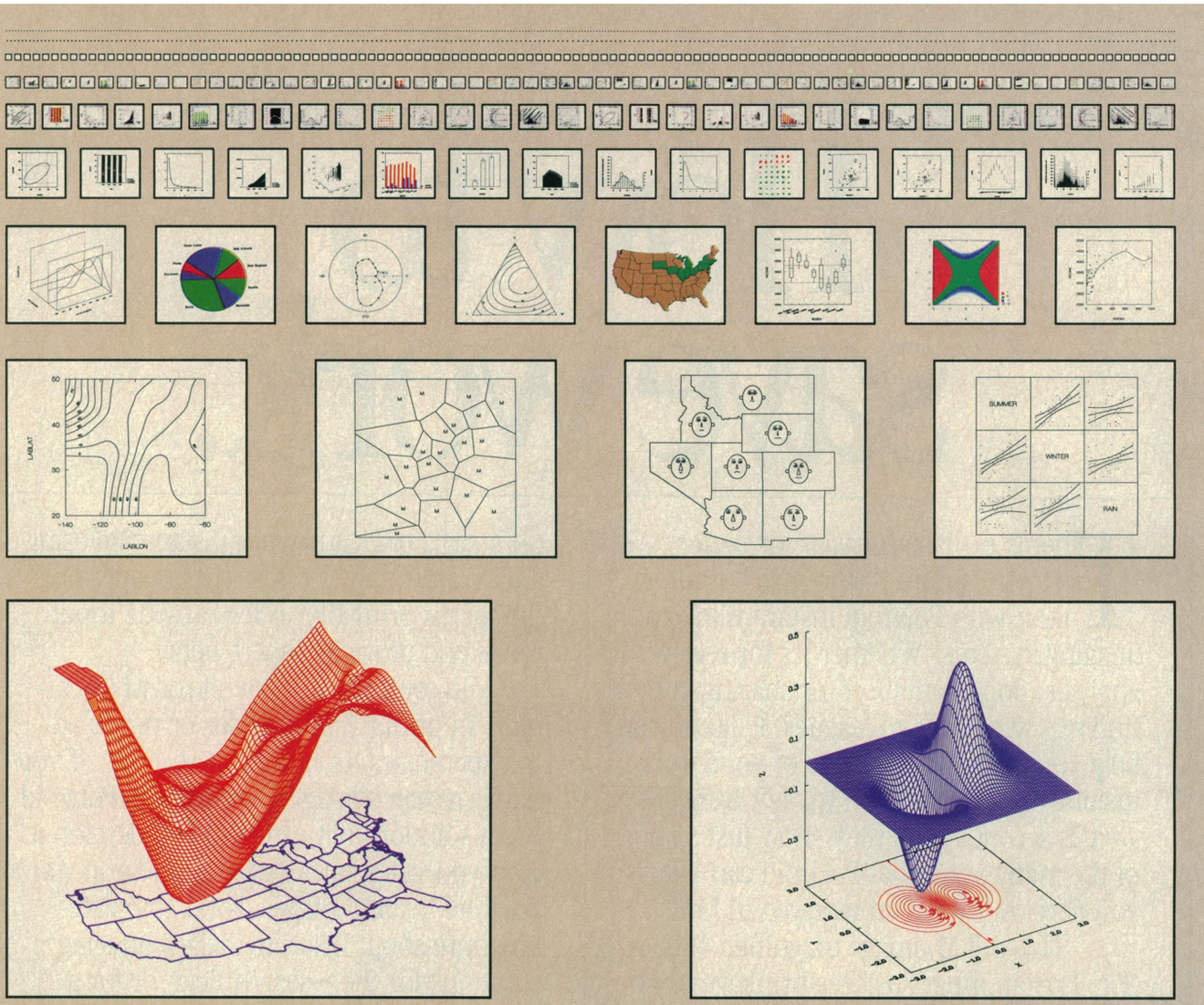



Fig. 1

Fig. 2


Fig. 3

Fig. 4





