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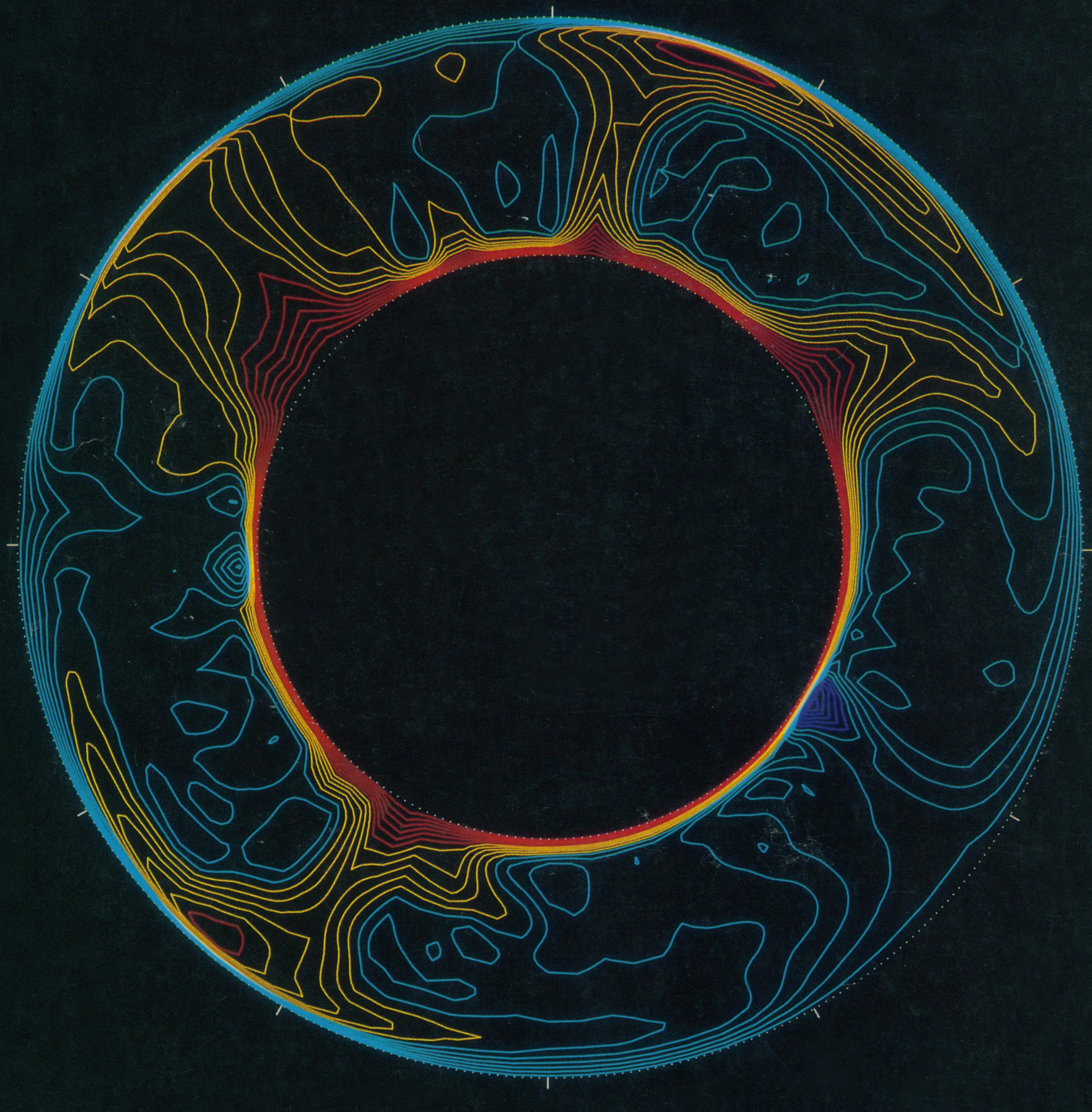

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■ The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve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

COVER Contours of constant entropy in a cross section of a spherical shell in which thermal convection in the mantle is numerically simulated. The shell is uniformly heated along its inner boundary. Red and yellow contours show hot upwelling currents; light and dark blue contours show regions of relatively cold downwelling currents. Upwelling occurs in columnar plumes and downwelling occurs primarily in planar sheets, similar to upwelling and downwelling in the earth's mantle. See page 950. [Image was made on a DICOMED D48CR film recorder from numerical data generated on a CRAY XMP-48 at the San Diego Supercomputer Center by D. Bercovici, G. Schubert, and G. A. Glatzmaier]

Reports

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This Week in SCIENCE

Mantle dynamics

THREE-DIMENSIONAL models of thermal convection in a sphere—a proxy for how the earth's mantle flows (the driving force for plate tectonics on the surface)—indicate that two naturally occurring tectonic phenomena are inherent features of convective flow (page 950). One is subduction, movement of oceanic crust back into the mantle; the other is hotspots, areas of anomalous heat flow and volcanism at the crust that are thought to be related to hot plumes in the mantle. Bercovici *et al.* find that both downwelling sheets and upwelling cylindrical plumes developed in simulations (cover) whether the model mantle was heated at the core-mantle boundary, internally, or in both. Active sheetlike upwellings did not develop in any simulation, consistent with the notion that mid-ocean ridge upwelling (sea-floor spreading) is not a result of mantle convection but may reflect tearing of ocean crust as slabs sink into the mantle.

Greenland ice sheet

THE Greenland ice sheet may have melted completely or almost completely during the last interglacial period (the Sangamon). The thick (3000+ meters) layer of ice that now covers Greenland would therefore be "new" ice deposited just in the past 120,000 years. This ice sheet was thought to be much older and to consist of ice from several glacial periods; a more recent origin for it is proposed by Koerner after reassessment of ice core data (page 964). Isotope and gas bubble signatures in the ice are consistent with deposition of ice onto bedrock during the last interglacial; the basal layer includes a type of ice that forms when surface snow melts and refreezes. The distribution of dirt particles in cores also fits with the concept of an ice-free Sangamon: particle sizes and abundances decrease upward in the cores, suggesting that, as the ice sheet formed and expanded and ice-free zones shrank, smaller and fewer particles would have blown onto the ice surface. Sea level was 6 meters higher in the Sangamon than it is today; the source of all the water could have been the melt from the Greenland ice sheet.

