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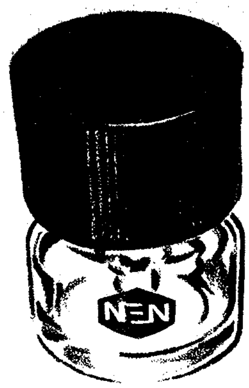
SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COMPUTERS AND ELECTRONICS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12 February 1982

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SCIENCE

Computers and Electronics

Edited by Philip H. Abelson and Mary Dorfman

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COVER

Fractal surface shown in this image has statistical properties that approximate those of natural terrain. See page 767. [Loren Carpenter, Lucasfilm Ltd., San Rafael, California]

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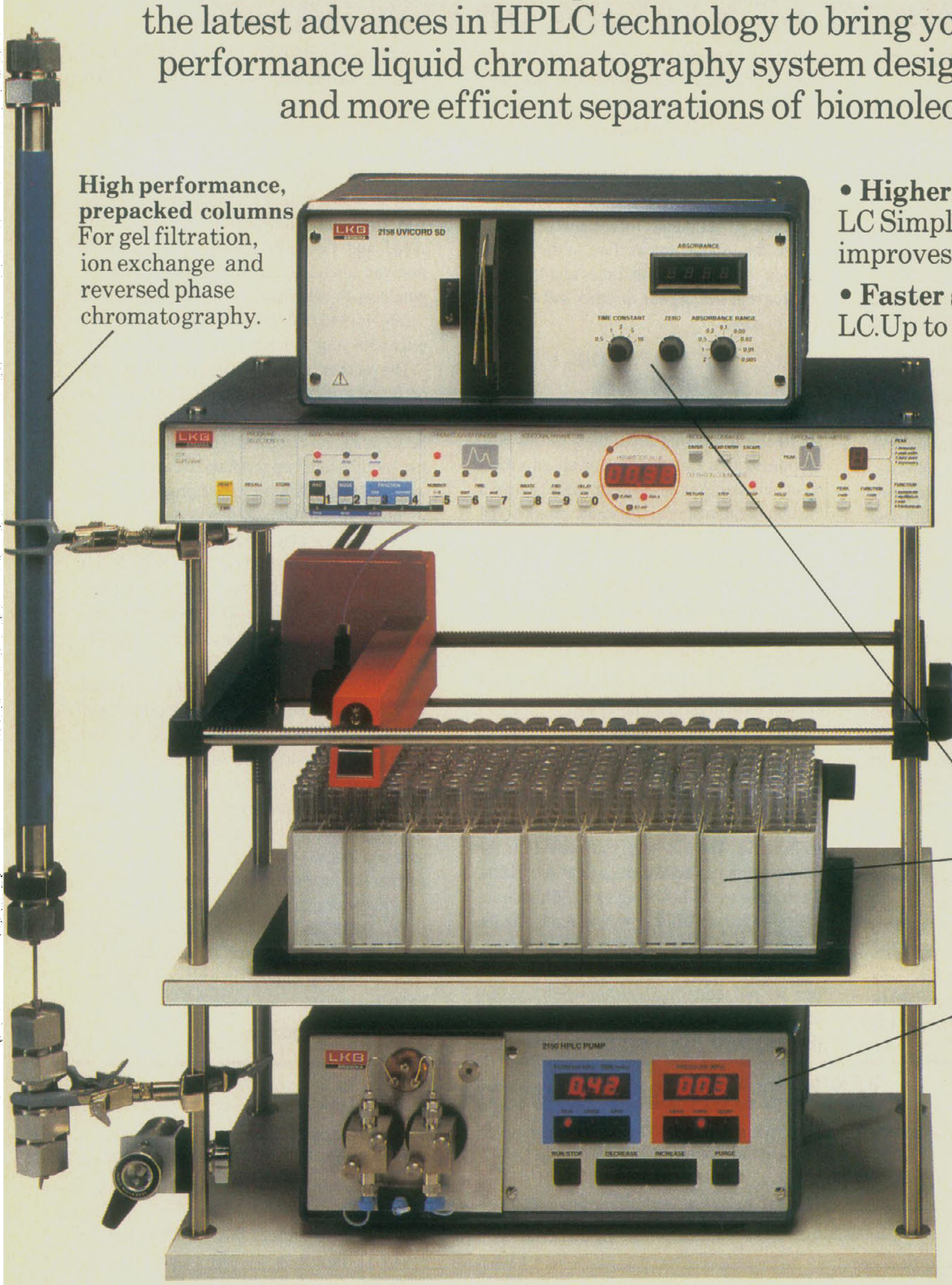