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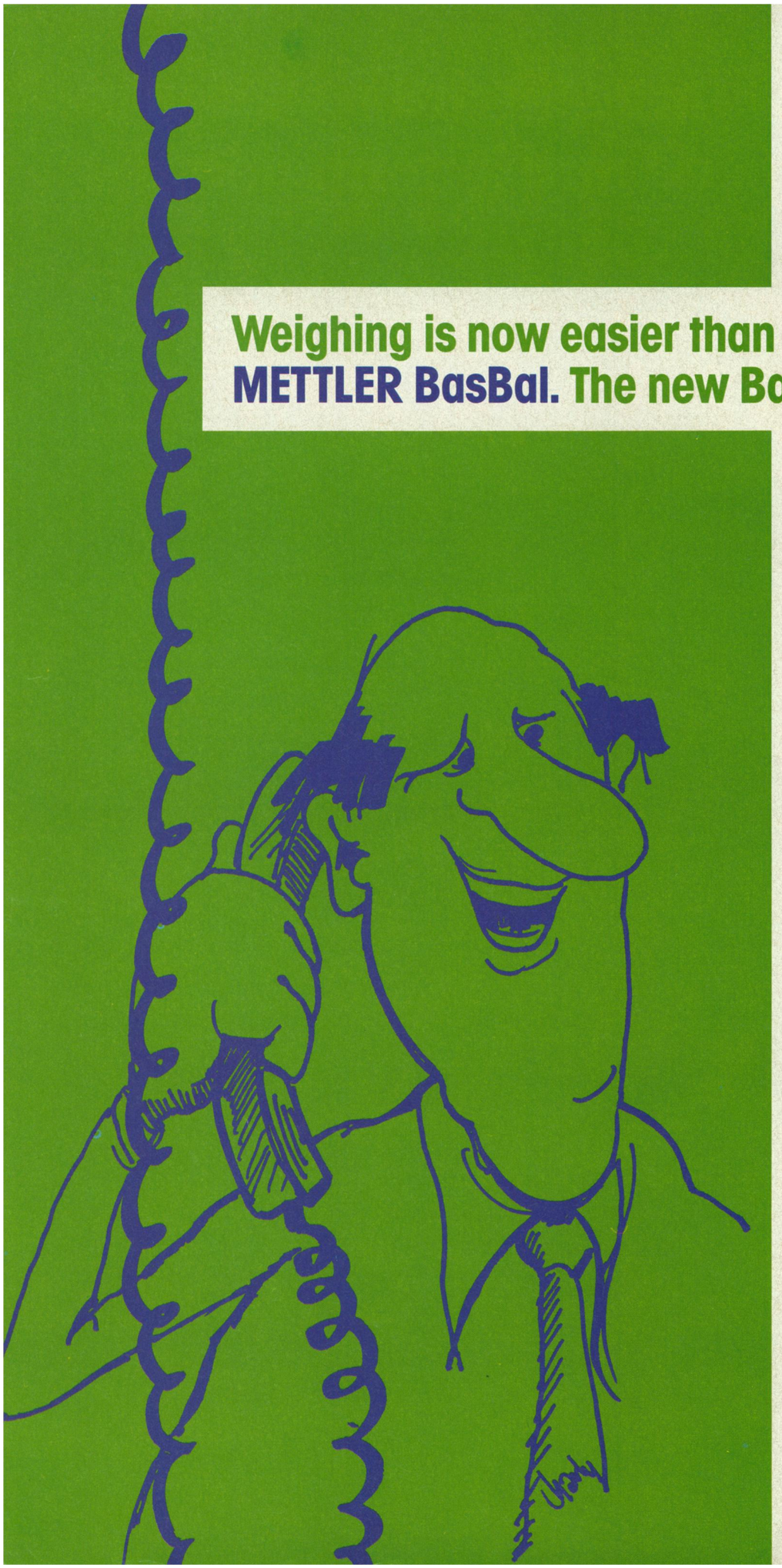