Membrane power

A chemical reaction that is essential for vision in vertebrates is the conversion of dietary vitamin A to 11-*cis*-retinal, which then complexes with protein opsin to form rhodopsin, the light-sensitive pigment in the eye. One step in this conversion is isomerization of vitamin A (all-*trans*-retinol) to 11-*cis*-retinol, a reaction that requires input of energy. Deigner *et al.* show that energy for the reaction can come from membrane phospholipids (page 968). A membrane preparation from retinal pigment epithelium was able, like the living eye, to process vitamin A. Crucial to the conversion were transfer of an acyl group from membrane phospholipids to vitamin A, isomerization of the resulting ester, and subsequent elimination of the acyl group. That membrane phospholipids can serve as energy sources is a new finding; because many biochemical reactions take place in membranes, it is possible that some of them may similarly be powered by phospholipids.

Flu antidote

AN enzyme that scavenges and destroys superoxide free radicals (O_2^-) prevents mice from dying of otherwise lethal flu infections (page 974). Free radicals can be a mixed blessing during viral infections because, although they help to kill invading viruses, they also cause harm to host cells and tissues. During influenza infections, free radicals are generated by cells of the immune system that were mobilized to fight the virus and by the substance xanthine oxidase that is present (in excess amounts) in the blood stream and in extracellular spaces. Oda *et al.* chemically coupled the enzyme superoxide dismutase, which is a free-radical scavenger, to a polymer that increased the enzyme's survival in the blood. The complex was injected into influenza-infected mice and protected them from lethal influenza infections. Oxygen free radicals are not exclusive to influenza but contribute to pathology in other diseases; therefore, similar scavenger-polymer complexes might have broad therapeutic applications.

Categorization: For the birds

ONE process that helps humans to perceive speech is categorization, the sorting of sounds into discrete categories. Nelson and Marler report that territorial swamp sparrows also are able to categorize and thus constitute a relatively simple model in which to evaluate this facet of communication and perception (page 976). The songs of swamp sparrows are trills of syllables that last 2 seconds; each syllable consists of two to five notes, and notes fall into six categories based on acoustic criteria, including their duration. For example, category 1 notes last, on average, 6.6 milliseconds and those in category 6 last about 25 milliseconds; because the notes form a natural continuum, however, two notes within a category may differ more in length than do two notes at boundaries between categories. Sparrows were habituated to one three-note song; then they were tested with the same song or a different song. They responded most aggressively—raising and fluttering their wings—when the two songs began with notes from different categories. The ability to categorize and respond to sounds permits these sparrows to quickly determine whether familiar songs are being sung in their territory.

Levitating hopes fall

Accumulating structural data suggest that some proposed applications of high-temperature superconductors will be more difficult to achieve than expected; others (such as levitating trains) may be impossible (page 914).

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Earth Observations from Space

For most of its existence the National Aeronautics and Space Administration (NASA) has emphasized projects other than detailed exploration of Planet Earth. But public concerns about the consequences of human activities on our habitat are forcing consideration of a shift in relative priorities. The discovery and confirmation of chlorofluorocarbon effects on polar ozone have lent added emphasis to the need for profound understanding of factors affecting global change.

In testimony before a Senate committee, Lennard A. Fisk, Associate Administrator of NASA for Space Science and Applications, has outlined some of NASA's present rationale and plans. He reminded the committee that human activities were altering the composition of the atmosphere and destroying tropical forests. Consequences from these trends are expectable. But what is not known is how much and when. Modelers have attempted to find the answers, but they have been dealing with incomplete data. As a result, they cannot predict the magnitude and timing of any global warming accurately. Various global circulation models differ by 50% in the predicted temperature rise for a doubling of atmospheric CO_2 and by a factor of 2 for changes in precipitation. The models differ even more in their predictions of regional and seasonal climate changes.

Fisk stated that the models fail because our knowledge of earth processes is insufficient. The modelers are not yet able to include major feedback phenomena. One of these is the effects of clouds, which can either warm or cool the global climate. Global warming is projected to lead to more clouds. Recent analysis of data collected in April 1983 has shown that cloud cover at that time resulted in a cooling of the earth by 15°C, or about three times the amount of warming predicted to accompany a doubling of CO_2. A better understanding of natural variations in climate and of mechanisms of global response to greenhouse gases is needed.

NASA has under construction three satellite projects that will provide some data on global change. One, to be launched in 1991, will measure chemistry and dynamics of the upper atmosphere, including a complete global set on the ozone layer. Another satellite (1992), a joint project with France, will measure with great accuracy the height of the world's oceans from which global ocean circulation can be deduced. A third project (1994) involves equipment to be flown on a Japanese satellite to measure wind stress on ocean surfaces.

NASA is engaged in planning for an extensive, integrated set of measurements to be obtained by an Earth Observing System. Major components of the system would be polar-orbiting satellites equipped with instrument packages capable of monitoring in detail terrestrial, oceanic, and atmospheric phenomena. The first satellite of a series would be launched in 1996. About 5 years of preliminary studies for the system have already been conducted. Most of the sensors are under development. The large number of instrument packages have impressive capabilities. As one example, the High-Resolution Imaging Spectrometer is designed to acquire simultaneous images in 192 spectral bands in wave lengths between 0.4 and 2.5 micrometers. Observing reflected solar illumination with this kind of resolution will make possible detailed identification of minerals and soils, examination of suspended sediments and phytoplankton in coastal and inland waters, estimation of grain size of snow and its impurities, and study of biochemical processes in vegetation canopies.

Another package uses lasers to measure atmospheric water vapor, surface topography, atmospheric scattering properties, and tropospheric winds. Synthetic aperture radar will create images of land, ocean, and ice surfaces during cloudy weather or at night.

