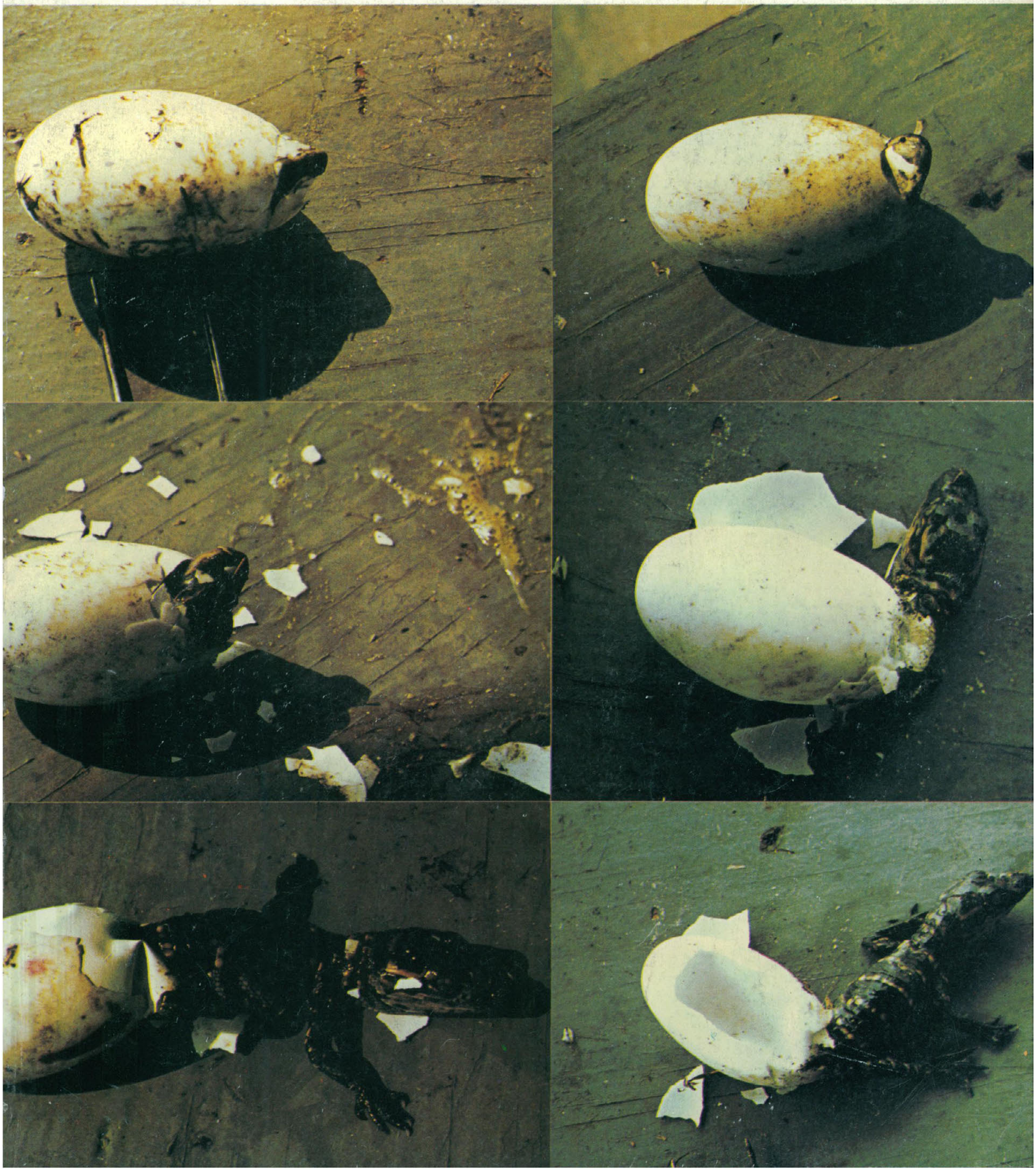
4 December 1981 • Vol. 214 • No. 4525 $2.00

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



How do you make the best high-speed centrifuge better? Add microprocessor control and a new drive.