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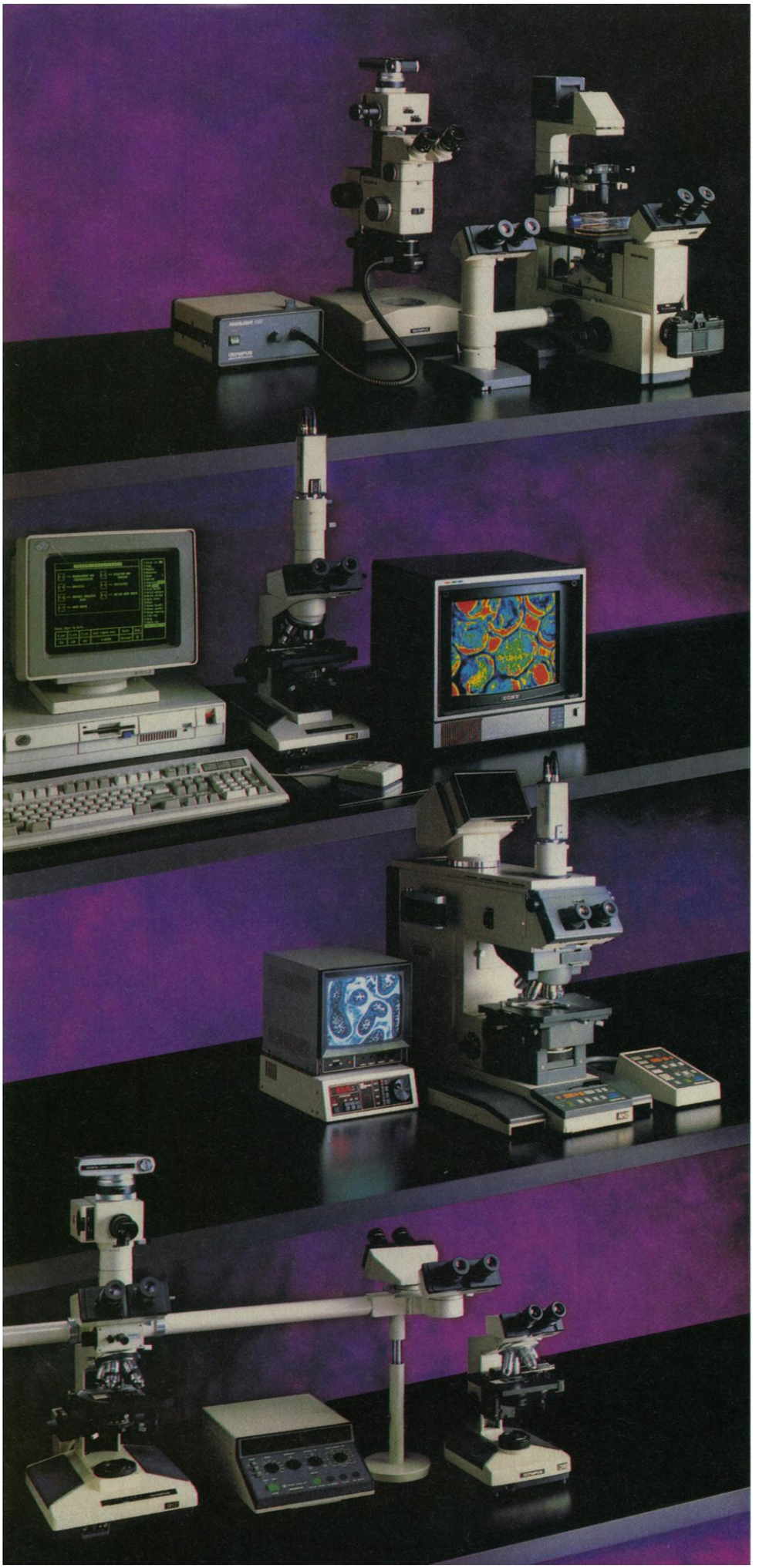

