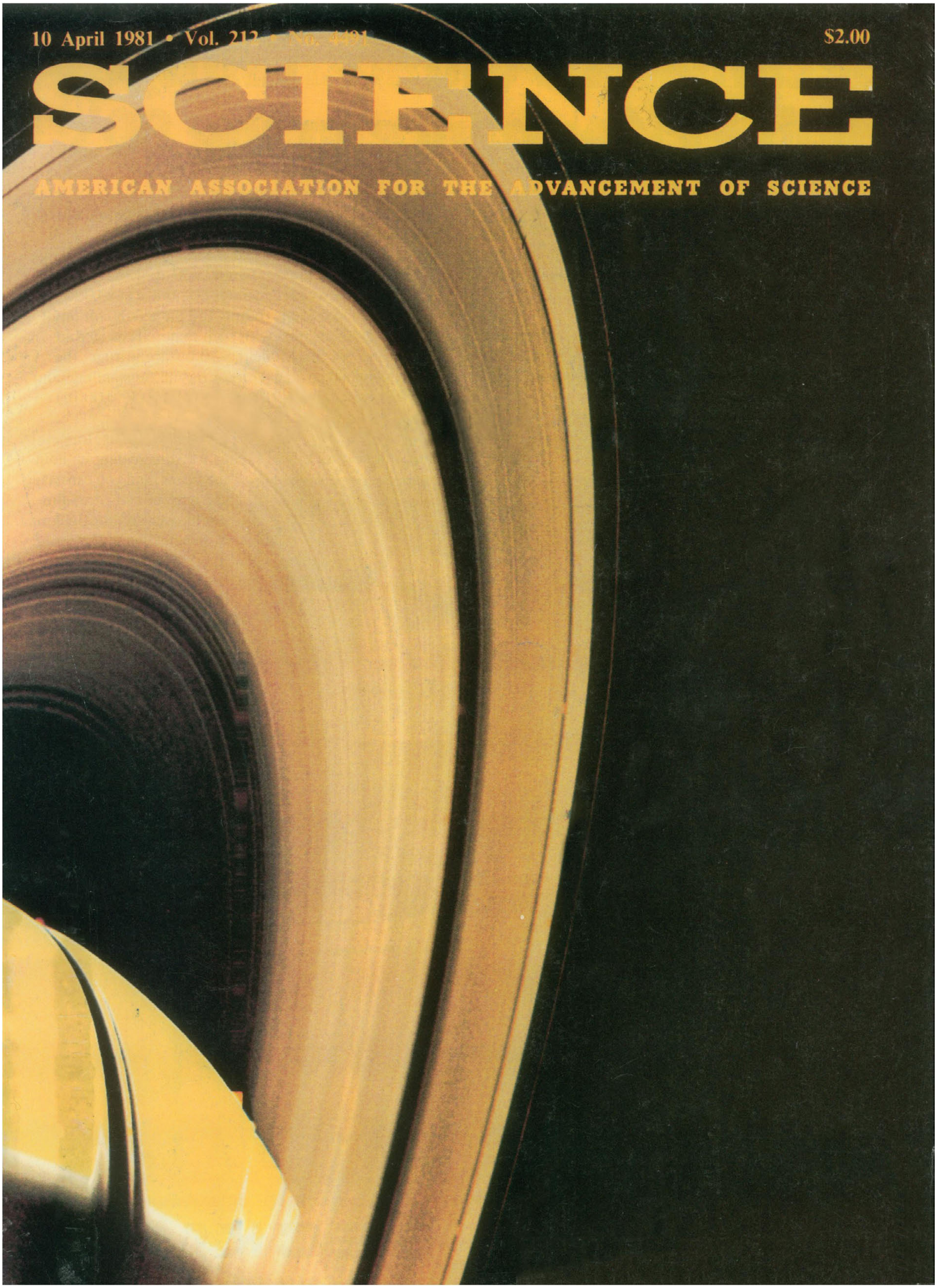
10 April 1981 • Vol. 212 • No. 4491 $2.00

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Beckman L8 Ultracentrifuges–High Performance in the 80's

From every aspect of performance, the L8 ultracentrifuges are unsurpassed. Whether you choose the 80,000-rpm Model L8-80, or the 70,000 or 55,000-rpm models, you get the most advanced drive system, programming capability, over 40 rotors to choose from, and a host of built-in features which assure you top performance in the years ahead.