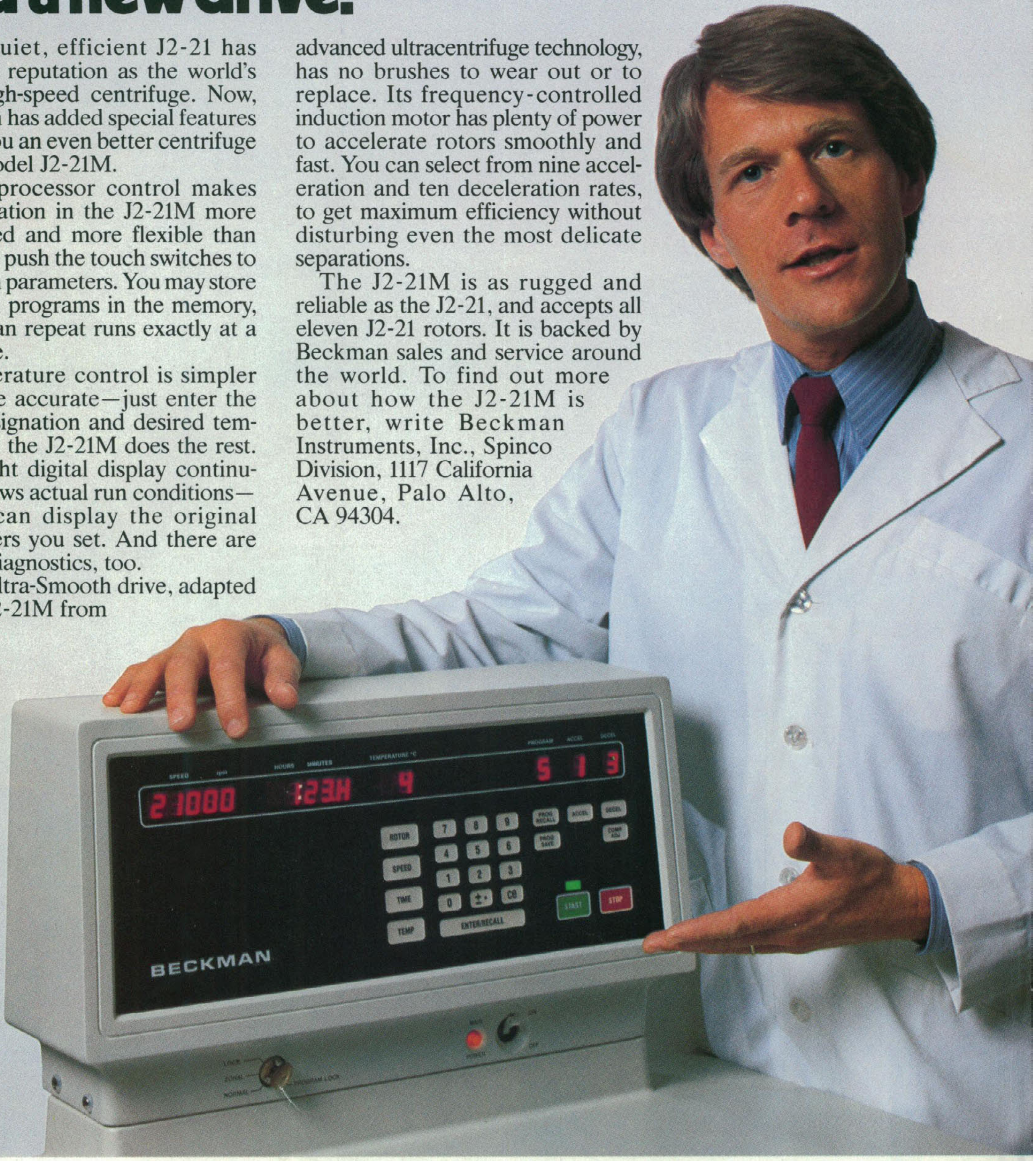
The quiet, efficient J2-21 has earned a reputation as the world's finest high-speed centrifuge. Now, Beckman has added special features to give you an even better centrifuge—the Model J2-21M.

Microprocessor control makes centrifugation in the J2-21M more automated and more flexible than ever. You push the touch switches to set up run parameters. You may store up to ten programs in the memory, so you can repeat runs exactly at a later time.

Temperature control is simpler and more accurate—just enter the rotor designation and desired temperature: the J2-21M does the rest. The bright digital display continuously shows actual run conditions—or you can display the original parameters you set. And there are built-in diagnostics, too.

The Ultra-Smooth drive, adapted for the J2-21M from advanced ultracentrifuge technology, has no brushes to wear out or to replace. Its frequency-controlled induction motor has plenty of power to accelerate rotors smoothly and fast. You can select from nine acceleration and ten deceleration rates, to get maximum efficiency without disturbing even the most delicate separations.

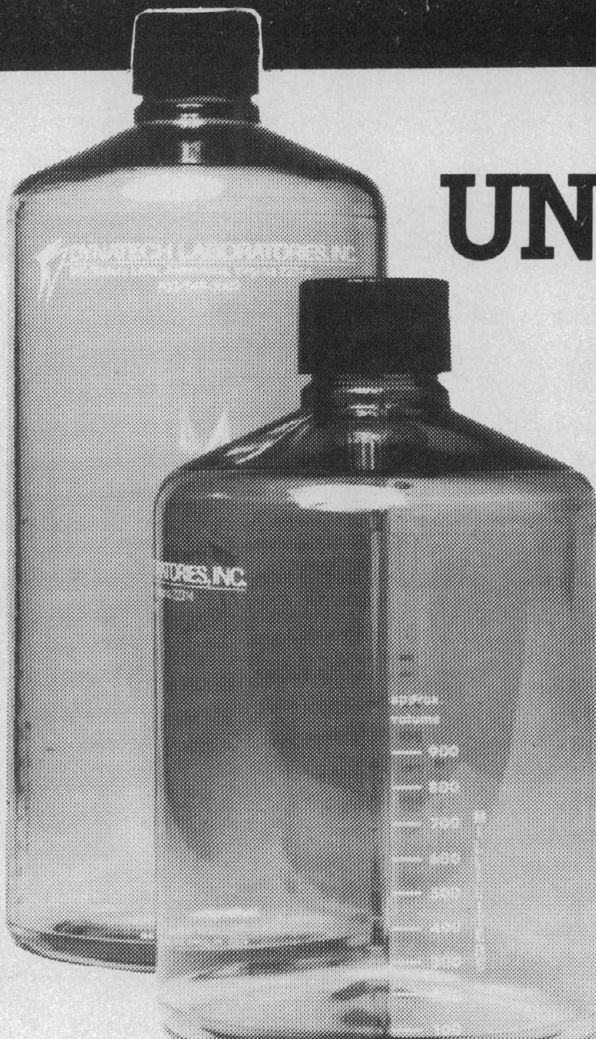
The J2-21M is as rugged and reliable as the J2-21, and accepts all eleven J2-21 rotors. It is backed by Beckman sales and service around the world. To find out more about how the J2-21M is better, write Beckman Instruments, Inc., Spinco Division, 1117 California Avenue, Palo Alto, CA 94304.