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SCIENCE/SCOPE

The first carbon-dioxide laser rangefinder developed in the U.S. for tactical military use offers several advantages over existing solid-state lasers to improve the first-round accuracy of tank gunners. The new laser, being developed at Hughes for the Army's M1 main battle tank, will penetrate battlefield smoke and dust much better. Because the laser is harmless to the human eye and requires minimal safety restrictions to be operated, gunners will have more training time than they do with the solid-state unit and will become more proficient. The Army is evaluating an advanced development model.

A new adaptive radar, using technology that could be applied in the future to many different weapon control systems, has completed feasibility tests. The radar, called FLEXAR (Flexible Adaptive Radar), uses a multimode transmitter and a programmable signal processor that are now in production, plus a new lightweight, low-cost electronically-scanned antenna. The antenna rotates once each second while the beam electronically scans up and down and back and forth. Waveforms are selected automatically to match the environment. Such flexibility enables the radar to adapt its waveform beamwidth and scan rate as needed to acquire and track targets. Hughes developed FLEXAR for the U.S. Navy.

Besides taking pictures of clouds every 30 minutes, a new satellite provides meteorologists with other important information. The GOES-5 spacecraft relays data from more than 1,500 stations that monitor sea ice conditions and water and snow distribution in remote areas, providing flood warning, among other services. It also measures solar winds and detects solar flares and fluctuations in the earth's magnetic field. This data, besides being useful in weather predictions, is used in communications and electrical power distribution. GOES-5 is the second of three Geostationary Operational Environmental Satellites built by Hughes for the National Oceanic and Atmospheric Administration.

Hughes Industrial Electronics Group offers the advantages and opportunities of a small company backed by the resources of a $2-billion company. Our facilities are in the Southern California communities of Carlsbad, Irvine, Newport Beach, Torrance, and Sylmar. Our programs incorporate 34 different technologies. They include silicon and GaAs semiconductor technologies, fiber optics, microwave and millimeter-wave communications, microprocessors, lasers, and solar cells. Send resume to B.E. Price, Hughes Industrial Electronics Group, Professional Employment, Dept. SS, P.O. Box 2999, Torrance, CA 90509. Equal opportunity employer.

Better and timelier weather forecasts will be possible when a microwave sensor is launched aboard a military satellite in the mid-1980s. The instrument will tell how hard rain is falling in a specific area rather than simply how much has fallen over a wide area within 24 hours. It also will determine wind speed, atmospheric water content, soil moisture, and sea ice conditions. Because the satellite will follow a low polar orbit, the sensor will gather important data on the little-studied polar regions and oceans. Hughes will soon deliver the prototype Special Sensor Microwave/Imager to the U.S. Air Force.