The drive system is Ultra-8™—a frequency-controlled induction motor that drives the rotor directly from *inside* the vacuum system. We warrant the complete drive for 16 billion revolutions.

Programmability comes from microprocessor control using the Memory-Pac™ module. You insert a Memory-Pac in the L8 control panel, and seconds later it is programmed with whatever rotor speed, temperature, etc., you wish. You're assured of error-free duplicate runs with no time spent in set-ups.

L8 features include a Dry Cycle to remove moisture from the chamber, an ω^2t Integrator for accurately reproducing runs in sucrose gradients, and internal diagnostic systems for simple servicing.

For high performance rotors, no one comes close to Beckman. There are two 80,000-rpm rotors: the 80 Ti fixed angle which generates 602,000 *g* at 80,000-rpm—highest force of any rotor—and the VTi-80 for rapid density gradient runs with such materials as steroid receptors. For the Model L8-70 ultracentrifuge, the 70,000-rpm Type 70.1 Ti rotor has an outstanding combination of volume (163 mL) and force (450,000 *g*) for such separations as plasmid DNA.

Add a superb line of tubes and adapters, topped by the unique Quick-Seal™ tubes for sure sealing without tube caps, and you can easily see why investigators the world over choose Beckman ultracentrifuges. For more information, write Beckman Instruments, Inc., Spinco Division, 1117 California Ave., Palo Alto, CA 94304.

BECKMAN

Circle No. 94 on Readers' Service Card

ISSN 0036-8075

10 April 1981

Volume 212, No. 4491

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®** 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.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Computer-enhanced photo of Saturn (taken 13 November 1980 by Voyager 1) shows Saturn's rings and their shadows against the lighted crescent of the planet. The photo was taken from a distance of 1,570,000 kilometers beyond the planet. The bright, overexposed limb of Saturn is visible through the rings. Radial spokes in the B ring, which appeared dark in pictures taken when Voyager 1 was approaching Saturn, can be seen here as bright markings, suggesting that the spoke particles are a few microns in diameter. The thin F ring displays brightness variations that are caused by nonuniform distribution of material in that ring. See page

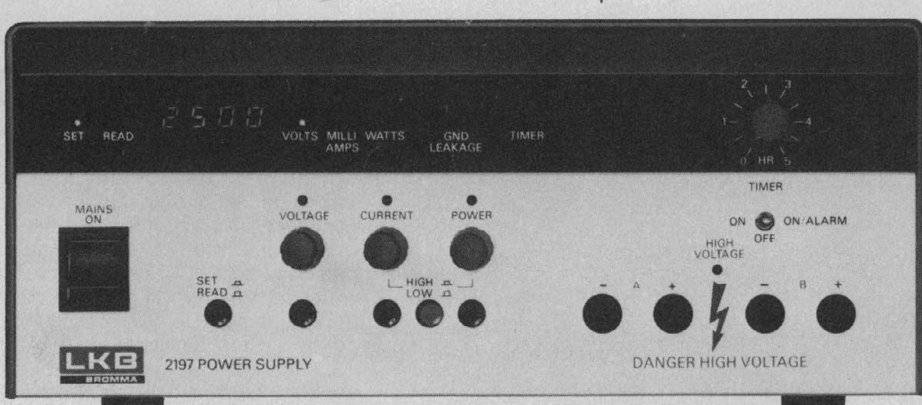
LKB ANNOUNCES MORE.

MORE CONVENIENCE

New pre-blended Ampholine® carrier ampholytes for electrofocusing are available in three narrow and one wide pH range. Now there's no need to spend time mixing to achieve these specific ranges. Just select the pre-blended Ampholine you need (pH 2.5 to 4.5, 4.0 to 6.5, 5.0 to 8.0 and 3.5 to 9.5). They're designed to give the same linear, virtually drift-free pH gradient achieved using standard Ampholine with LKB Agarose-EF or acrylamide gels.