The Earth Observing System will involve substantial international collaboration both in the design of instruments and the manufacture of their satellites. The cooperation of many countries in collecting ground truth will be essential. Personnel of other government agencies as well as thousands of academic scientists will participate in using information from the satellites. Enormous data streams and their storage and analysis will challenge human capabilities. But from this complex activity will come a vastly enhanced capability to understand and predict earth processes.—PHILIP H. ABELSON

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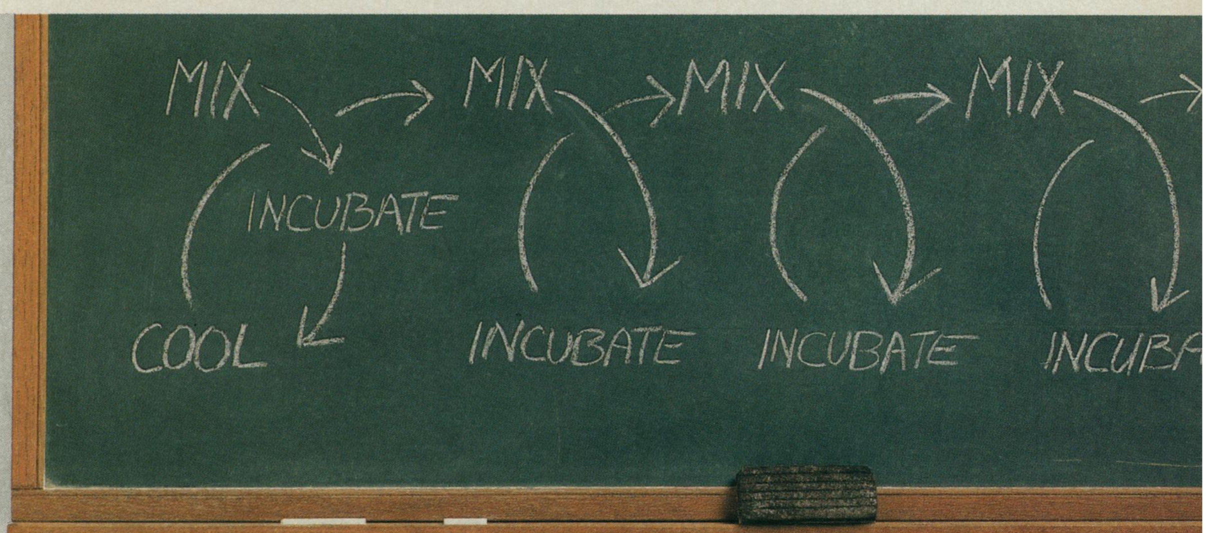

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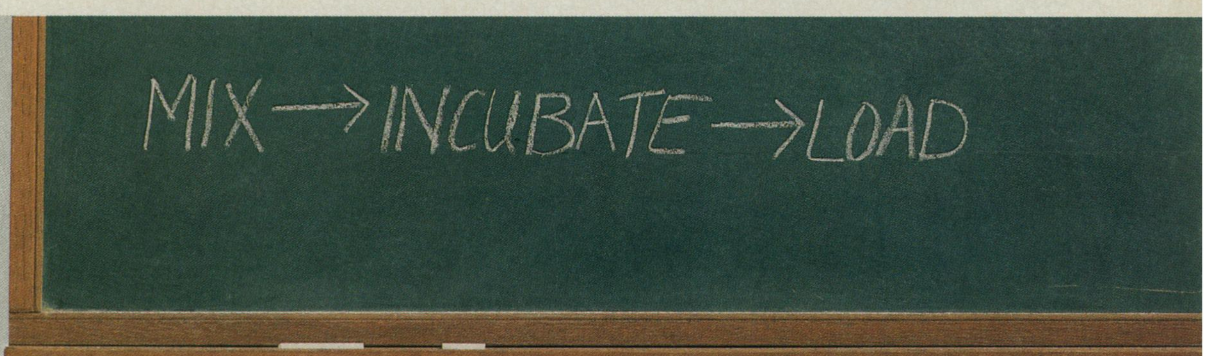

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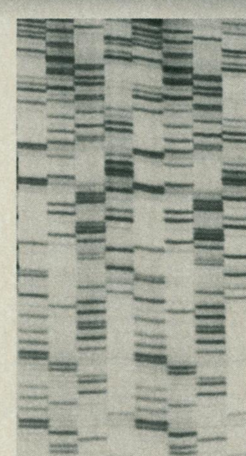

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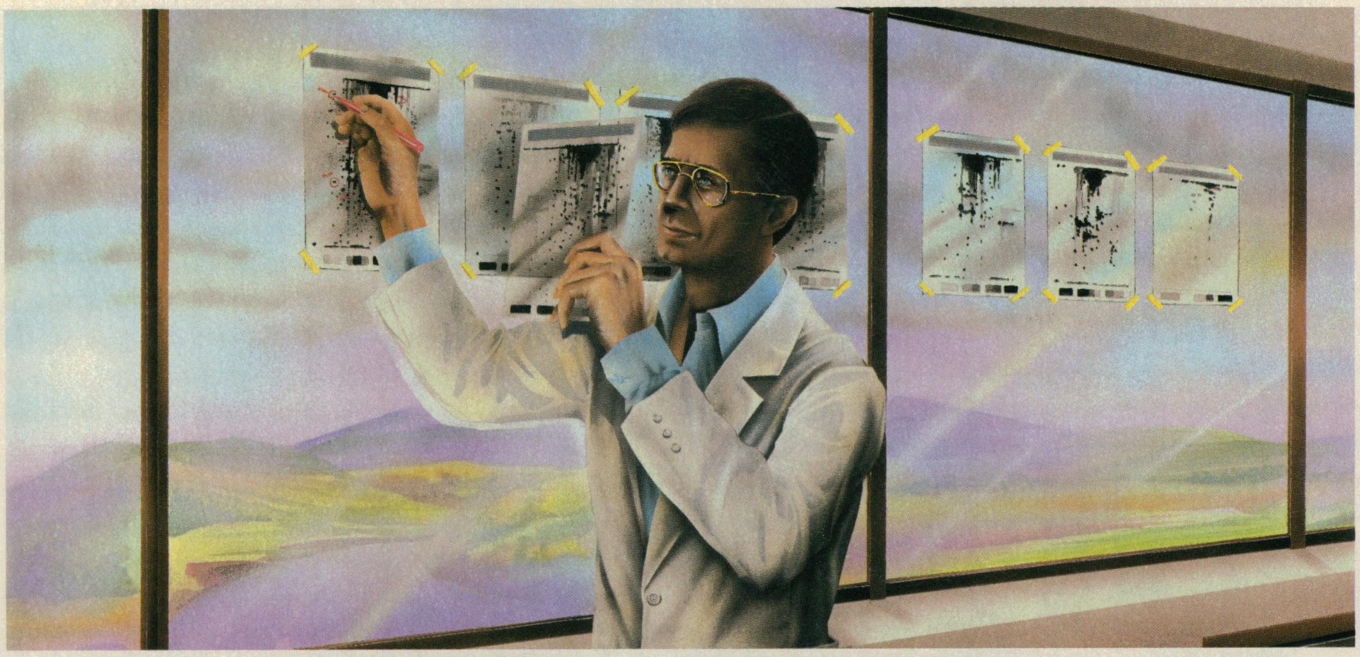