BECKMAN

Circle No. 348 on Readers' Service Card

BREAKTHROUGH



UNBREAKABLE RE-USABLE PLASTIC ROLLER BOTTLES

Dynatech's new plastic Roller Bottles are autoclavable, unbreakable, re-usable, economical, long-lived and light-weight. Even after 20 washings and autoclavings, Dynatech's new Roller Bottles and silicone-lined screw caps show no signs of deterioration. So, with only 20 uses, you can save as much as $1.50 per bottle in your lab.

If you use 100 disposables every 30 days, Dynatech's plastic re-usable Roller Bottles can save you $150 a month, or $1,800 a year! That's worth looking into.

You have a choice of two sizes: 750 cm² and 400 cm² of usable surface area. They are non-toxic, transparent with good optics, lighter in weight than glass and easier to handle. Each bottle is individually protected in a plastic bag, packed six to a box. And, you can get them only from Dynatech. Order yours now . . . and start saving big money in your lab.

DYNATECH LABORATORIES, INC.

Dynatech is the World's Only Manufacturer of Microtiter® Products.
900 Slaters Lane, Alexandria, Virginia 22314 Dept. MB
Call (800)336-4543 In Virginia, call (703)548-3889

Circle No. 42 on Readers' Service Card

ISSN 0036-8075
4 December 1981
Volume 214, No. 4525

SCIENCE

SCIENCE is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. Second-class postage (publication No. 484460) paid at Washington, D.C., and at an additional entry. Now combined with **The Science Monthly**® Copyright © 1981 by the American Association for the Advancement of Science. Domestic individual membership and subscription (51 issues): $43. Domestic institutional subscription (51 issues): $80. Foreign postage extra: Canada $24, other (surface mail) $27, air-surface via Amsterdam $55. First class, airmail, school-year, and student rates on request. Single copies $2 ($2.50 by mail); back issues $3 ($3.50 by mail); classroom rates on request. **Change of address:** allow 6 weeks, giving old and new addresses and seven-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* and in several specialized indexes.

COVER

Hatching of *Alligator mississippiensis*. Prior to and during hatching the eggshell becomes extensively cracked and peels away from the underlying eggshell membrane. The weakening and cleavage of the eggshell greatly facilitate hatching, as the alligator has only to slit the eggshell membrane with the egg caruncle at the tip of it snout and then to emerge from the egg, head first. Eggs incubated without nesting media never hatch due to an abnormally tough shell. Length of the egg is 70 millimeters; length of the embryo is 230 millimeters. Hatching time (from the first to last photograph) is 1.2 minutes. See page 1135. [Mark W. J. Ferguson, Queen's University of Belfast, Northern Ireland]

THE LEADING EDGE

#1 in a series of reports on new technology from Xerox

About a year ago, Xerox introduced the Ethernet network—a pioneering new development that makes it possible to link different office machines into a single network that's reliable, flexible and easily expandable.

The following are some notes explaining the technological underpinnings of this development. They are contributed by Xerox research scientist David Boggs.

The Ethernet system was designed to meet several rather ambitious objectives.

First, it had to allow many users within a given organization to access the same data. Next, it had to allow the organization the economies that come from resource sharing; that is, if several people could share the same information processing equipment, it would cut down on the amount and expense of hardware needed. In addition, the resulting network had to be flexible; users had to be able to change components easily so the network could grow smoothly as new capability was needed. Finally, it had to have maximum reliability—a system based on the notion of shared information would look pretty silly if users couldn't get at the information because the network was broken.

Collision Detection

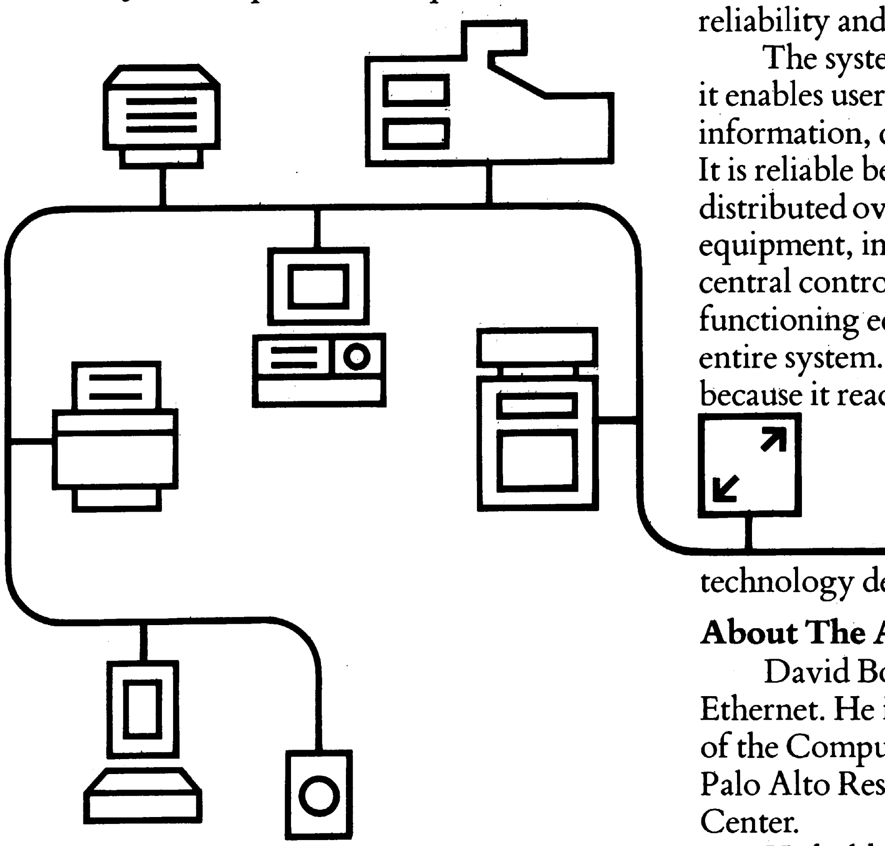
The Ethernet network uses a coaxial cable to connect various pieces of information equipment. Information travels over the cable in packets which are sent from one machine to another.