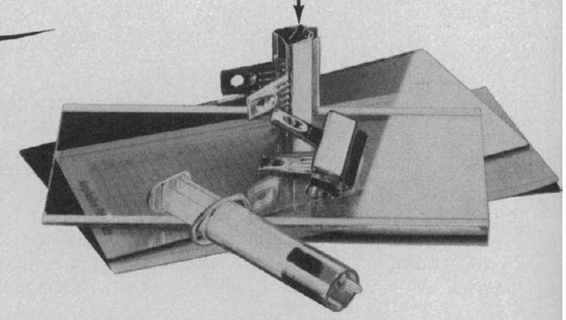
MORE POWER

The new Model 2197 Power Supply for electrofocusing and electrophoresis offers top-of-the-line features at a very affordable price. The Model 2197 delivers up to 2500V for high-resolution electrofocusing and its 250mA output makes it useful for other electrophoretic techniques. Choose constant power/constant voltage/constant current/time control modes to suit your application. Automatic crossover between running modes compensates for varying gel conditions. Built-in timer with alarm and automatic shutoff allows for time control. With accurate control of four parameters, you can achieve maximum resolution and reproducibility in all your electrofocusing and electrophoresis experiments. Bright LED display lets you monitor performance easily and the Model 2197 is designed to comply with all relevant safety standards.



MORE ECONOMY

LKB's new capillary gel casting system easily produces gels only one quarter the thickness of standard ones. You save substantially on reagent use and you'll be able to employ higher voltage for decreased run times because the new thinner gels dissipate heat more efficiently. The capillary gel casting kit works with agarose and acrylamide gels. Combine it with the new pre-blended Ampholine and the 2500 volt power supply to significantly reduce your run times while cutting costs. Ask your local LKB representative for more information on these new products and the complete line of LKB instruments and consumables. Depend on the leader in electrofocusing to give you more.



LKB

Head office:
LKB Produkter AB
Box 305
S-161 26 Bromma, Sweden
Tel. 08/98 00 40, telex 10492

Main US sales office:
LKB Instruments, Inc.
12221 Parklawn Drive
Rockville, Md 20852
Tel. 301-881 2510
telex 230 89 682

Other sales offices in:
Athens (for the Middle East), Copenhagen, Ghent, The Hague, Hong Kong, London, Munich, Paris, Rome, Turku, Vienna

Circle No. 5 on Readers' Service Card

International Study Center for Environmental Health Sciences

An Academic Review: Safety Assessment of Artificial Sweeteners

MAY 12 & 13, 1981 • WASHINGTON, D.C. • HOLIDAY INN – CAPITOL

The symposium will address the basic medical sciences involved in safety assessment and the practical aspects of risk assessment as regards saccharin, cyclamates and other artificial sweeteners. It is particularly timely in light of the June 30th expiration of the Congressional moratorium on banning saccharin.

To generate the indepth understanding the subject area merits, the International Study Center, a New York based non-profit organization of leading university scientists and physicians, is sponsoring the conference. The symposium will feature a panel of some 15 leading scientists and academic physicians who will air matters concerning the safety and risk assessment of artificial sweeteners... an academic review of these compounds.

SYMPOSIUM CO-CHAIRMEN

Benjamin L. Van Duuren, Sc.D. Professor of Environmental Medicine at New York University School of Medicine and Associate Director of the Institute of Environmental Medicine at the NYU Medical Center. An internationally known expert on chemical carcinogenesis and one of the originators of research on promoters and co-carcinogens. Dr. Van Duuren has published more than 300 scientific papers and is a frequent presentor at major scientific symposia in this country and Europe.

Bernard M. Wagner, M.D. Professor of Pathology at Columbia University College of Physicians and Surgeons and Director of Laboratories at Overlook Hospital. President-elect of the International Academy of Pathologists and Chairman of the Committee on Pathology of the American College of Toxicology. Dr. Wagner has published over 100 scientific papers and is an active participant in international medical symposia.