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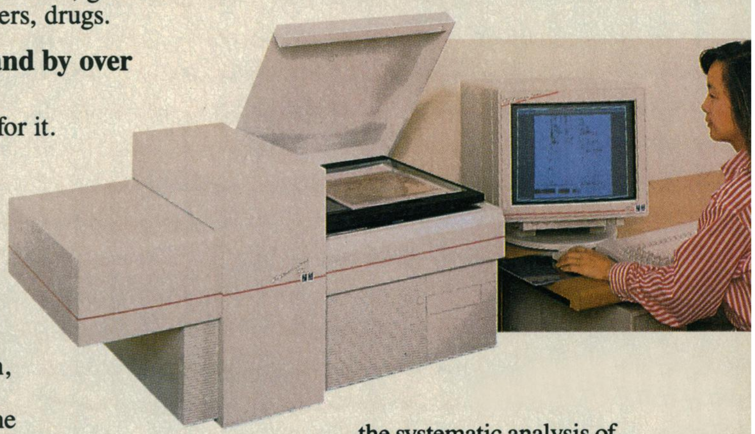

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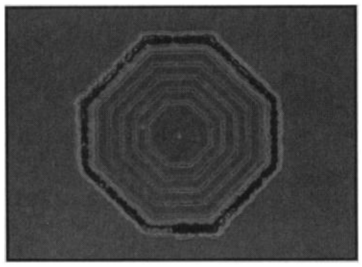

CHO cell isolated by "Cookie Cutter" technique. (Courtesy of Dr. Margaret Wade, Meridian Instruments)

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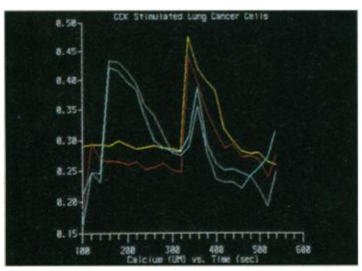

Cholecystokinin induced increase in intracellular calcium levels in human small cell lung cancer cells. Only 2 cells responded to cholecystokinin, whereas all 4 cells responded to carbachol as evidenced by the later peaks. (Courtesy of Dr. Ronald Barrett, Abbott Laboratories.)

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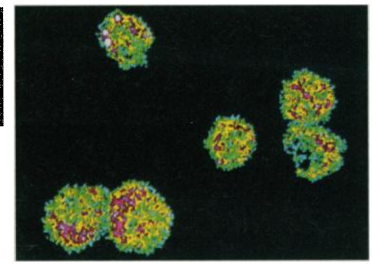

Detection of 30-60 copies of ABL mRNA by in situ hybridization in the leukemia cell line, K562. (Courtesy of Dr. Joel Bresser, M.D. Anderson Hospital.)

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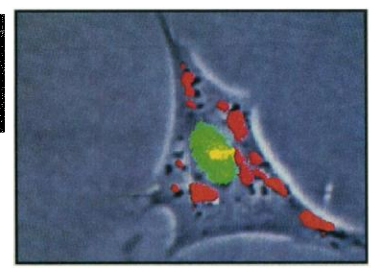

Overlay of phase contrast and two fluorescence images of a 3T3 cell labeled with acridine orange (Green: nucleus; Red: lysosomes). (Courtesy of Dr. Margaret Wade, Meridian Instruments.)

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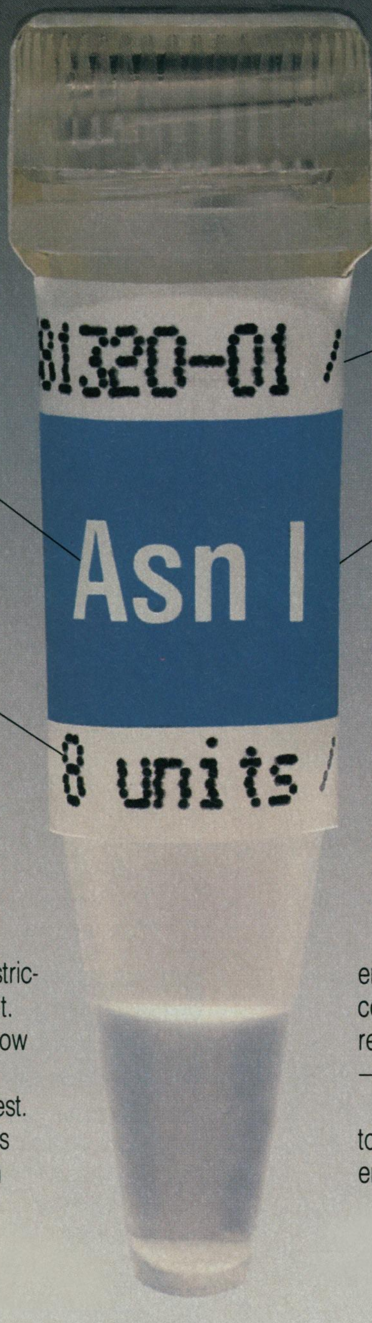

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SDS-PAGE

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Synthetic peptides V(H)(27-68) and V(H)(16-68) of the myeloma immunoglobulin M603 heavy chain and their association with the natural light

3 years after

On March 10, 1986, when PhastSystem™ was introduced, it represented a totally new concept in electrophoresis. Today, most of the major biotechnology industries in the world are equipped with PhastSystem. And PhastSystem is rapidly setting the standard for purity control of healthcare products. In 1988 alone, over 5.2 million samples were tested on PhastSystem.