A key problem in any system of this type is how to control access to the cable: what are the rules determining when a piece of equipment can talk? Ethernet's method resembles the unwritten rules used by people at a party to decide who gets to tell the next story.

While someone is speaking, everyone else waits. When the current speaker stops, those who want to say something pause, and then launch into their speeches. If they *collide* with each other (hear someone else talking, too), they all stop and wait to start up again. Eventually one pauses the shortest time and starts talking so soon that everyone else hears him and waits.

When a piece of equipment wants to use the Ethernet cable, it listens first to hear if any other station is talking. When it hears silence on the cable, the station starts talking, but it also listens. If it hears other stations sending too, it stops, as do the other stations. Then it waits a random amount of time, on the order of microseconds, and tries again. The more times a station collides, the longer, on the average, it waits before trying again.

In the technical literature, this technique is called carrier-sense multiple-access with collision detection. It is a modification of a method developed by researchers at the University of Hawaii and further refined by my colleague Dr. Robert Metcalfe. As long as the interval during which stations elbow each other for control of the cable is short relative to the interval during which the winner uses the cable, it is very efficient. Just as important, it requires no central



control—there is no distinguished station to break or become overloaded.

The System

With the foregoing problems solved, Ethernet was ready for introduction. It consists of a few relatively simple components:

Ether. This is the cable referred to earlier. Since it consists of just copper and plastic, its reliability is high and its cost is low.

Transceivers. These are small boxes that insert and extract bits of information as they pass by on the cable.

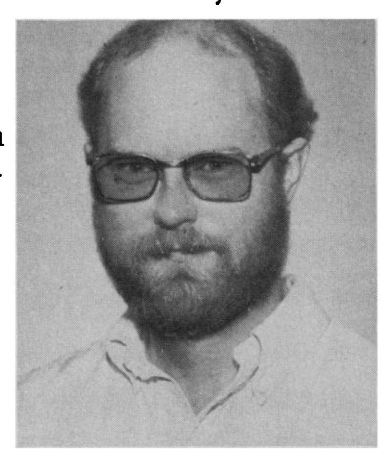
Controllers. These are large scale integrated circuit chips which enable all sorts of equipment, from communicating typewriters to mainframe computers, regardless of the manufacturer, to connect to the Ethernet.

The resulting system is not only fast (transmitting millions of bits of information per second), it's essentially modular in design. It's largely because of this modularity that Ethernet succeeds in meeting its objectives of economy, reliability and expandability.

The system is economical simply because it enables users to share both equipment and information, cutting down on hardware costs. It is reliable because control of the system is distributed over many pieces of communicating equipment, instead of being vested in a single central controller where a single piece of malfunctioning equipment can immobilize an entire system. And Ethernet is expandable because it readily accepts new pieces of information processing equipment. This enables an organization to plug in new machines gradually, as its needs dictate, or as technology develops new and better ones.