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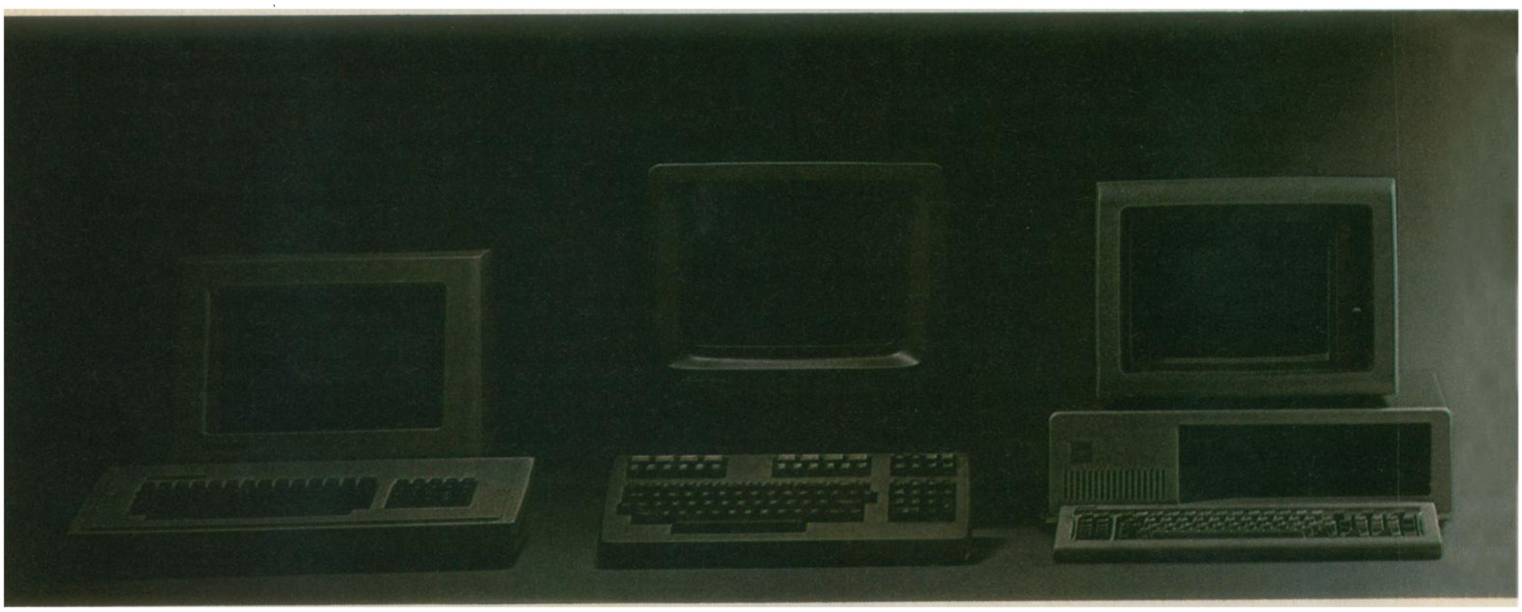

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SOS is the Apple III's Sophisticated Operating System, an elegant software interface that frees you from most system control tasks. It features a hierarchical file system, device- and user-level interrupt capabilities, a device-independent file system and memory management capability.

Since all Apple III languages use SOS, they share a common disk format. So Apple III programs can merge and communicate—a Pascal application program can directly access a BASIC text file, for example.

Xerox 820	Hewlett-Packard 125—Model 10	IBM Personal Computer	Apple III
Standard Memory			
64K	64K	64K	128K
*Maximum Memory when fully configured**			
64K	64K	192K	256K
Expandability			
No expansion slots	No expansion slots	No extra expansion slots in fully configured* 192K system	4 extra expansion slots in fully configured 256K system*
Diskette Storage (per drive)			
92K	256K	160K	140K
Mass Storage (per drive)			
—	1.16 megabyte Floppy Disk	—	5 megabyte Hard Disk
Display Graphics Capability			
High resolution B/W	High resolution B/W	High resolution B/W or 4-color (color requires additional card)	High resolution B/W or 16-color
Software Available			
Word Processing Super Calc® — Communications — CP/M® library	Word Processing VisiCalc® 125 Business Graphics Communications — CP/M® library	Word Processing VisiCalc® — Communications — CP/M® 86 programs	Word Processing VisiCalc® III Business Graphics Communications Apple II software library CP/M® library (available Spring, 1982)

*"Fully configured" means system includes, at minimum, monitor, printer, 2-disk drives and RS-232 communicator. NOTE: Chart based on manufacturer's information available as of December, 1981.

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SOS allocates system resources to make the most of dynamic memory, simplifies programming with standard device and file interfaces for all languages, and speeds software development by reducing program size and complexity.

OUR NEW PROFILE.

ProFile™ is Apple's new personal mass storage system—a quick, quiet 5MB hard disk ideal for software development or any mass storage application. Shown above twixt monitor and console, it comes with everything you need to get up and running, including interface card and driver software.

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The 128-character ASCII-encoded keyboard happens to be fully-programmable. So you can (with SOS) do neat things like remap it into DVORK. Or create armies of special function keys. Or teach your Apple to write Chinese.