SYMPOSIUM DETAILS

The symposium will be held on Tuesday and Wednesday, May 12 and 13 at the Holiday Inn – Capitol, located across from the Smithsonian. Ticket prices are $500 each and include meeting materials and lunch on both days. Early registration is strongly advised.

A limited number of scholarship tickets are available for university faculty; government rates for federal and state officials. Hotel room reservations can be made by calling the Holiday Inn Capitol direct; toll free phone number is 800-424-9130.

For more information and copies of the symposium agenda and list of panelists, call or write the Study Center.

International Study Center for Environmental Health Sciences
503 Grasslands Road, Valhalla, New York 10595

^{32}P nucleotides you simply open and use

Our >600Ci/mmol dNTPs,[α - ^{32}P] - are now also available concentrated to ~10mCi/ml in an aqueous solution, ready to pipet directly into your reaction mixture. No need to remove or concentrate the packaging solution. No unnecessary handling.

What's more, we've extended their radiochemical stability significantly with 10mM Tricine, a buffer known to be compatible in research systems. Biological testing by nick translation verifies their biological activity and assures you of reliable performance.

NEG-012A dATP,[α - ^{32}P] - NEG-014A dGTP,[α - ^{32}P] -
NEG-013A dCTP,[α - ^{32}P] - NEG-005A dTTP,[α - ^{32}P] -
>600Ci/mmol, ~10mCi/ml, in 10mM aqueous Tricine buffer solution (pH 7.6), Combi-V-Vial

Produced weekly and shipped daily. Send for complete ordering information on these and our standard concentration dNTPs,[α - ^{32}P] - .

Not for use in humans or clinical diagnosis

NEN New England Nuclear
®

549 Albany Street, Boston, Massachusetts 02118
Call toll free: 800-225-1572
(In Massachusetts and International: 617-482-9595)

NEN Chemicals GmbH: D-6072 Dreieich, W. Germany, Postfach 401240, Tel. (06103) 85034, Telex 4-17993 NEN D
NEN Canada: 2453 46th Avenue, Lachine, Que. H8T 3C9, Tel. 514-636-4971, Telex 05-821808

Circle No. 172 on Readers' Service Card

NOW... TOP-LOADERS BECOME ANALYTICALS.

SARTORIUS COMBINES 0.1 mg READABILITY WITH COMPACT SIZE AND CONVENIENCE.

• Fully Electronic • Digital Readout • Instant Taring • No Weight Dialing • Portable

These microprocessor-equipped Sartorius Electronic Balances are as compact as top-loaders, yet as accurate as analyticals.

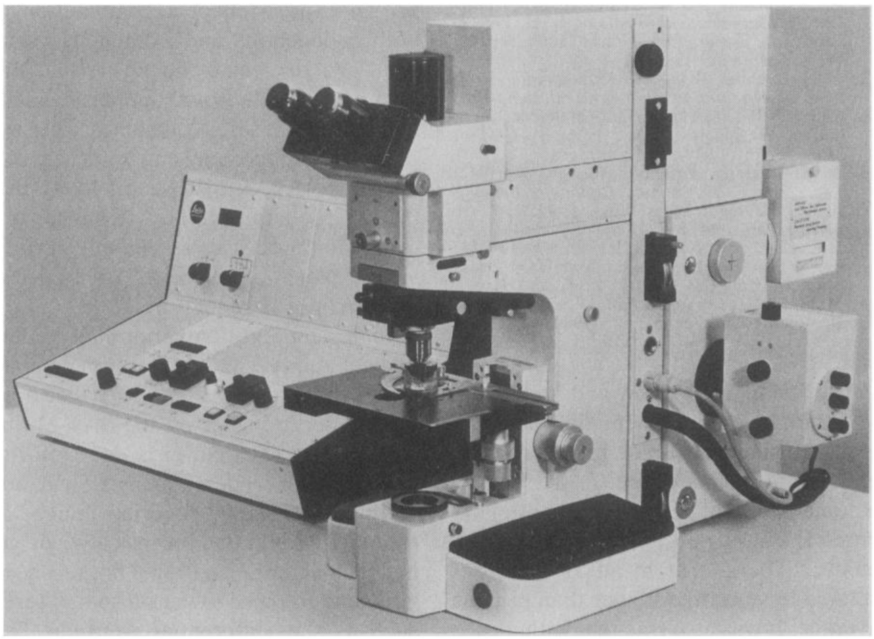
Model 1602MP (left) weighs 160g to 0.1mg; Model 1207MP (right) weighs 80g to 0.1mg. Operation is completely automatic; there are no weights to 'dial in' and no suspended 'swinging' pan. Far smaller and lighter than comparable analytical balances, these models may easily be moved to any weighing location as needed.