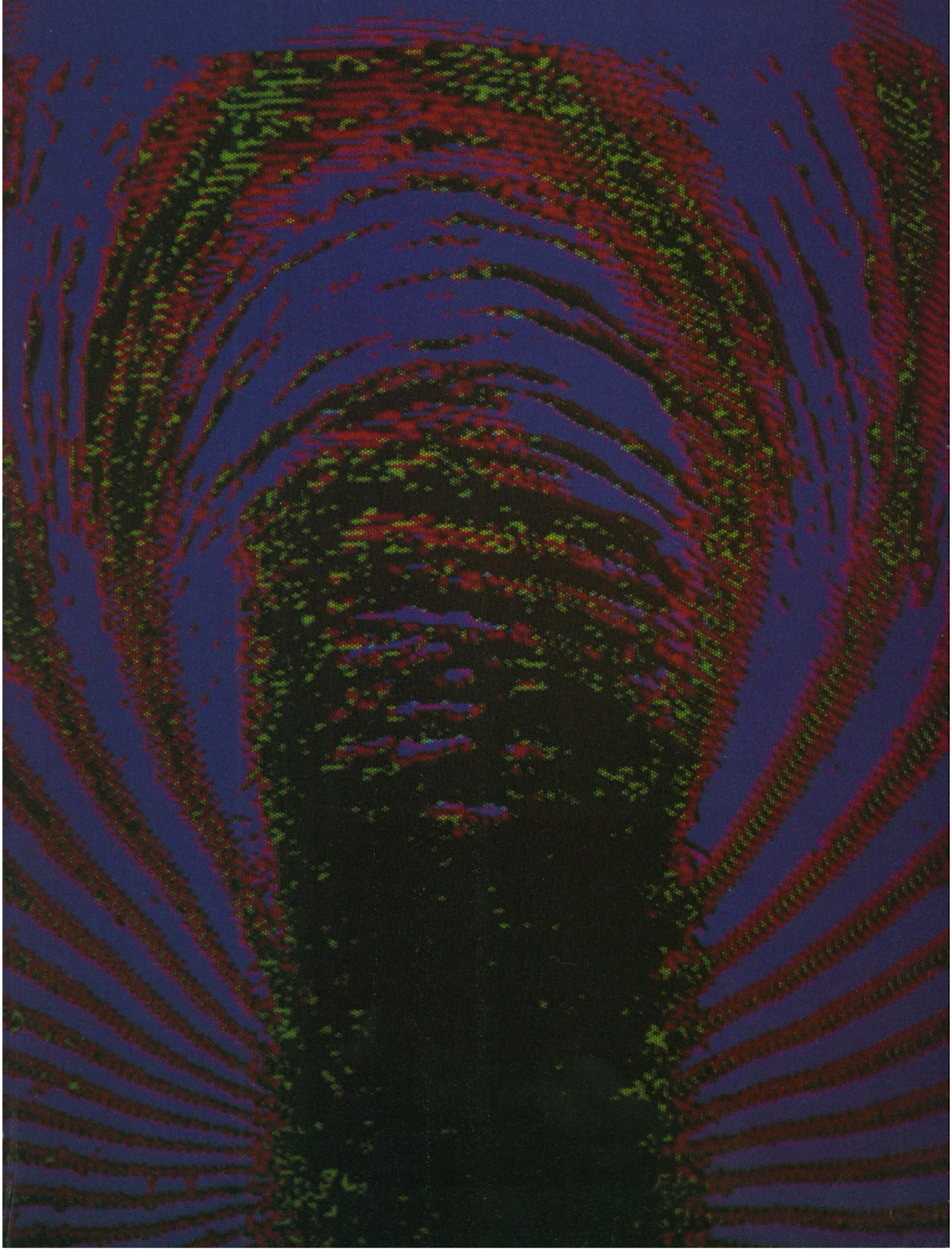
About The Author

David Boggs is one of the inventors of Ethernet. He is a member of the research staff of the Computer Science Laboratory at Xerox's Palo Alto Research Center.



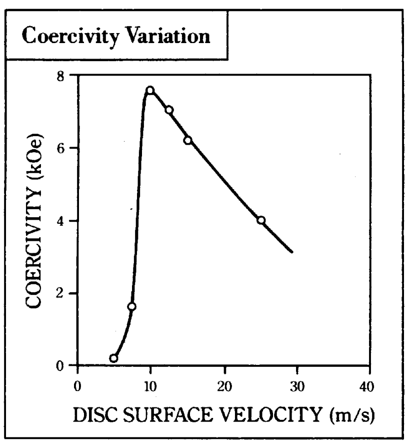
He holds a Bachelor's degree in Electrical Engineering from Princeton University and a Master's degree from Stanford University, where he is currently pursuing a Ph.D.

The Critical Interval



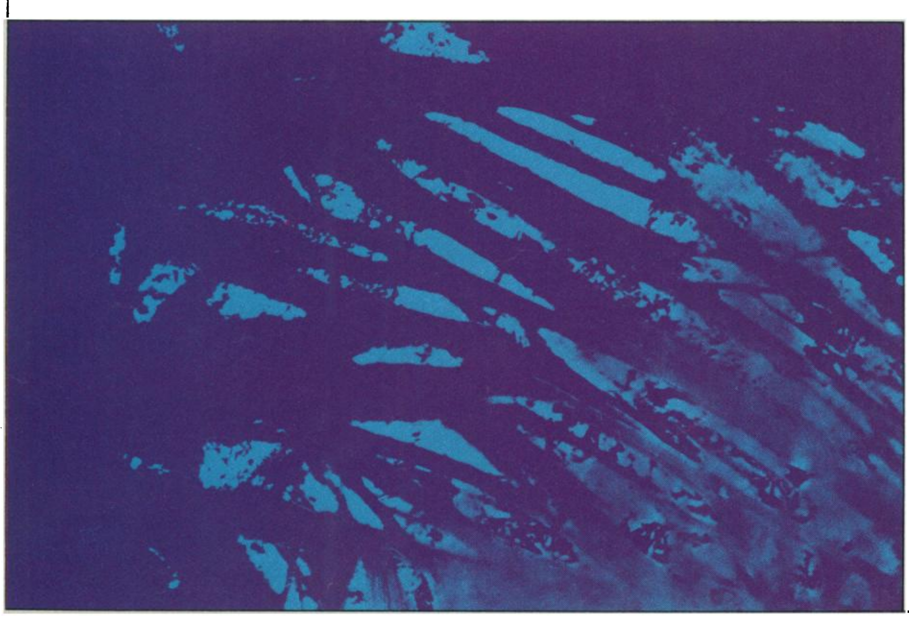
The Critical Interval

There has long been a need in the industrial world for low-cost, high-performance permanent magnets. Recent discoveries at the General Motors Research Laboratories show promise of meeting this challenge by the application of new preparation techniques to new materials.



Coercivity of $Pr_{0.4}Fe_{0.6}$ plotted as a function of disc surface velocity.

Color-enhanced transmission electron micrograph of melt-spun $Nd_{0.4}Fe_{0.6}$ having 7.5 kOe coercivity.



TWO properties characterize desirable permanent magnets: large coercivity (magnetic hardness or resistance to demagnetization) and high remanence (magnetic strength). Higher-performance magnets are required to reduce further the size and weight of a wide variety of electrical devices, including d.c. motors. Such magnets are available, but the cost of the materials necessary to produce them severely limits their use. The research challenge is to select, synthesize, and magnetically harden economically attractive materials of comparable quality.

Prominent among alternative materials candidates are alloys composed of iron and the abundant light rare earths (lanthanum, cerium, praseodymium, neodymium). Investigations conducted by Drs. John Croat and Jan Herbst at the General Motors Research Laboratories have led to the discovery of a method for magnetically hardening these alloys. By means of a rapid-quench technique, the researchers have achieved coercivities in Pr-Fe and Nd-Fe that are the largest ever reported for any rare earth-iron material.

Drs. Croat and Herbst selected praseodymium-iron and neodymium-iron based upon fundamental considerations which indicate that these alloys would exhibit properties conducive to permanent magnet development. These properties include ferromagnetic alignment of the rare earth and iron magnetic moments, which would foster high remanence, and significant magnetic anisotropy, a crucial prerequisite for large coercivity.