These developments reflect industry confidence. Confidence in itself as a reliable source of healthcare products. Confi-

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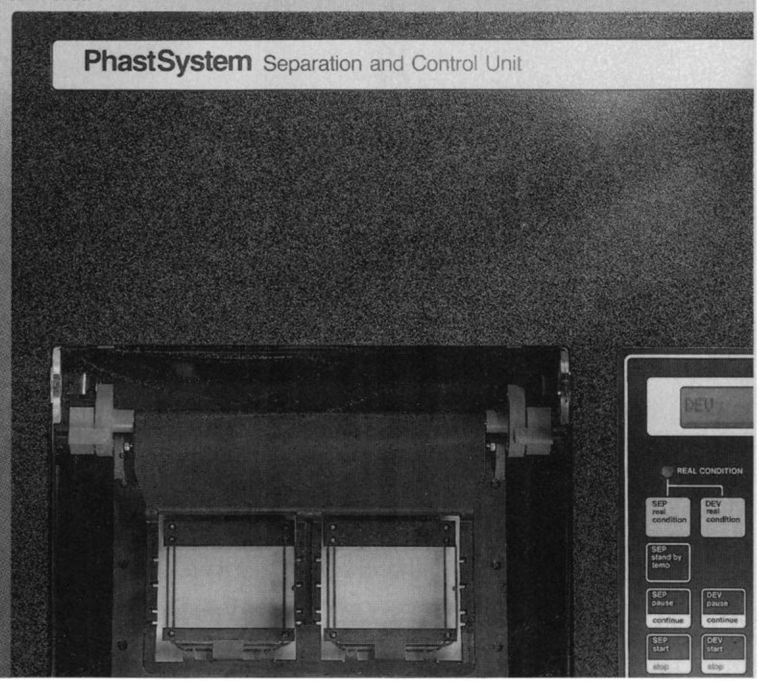

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PhastSystem owners throughout the world regularly receive a newsletter that keeps them informed on the latest additions to the system, new applications, valuable method tips and updated reference lists. Over a hundred workshops and seminars have been conducted to date on PhastSystem techniques. And within the next few months several new gels and major accessories to PhastSystem will be introduced worldwide.

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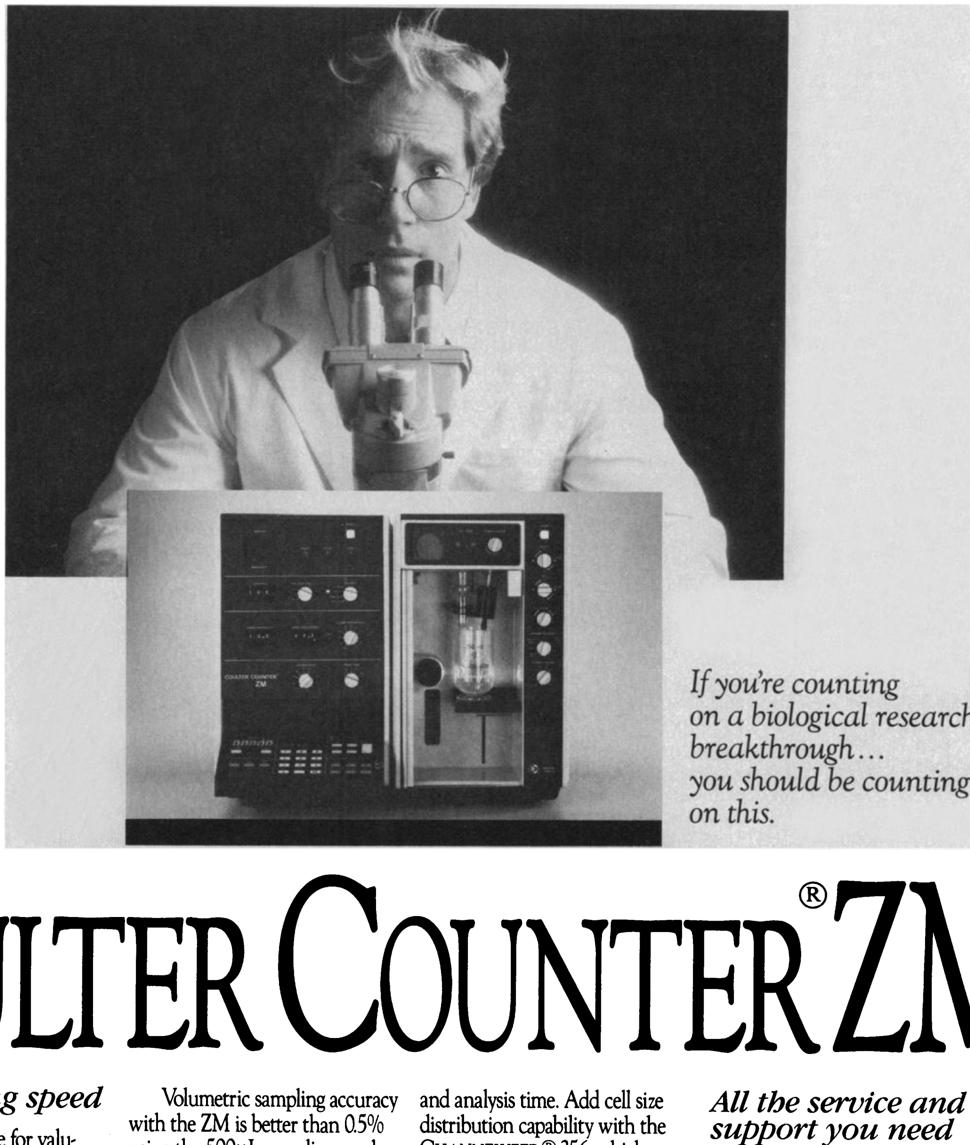