Sartorius . . . those remarkable yellow balances. For literature, write: Sartorius Division, Brinkmann Instruments, Inc., Subsidiary of Sybron Corp., Cantiague Road, Westbury, NY 11590, or call 516/334-7500.

For information circle No. 110 on Readers' Service Card
For a demonstration circle No. 111 on Readers' Service Card

sartorius

Leitz MPV-3 Microscope Photometer. Unlimited modularity for unlimited versatility.



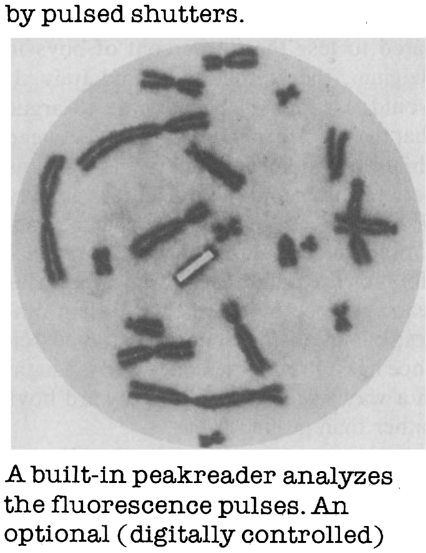
Leitz has been building Microscope Photometers for over half a century. This expertise, combined with our practical experience in user applications, has brought us to the third generation of Modular Photometer Systems, the MPV-3. Now the art of light measurement in the microscope image is so refined that photometric analysis on as small as ½ μm-size structures can be performed routinely.

The MPV-3 incorporates many new innovations and system components. And it is built around the Leitz Orthoplan® Research Microscope.

Unlimited modularity

There are rapidly interchangeable photometer heads that accommodate both emission spectral and X-Y mirror scanning. Of course, all static measurements such as absorption, autoradiography and fluorescence analysis are within the range of the basic MPV-3 abilities.

The MPV-3 lets you mask image details with a variable or fixed diaphragm projected in the observation tube. A motorized prism rotates to align masks and specimen structures. Everything seen can be photographed. The problem of fluorescence fading is eliminated by pulsed shutters.



A built-in peakreader analyzes the fluorescence pulses. An optional (digitally controlled) illumination monochromator, plus various range and speed scanning stages, and a large selection of illuminators and optics, round out the program.

The control console allows automatic measurement sequences and accepts add-on modules for electronic shutter control, CCTV, data printer, and monochromator and scanning stage controls. Interfaces, digital and analog outputs on the MPV-3 connect to data processing equipment.

Unlimited applications

The range of biomedical applications extends from integral absorption measurement on quantitatively stained cells to extinction pattern analysis of scanned structures. From automated silver grain counting in autoradiography to fast spectral analysis of fading fluorescence or histogramming of intensities of fluorescent detail.

Send in the coupon, we'll tell you more.

Leitz means precision. Worldwide.

E. Leitz,® Inc. S 410
Rockleigh, N.J. 07647

Please tell me more about the Leitz MPV-3 photometer.