That these materials do not form suitable crystalline compounds, an essential requirement for magnetic hardening by traditional methods, presents a major obstacle. Drs. Croat and Herbst hypothesized that a metastable phase having the necessary properties could be formed by cooling a molten alloy at a sufficiently rapid rate. They tested this idea by means of the melt-spinning technique, in which a molten alloy is directed onto a cold, rotating disc. The cooling rate, which can be varied by changing the surface velocity of the disc, can easily approach 100,000°C per second. The alloy emerges in the form of a ribbon.

THE researchers found that variations of the cooling rate can dramatically affect the magnetic properties of the solidified alloys. In particular, appreciable coercivity is achieved within a narrow interval of quench rate.

Equally remarkable, synthesis and magnetic hardening, two steps in conventional processing, can be achieved simultaneously.

"X-ray analysis and electron microscopy of the high coercivity alloys reveal an unexpected mixed microstructure," states Dr. Croat. "We observe elongated amorphous regions interspersed with a crystalline rare earth-iron compound."

Understanding the relationship between the coercivity and the microstructure is essential. The two scientists are now studying the extent to which the coercivity is controlled by the shape and composition of the amorphous and crystalline structures.

"The development of significant coercivity is an important and encouraging step," says Dr. Herbst, "but practical application of these materials requires improvement of the remanence. Greater knowledge of the physics governing both properties is the key to meeting the commercial need for permanent magnets."

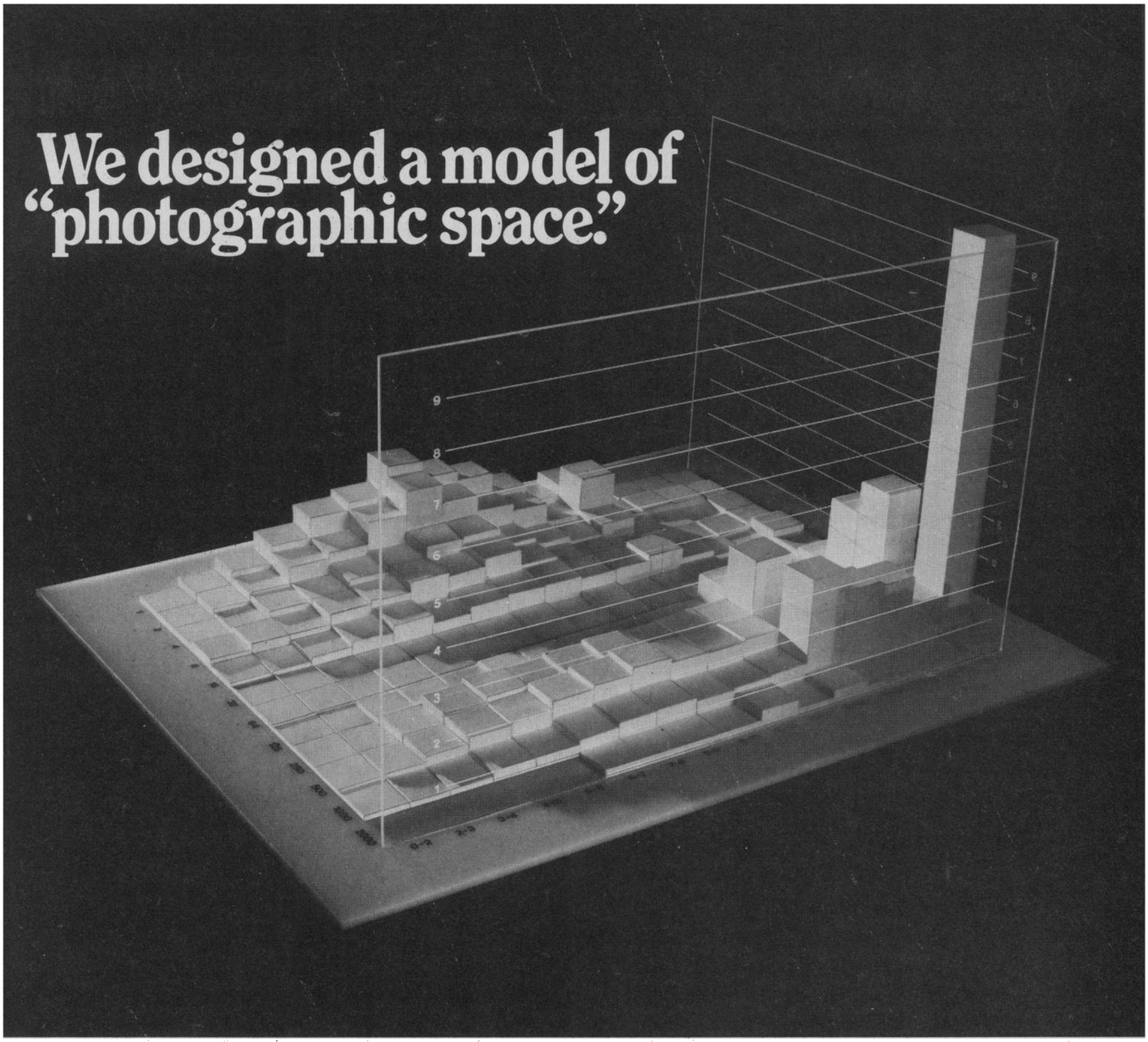
THE MEN BEHIND THE WORK

Drs. Croat and Herbst are Staff Research Scientists in the Physics Department at the General Motors Research Laboratories.

Dr. Croat (right) received his Ph.D. in metallurgy from Iowa State University. His research interests include the magnetic, magneto-elastic and catalytic properties of pure rare earth metals and their alloys and compounds.