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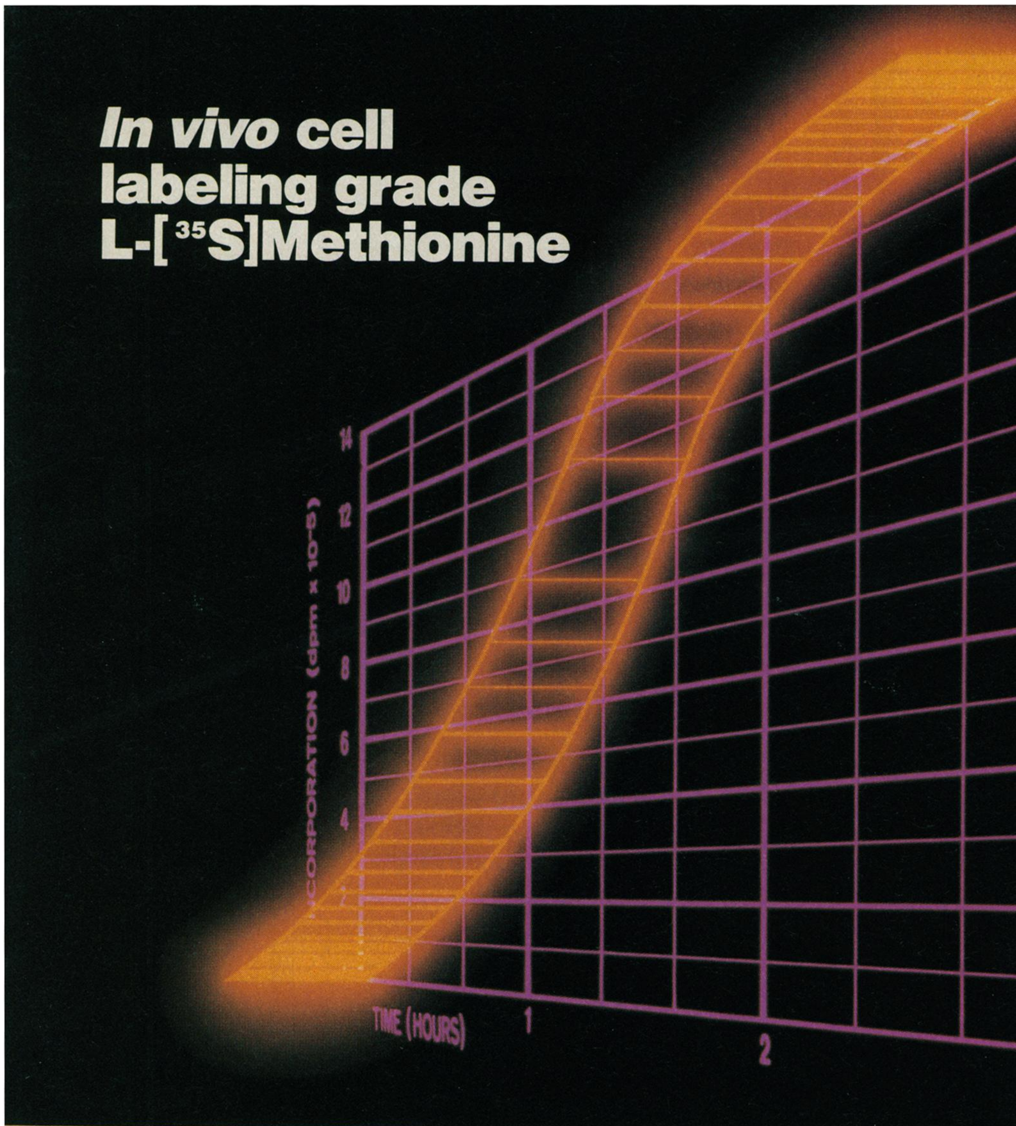

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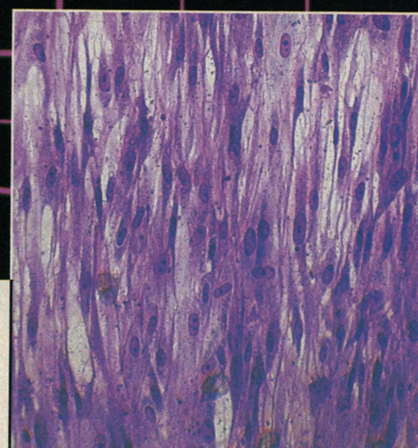

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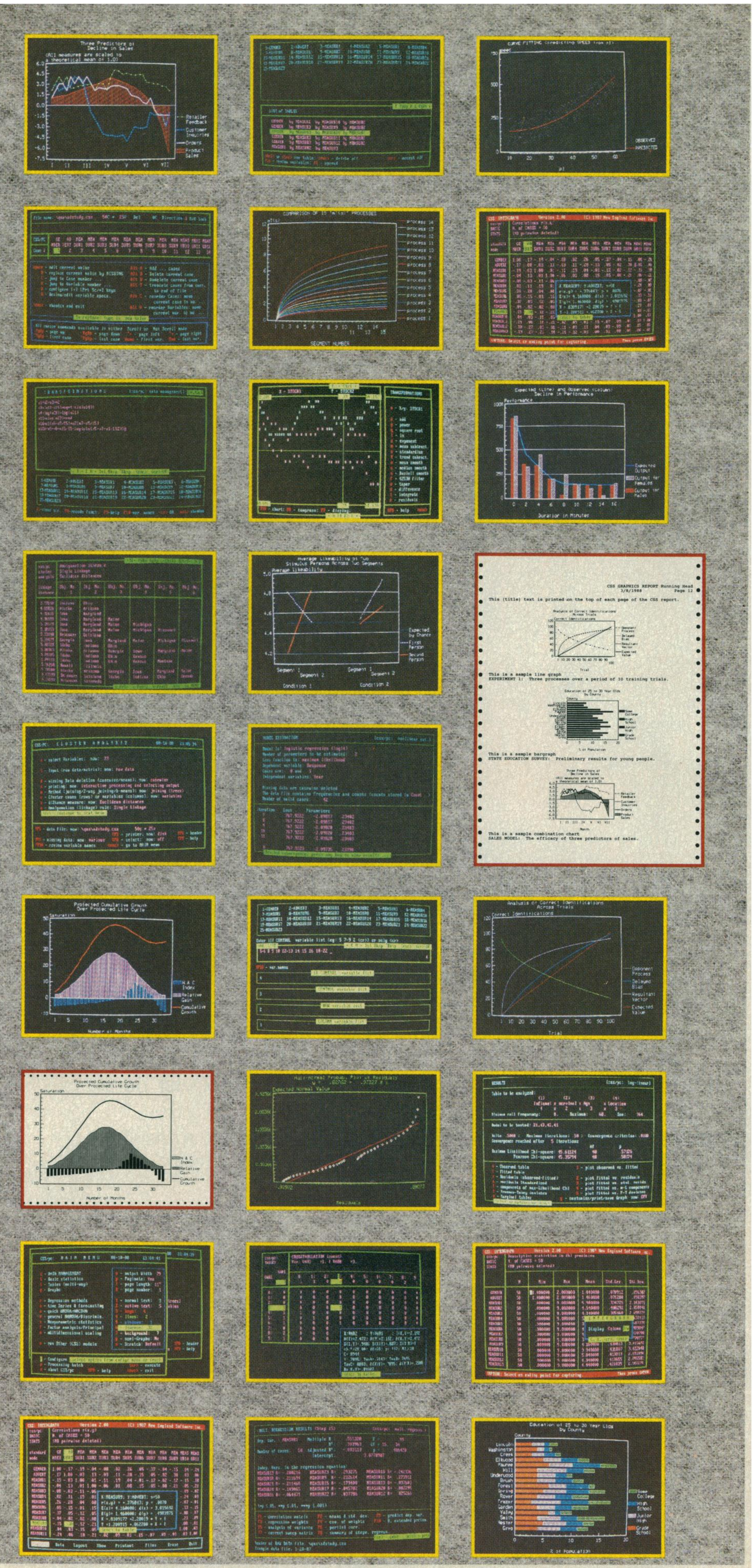