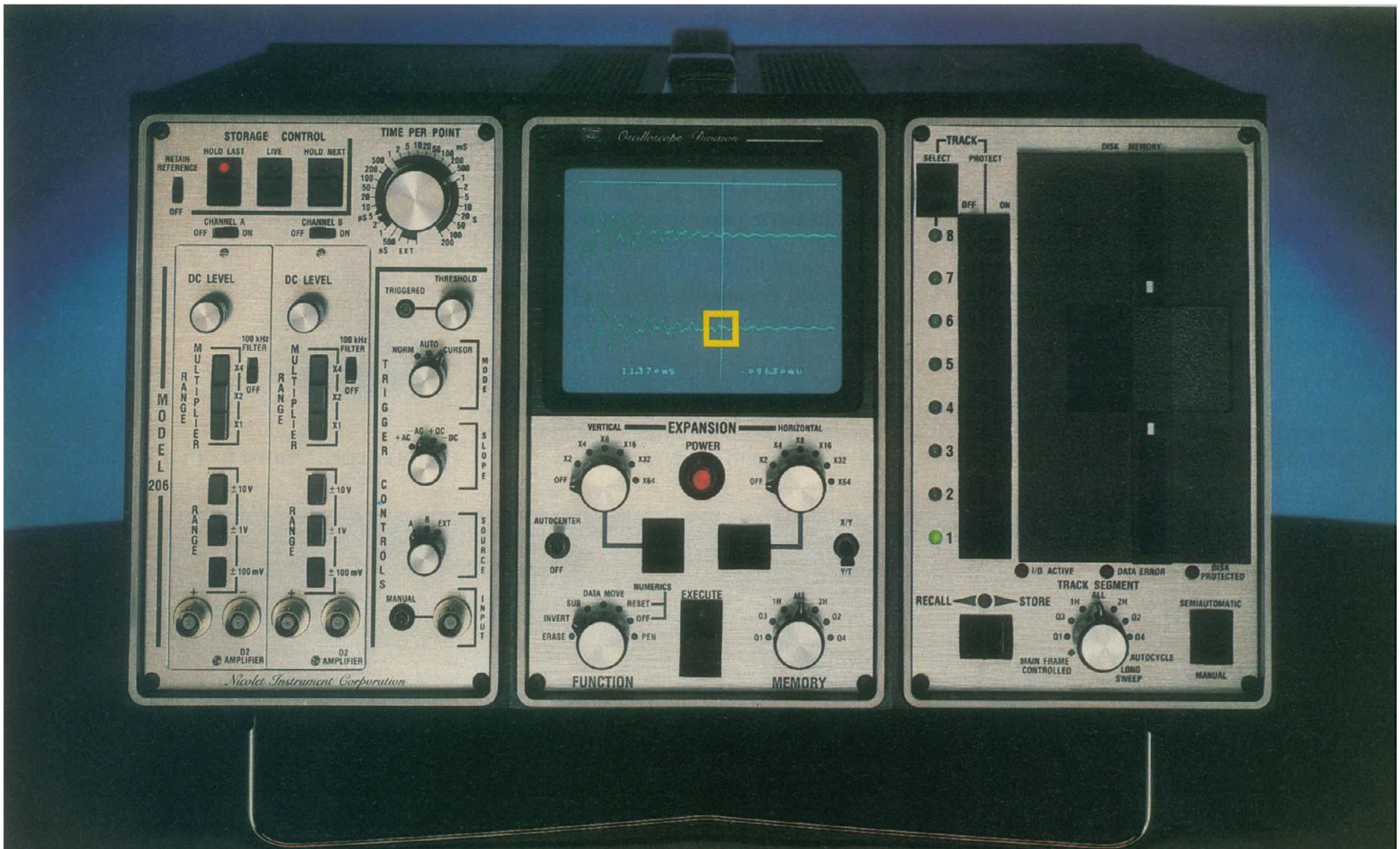
NAME ______

INSTITUTION ______

ADDRESS ______

CITY ______ STATE ______ ZIP ______

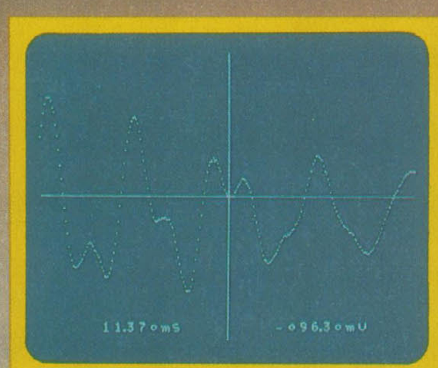
Circle No. 166 on Readers' Service Card



See things you've never seen before.