Dr. Herbst (left) received his Ph.D. in physics from Cornell University. In addition to the magnetism of rare earth materials, his research interests include the theory of photo-emission and the physics of fluctuating valence compounds.

Dr. Croat joined General Motors in 1972; Dr. Herbst, in 1977.



Then built a model camera around it.

"Photographic space" is a concept Kodak engineers developed that tells more than just the lighting conditions and distances at which average people take pictures.

Its vertical third dimension graphically shows the *percentage* of times photographs are taken at any given light/distance range.

Plotting data gathered from an extensive sample, encompassing all kinds of amateur films (110, 126, 135, and instant), the study produced some surprising results. When graphed on three axes, our engineers were able to learn as much from the valleys and plateaus as from the high peaks.

They soon hypothesized that the lack of significant photographic activity in the ideal close-up range (2 to 4 feet) was more due to shortcomings in the cameras themselves than a lack of consumer interest.

If a simple camera could produce quality close-up images, both at outdoor and indoor (flash) light levels, it could provide substantial consumer benefits.

One result of our studies is now on sale. The Kodak Colorburst 350 instant camera is the culmination of years of computer design and market research. Not to mention product refinement.

This instant camera lets anyone buy more "photographic space" at the touch of a button. And at reasonable cost.

If you'd like to learn more about "photographic space," a report by Terry Faulkner and Tom Rice is available by writing Eastman Kodak Company, Dept. PS, 343 State Street, Rochester, N.Y. 14650.

Kodak

Zeiss is bright(er)

The great name in optics

ZEISS

West Germany

Circle No. 285 on Readers' Service Card

Zeiss fluorescence microscopes show you more

One thing leads to another for a brighter fluorescent image:
(1) Light sources—from 100W Halogen to high pressure Xenon;
(2) Collectors—perfectly matched to light sources for optimal excitation intensity;
(3) Matched filters and dichroic reflector—for the full spectral range of all known fluorochromes;
(4) Objectives—Plan-Neofluars with high numerical apertures and maximum transmission.

Zeiss has thought of everything

New techniques are constantly evolving—and, as they evolve, Zeiss is ready for them. For proof, check the number of references in the literatures from 1948 to the present. You'll find the names "Zeiss," "Standard," "Photomicroscope," and "Universal" at the forefront. You can be confident that your Zeiss Fluorescence Microscope will never be obsolete or outmoded.

Quality service—Expert dealers

Carl Zeiss, Inc., 444 5th Avenue, New York, N.Y. 10018 (212) 730-4400. Branches: Atlanta, Boston, Chicago, Houston, Los Angeles, San Francisco, Washington, D.C. In Canada: 45 Valleybrook Drive, Don Mills, Ontario, M3B 2S6. Or call (416) 449-4660.

The elements of brightness

A. **6 illuminators**—100W halogen, 50W Hg, 75W Xe, 100W Hg, 150W Xe, 200W Hg—with matching collectors. For intense light.

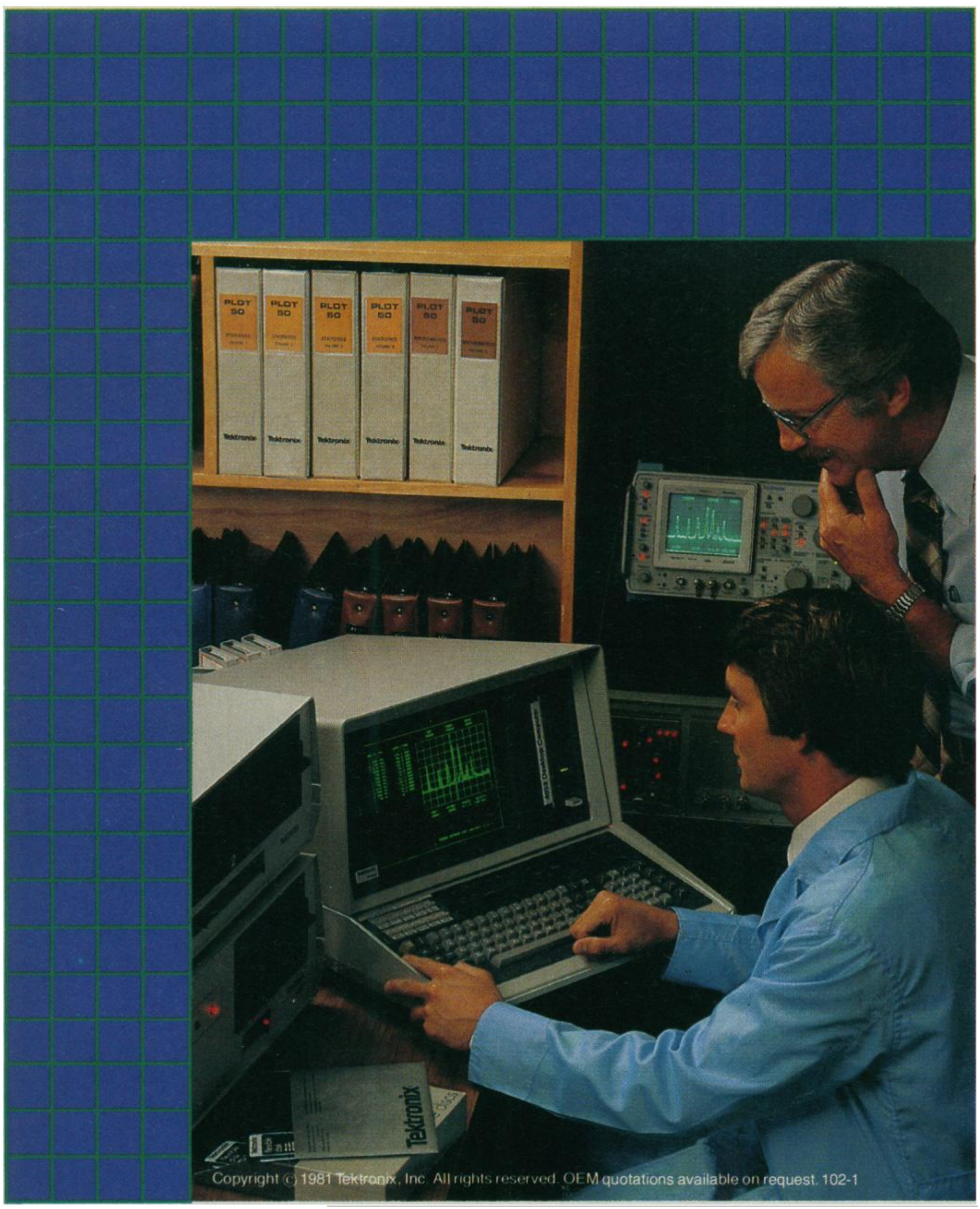
B. **Dichroic reflector and filter combinations** matched for specific fluorochromes. For maximum excitation and transmission.