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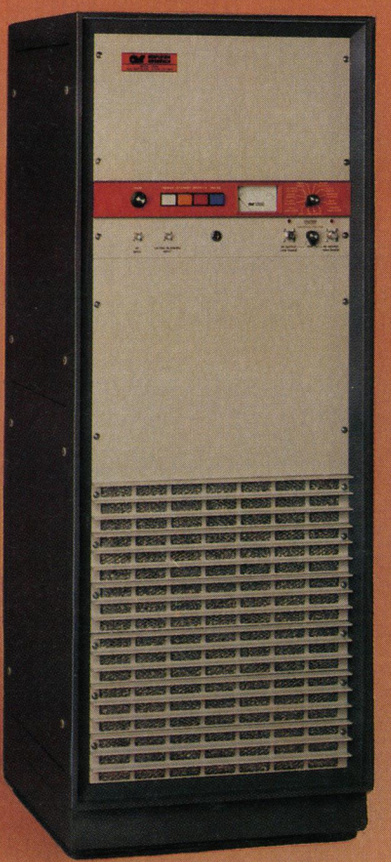

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frowned upon" (p. 158; cf. p. 263). Here Caffrey depicts Benedict as an innovator struggling against repression, but to do so creates an overly dramatic intellectual history. Most good anthropology theorizes as well as describes. And Caffrey herself indicates that Boas early approved the new directions that Benedict explored (p. 156). Finally, in a book that exhaustively footnotes its sources, Caffrey makes large claims, on apparently slim evidence, for the influence of feminist writings on Benedict's thought. Benedict's last great undertaking, the Research on Contemporary Cultures project, is described as explicitly feminist in spirit and organization. Yet to make this case, Caffrey must insert the writings of feminist Ellen Key into her narrative (pp. 346–347), as if they represented Benedict's own philosophy, even though Benedict's acquaintance with Key's work is only vaguely documented (p. 85). Ironically, Caffrey concludes her book with a celebration of this cooperative, egalitarian research organization, though she had earlier celebrated Benedict as a lone scientific discoverer.

In general, Caffrey's work has the plodding thoroughness of a doctoral dissertation. She summarizes enormous amounts of material from a number of disciplines. Her reviews of trends and ideas that influenced Benedict are revealing, and they explore themes in intellectual history overlooked by Benedict's other biographers. But, like her discussions of the history of anthropology, Caffrey's summaries are sometimes simplistic and, like her reviews of feminist thought, mechanically inserted into the narrative. Ruth Benedict taught that every culture has the vices of its virtues, and the same might be said of biography.

RICHARD HANDLER
*Department of Anthropology, University of Virginia, Charlottesville, VA 22906–9024*

## Ancient Mesopotamia

**The Early History of the Ancient Near East, 9000–2000 B.C.** HANS J. NISSEN. University of Chicago Press, Chicago, 1988. xiv, 215 pp., illus. $34.95. Translated from the German edition (Darmstadt, 1983) by Elizabeth Lutzeier with Kenneth J. Northcott.

The greatest achievement of ancient Near Eastern civilization, in the view of Hans J. Nissen, was the creation and elaboration of universally valid forms of political organization. In *The Early History of the Ancient Near East*, Nissen traces the development of those forms of organization from the first permanent settlements in the area to the establishment of regional states under dynasties centered at the southern Mesopotamian cities of Akkad (about 2334 to 2154 B.C.) and Ur (about 2112 to 2004 B.C.).

The book opens with an introductory chapter, "Sources and problems," that includes a provocative discussion of the respective characters of archeological and written sources. Ancient Near Eastern political developments are then treated according to phase: the time of settlement (roughly 9000 to 6000 B.C.), the evolution of isolated settlements into towns (6000 to 3200 B.C.), the periods of early high civilization (3200 to 2800 B.C.), rival city-states (2800 to 2350 B.C.), and the first territorial states (2350 to 2000 B.C.). There are a short conclusion, headed "Prospects," and a bibliography organized chapter by chapter.

Without any doubt, *The Early History of the Ancient Near East* is an original and coherent synthesis of 7000 years of political evolution, but it is also idiosyncratic. As Nissen admits in his preface, the book is one of several possible historical reconstructions. As such, it is not primarily for a general audience. It can be most effectively used by those with some background in the archeological and textual sources for the area and time periods in question and the ability to evaluate Nissen's arguments and interpretations, which provide a balance to the stock