Nicolet digital oscilloscopes offer you resolution, precision, dynamic range and transient capture capabilities unobtainable on analog oscilloscopes. *They are simple to operate and yet extremely versatile.*

Signals can be viewed live, continuously compared to a reference waveform or stored for detailed examination. Continuous, normal and pre-trigger operation are offered as standard and in all modes cursor-interactive time and voltage coordinates can be displayed concurrently with the signal. Stored waveforms can be displayed or plotted in XY or YT format, transferred to internal disk memory for permanent storage or output to other computing devices via industry standard interfaces.



Expansion of selected area in above photo, for detailed analysis.

In addition to offering you the performance you would expect from the industry leader, Nicolet digital oscilloscopes are extremely well proven with thousands in effective use throughout the world.

Find out how Nicolet can help you solve problems and see things you've never seen before.

For more information, simply circle the reader service card or call 608/271-3333. Or write: Nicolet Instrument Corporation, 5225 Verona Road, Madison, Wisconsin 53711.

NICOLET INSTRUMENT CORPORATION
OSCILLOSCOPE DIVISION

Sales and Service Offices Worldwide

Circle No. 114 on Readers' Service Card

Nicolet Digital Oscilloscopes

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

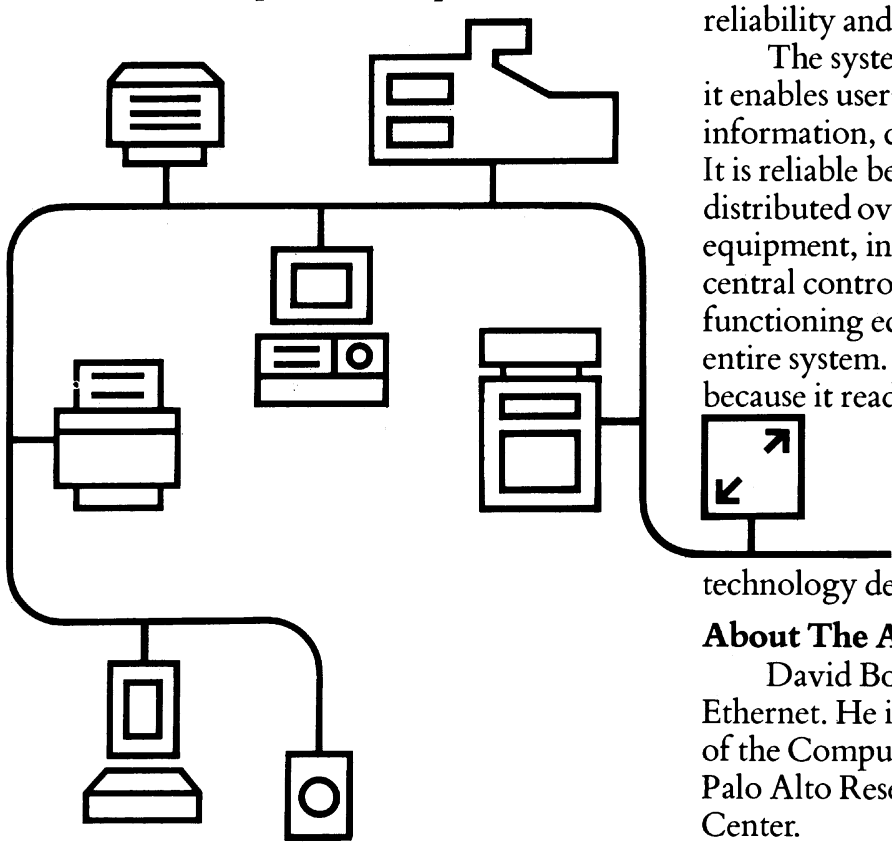
The Ethernet network uses a coaxial cable to connect various pieces of information equipment. Information travels over the cable in packets which are sent from one machine to another.

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.