C. **Unique Multiple-immersion Plan Neofluars**—use with water, glycerine and oil, with and without coverglass. For brilliant images.

D. **A full line of objectives**—Plan Neofluars, Planapochromats, Planachromats, Neofluars, Achromats—from the Great Name in Optics.

TEK 4052 DESKTOP COMPUTER — THE GRAPHICS STANDARD

Solve, plot and label a 20-pair linear regression in the time it takes to log-on to a host!



Tackle big problems with power and speed not previously available in a desktop computer. With convenience and economy impossible with timesharing.

Take a problem in simple linear regression: In less time than it takes to dial a computer and log-on, the 4052 can fit 20 pairs of data to an equation and plot the answers, numerically and graphically, complete with residuals.

Using the optional FFT ROM Pack, it takes less than 4 seconds to transform 1024 real data points into complex spectra... with the same 14-digit accuracy found in all other 4052 computation. With fast display of text and graphics that complements the fast computation.

Choose our data communications option to reach into central data bases and extra computing power. Applications software, including excellent volumes for statistics and math, minimize development costs, while our copiers, plotters and file manager maximize your problem-solving power.

This is one compact computer that lets you keep thinking big! For literature call, toll-free, 1-800-547-6711 (in Oregon, 800-452-6773).

Tektronix, Inc.
Information Display Division
P.O. Box 4828
Portland, OR 97208

Tektronix Europe B.V.
European Marketing Centre
Post Box 827
1180 AV Amstelveen, The Netherlands.

Tektronix®
COMMITTED TO EXCELLENCE

Circle No. 345 on Readers' Service Card

U.N. Energy Conference: Substance and Politics

The U.N. Conference on New and Renewable Sources of Energy held in Nairobi this past August was, from a substantive point of view, perhaps the most successful of the recent series of U.N. conferences on global issues. Reports from the series of technical panels and crosscutting issues groups generally ranged from good to excellent. A synthesis report put the various recommendations into a single document. The earlier drafts of the Programme of Action had incorporated most of this accumulated wisdom, often in conflicting paragraphs supported by individual nations or by one of two major groupings of nations: the Group of 77, representing the less-developed countries and led by Venezuela, and the EC-10, or the European Community, led by the United Kingdom. Delegates spent most of their time balancing the various approaches represented by the alternative wording; the result was a solid document providing guidelines for research and projects on the following energy sources: hydropower, fuel wood and charcoal, biomass, solar, geothermal, wind, oil shale and tar sands, ocean, draft animal power, and peat. The delegates' attention to detail at the microlevel meant that they were quite responsive to the recommendations by representatives of nongovernmental organizations for further clauses relating energy to environment, fuel wood, or the special needs and roles of women.

By many in the U.N. Secretariat, however, the conference was not considered a success. Previous global conferences have set up implementing institutions or funds for carrying out recommendations of the conference. This conference did neither. The United States stood firm, and virtually alone, against committing any new moneys to a multilateral fund, preferring bilateral aid and private investment. The debate on whether to set up a new institution was more diffuse; many delegates questioned any energy unit that would not include fossil fuels and nuclear power. The Programme of Action essentially ducked these difficult political issues by creating an interim intergovernmental committee to debate the issues further and report to the U.N. General Assembly in 1982.

Such a deferment of the politics of the conference to the General Assembly may indeed set a new model for the conferences on global issues by recognizing the limits of the special meetings. Most previous conferences have submerged the substantive issues under layers of rhetoric inapplicable to the topic at hand and inappropriate for the powers of the conference itself.

Perhaps the accommodating spirit of the energy conference was due to a new realism in the world community, one that accepts resource limitation, both material and monetary. Credit must also go to Enrique Iglesias, secretary-general of the conference, who encouraged the widest possible substantive debates both within the conference itself and at the parallel Non-Governmental Organization Forum. Many issues reflected basic development strategies and will require further research and evaluations. For example, if priority is given to making the traditional sectors self-sufficient, does that condemn these sections of a country to remain permanent "energy ghettos"? Are improved woodstoves not a way of ingraining second-class existence for the poorest? What is the long-term sustainable mix of energy sources that will allow for the development of modern industry and transportation networks yet still provide a modicum of improved quality of life for the poor?

The seriousness with which such issues were debated is a credit to the international community. The international donor community and national governments should respond to this energy Programme of Action with the funds and technical assistance with which to carry it out.—IRENE TINKER, *Director, Equity Policy Center, 1302 Eighteenth Street, NW, Washington, D.C. 20036*