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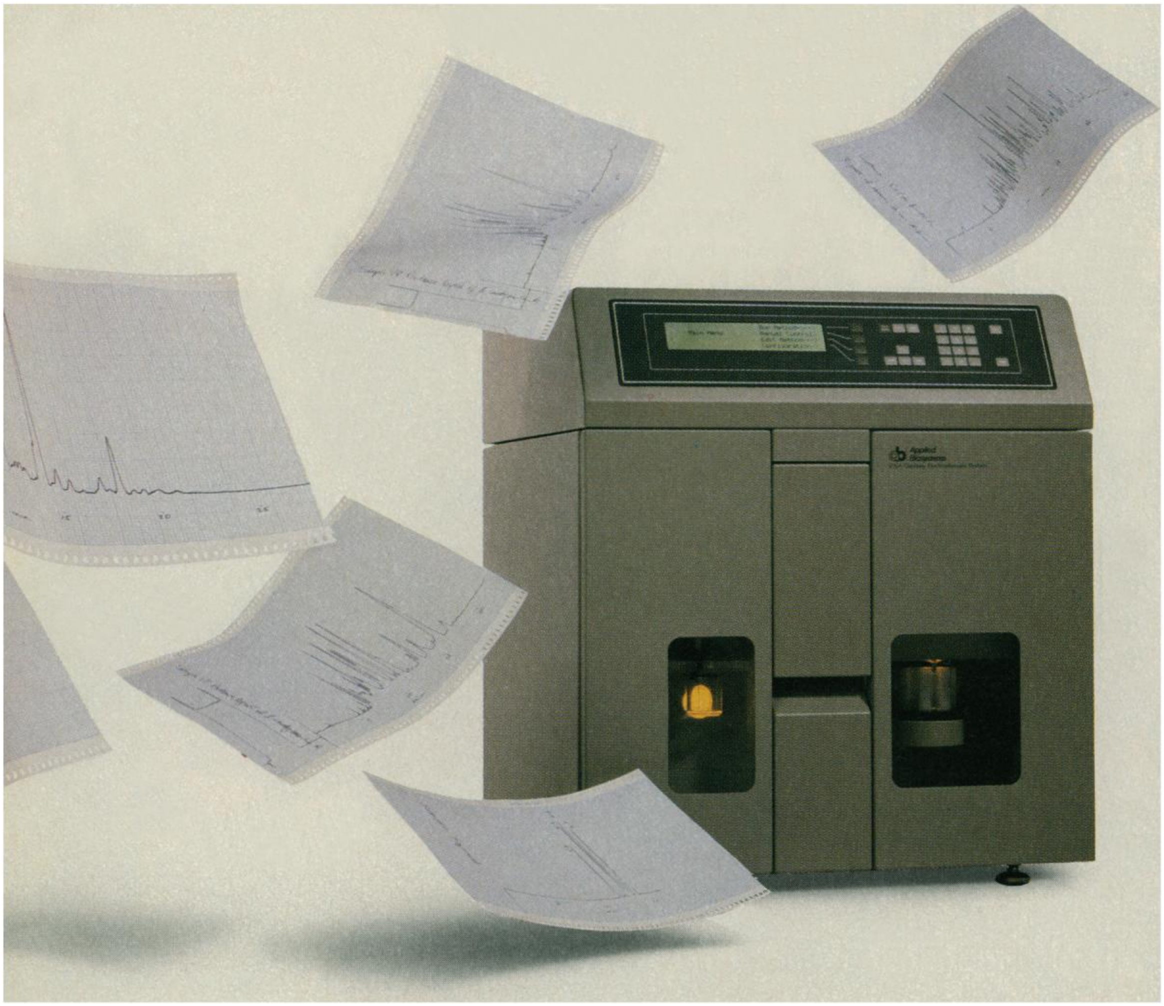