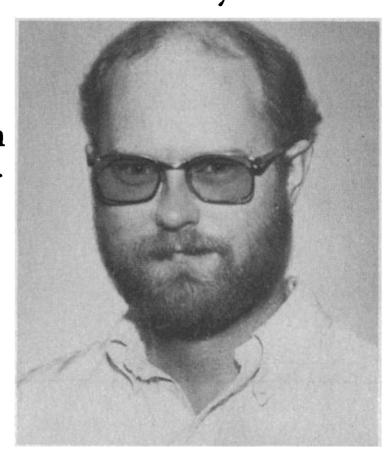
Controllers. These are large scale integrated circuit chips which enable all sorts of equipment, from communicating typewriters to mainframe computers, regardless of the manufacturer, to connect to the Ethernet.

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.

XEROX

10 April 1981, Volume 212, Number 4491 **SCIENCE**

Voyager Mission to Saturn

Voyager 1 made its closest approach to Saturn on 12 November 1980. On that day, the mission control center at Jet Propulsion Laboratory was the focus of intense worldwide attention. Interest in the Voyager mission to Saturn approached that accorded the first manned lunar landing. This issue contains the first set of scientific reports from the flyby of the planet, its many satellites, and its rings.

The Saturn system is a frigid mysterious world nearly 1.6 billion kilometers (1 billion miles) from Earth. Per unit area, it receives about 1 percent as much sunlight as does Earth. Spacecraft visiting it must be prepared to withstand extreme cold, to operate semi-autonomously, and to convey messages to and receive messages from Earth.

Saturn has a mass 95 times that of Earth. It has an atmosphere that consists mainly of hydrogen, with helium (approximately 11 percent) the next most abundant component. Methane, ammonia, ethane, ethylene, acetylene, and phosphine have also been detected. The temperature decreases from 150 K in the upper atmosphere to a minimum of about 85 K at a pressure of 100 millibars and then increases to about 160 K at 1.4 bars. The planet is obscured by clouds, which move at velocities that are a function of latitude. Eastward wind speeds near the equator as high as 480 meters per second (1100 miles per hour) were observed.

One of the major objectives of the Voyager mission was to gather information about Saturn's satellites. There are 15 of them, including three that were discovered during the flyby. Titan, the largest of the group, is the second largest satellite in the solar system (Jupiter's Ganymede is first) and the only one known to possess a substantial atmosphere. Although it is covered with clouds and haze, Voyager experimenters were able to determine its diameter (5140 kilometers). Using this datum and the mass, they calculated Titan's density to be 1.9, which corresponds to a 50:50 mix of rock and water ice. The atmospheric pressure at the surface of Titan is 1.6 bars and the temperature approximately 93 K. Nitrogen is the main constituent of the atmosphere, with methane next in abundance. At the conditions on the surface of Titan, gaseous, liquid, or solid methane might be present. The other satellites were not obscured by clouds. They were covered with water ice and in some cases are composed mainly of water ice. A striking feature of Mimas is a crater roughly 130 kilometers in diameter. Craters were also observed on most of the other satellites.

Saturn's rings were found to have a far more complex structure than predicted. They consist mainly of water ice. Voyager 1 results indicate that the A and C rings contain particles with effective diameters of 10 and 2 meters, respectively. The Cassini division, a classical ring element separating the A and B rings, itself contains five broad rings with substructure. The F ring has an unusual morphology, with two components that appear kinked and braided.

The foregoing paragraphs mention only a fraction of the information now available about the Saturn system. Moreover, only part of the experimental data has been analyzed thus far. When analysis is complete, a very substantial body of facts will be added. For centuries scientists have attempted to answer three major questions about the solar system: How did it originate? How did it evolve? and How does it operate today? The information gathered with manned and unmanned spacecraft greatly limits the range of permissible speculation. A theory that covers the origin and evolution of the solar system will illuminate processes that have occurred on Earth. Data about atmospheric motions on Earth, Mars, Jupiter, and Saturn will be used to test models of global circulation.

The Voyager 1 mission to Saturn has been another great success in a long series of U.S. exploits in space. The engineers, scientists, and technicians involved in the era of space exploration can take pride in their work. They have participated in one of humanity's greatest achievements.

—PHILLIP H. ABELSON