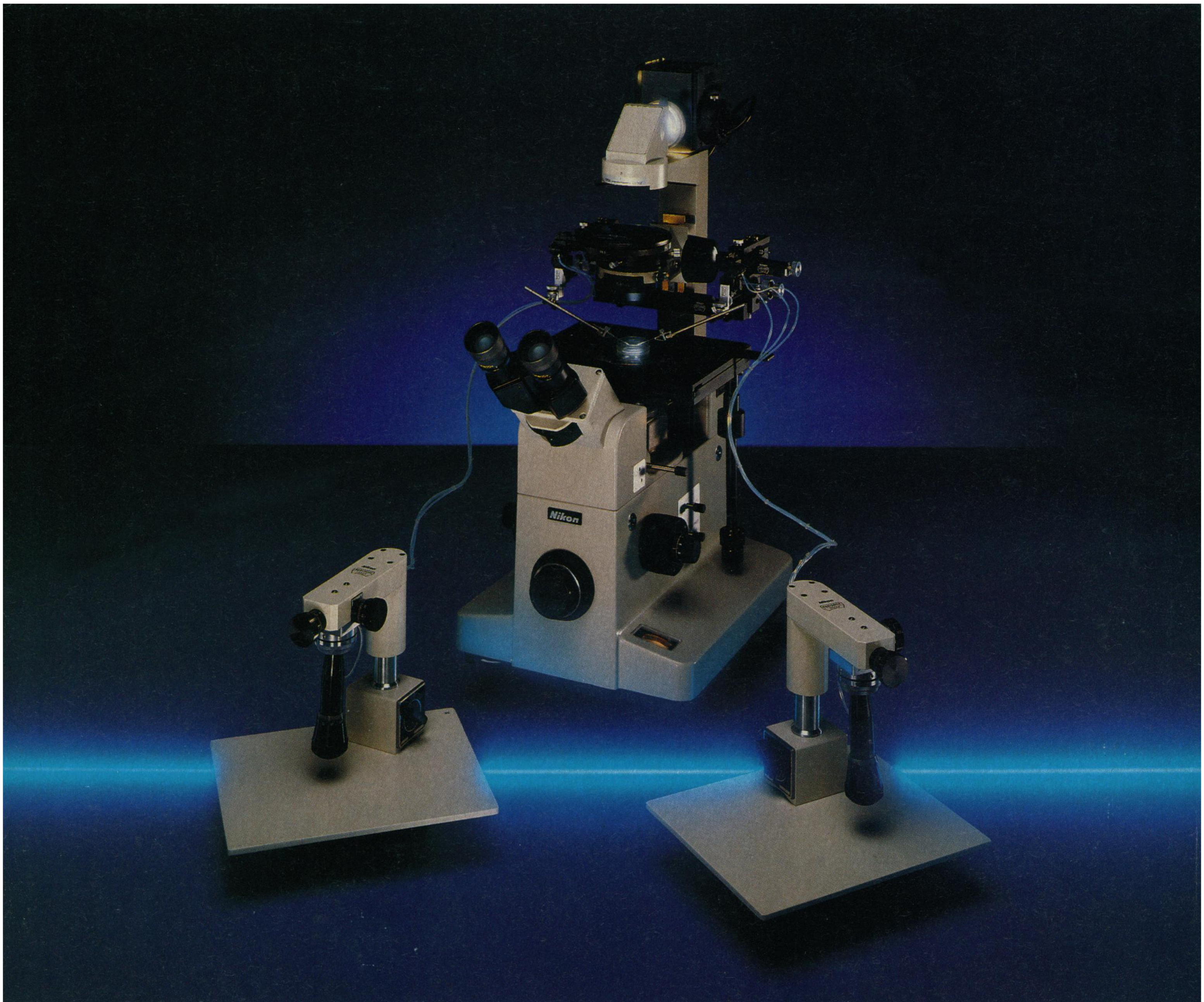

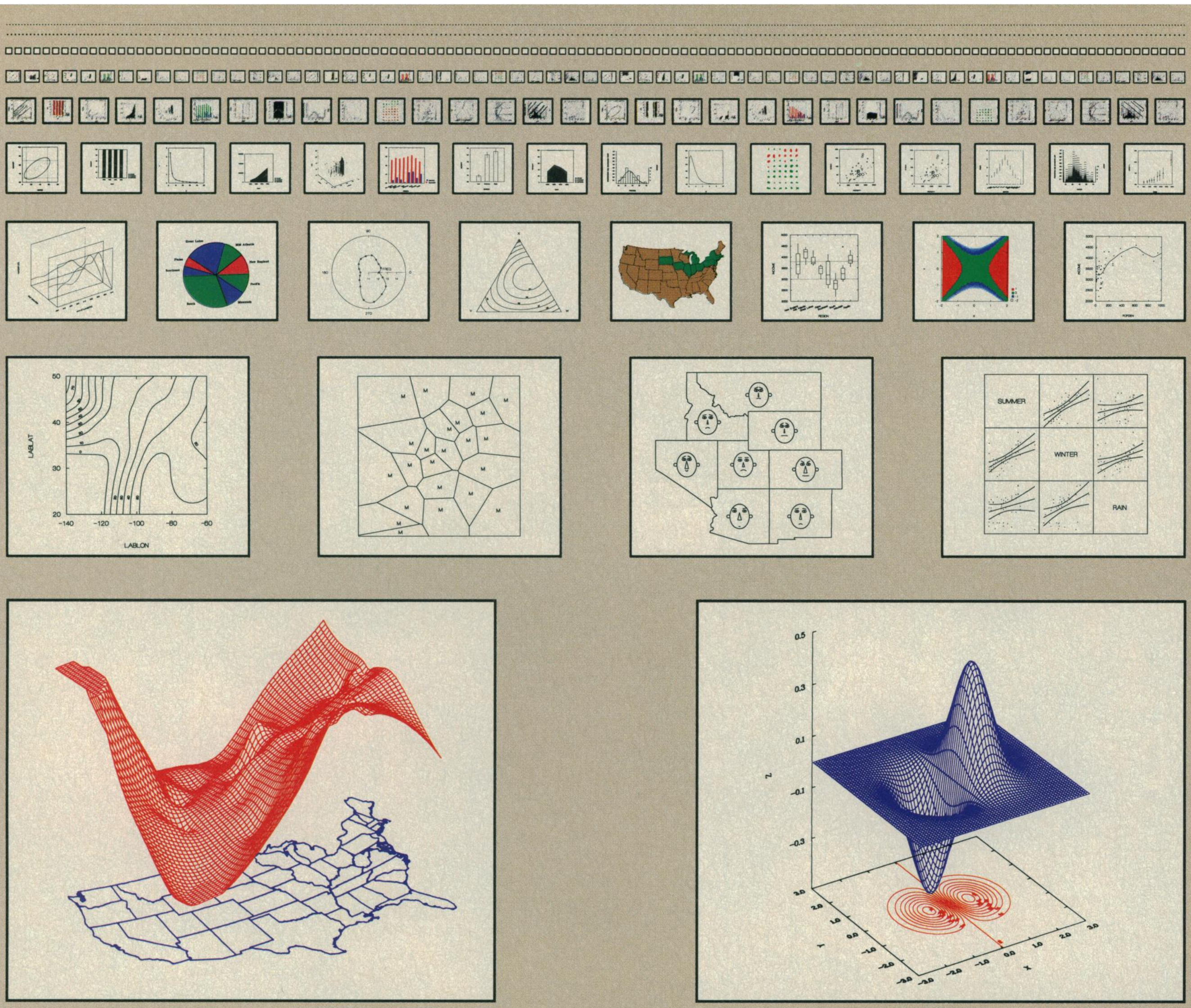
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