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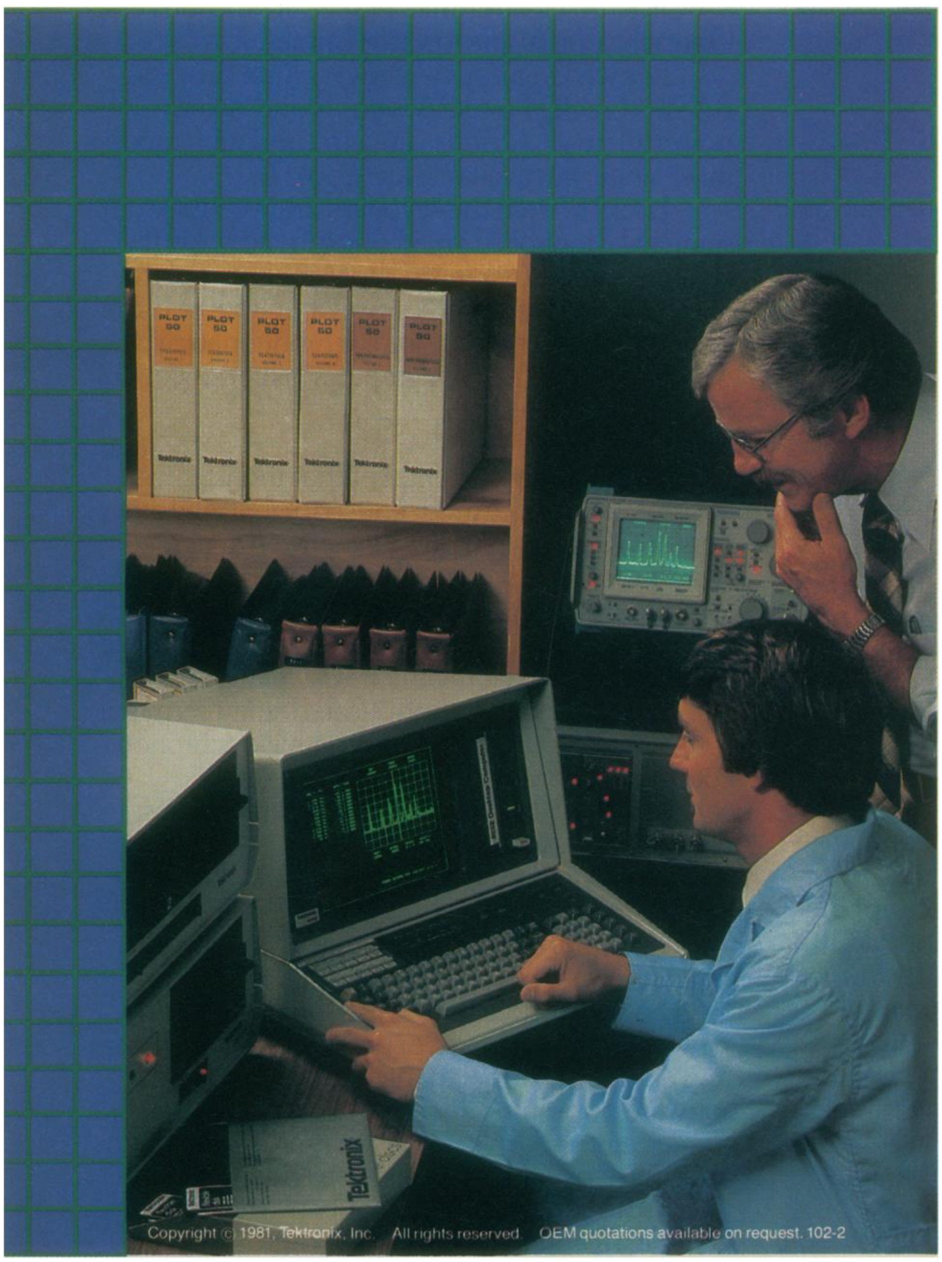

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RULE SHOWN ACTUAL SIZE. MEASURE YOUR SPACE WITH THIS PAGE TO SEE IF A LAUDA RM-3 WILL FIT.

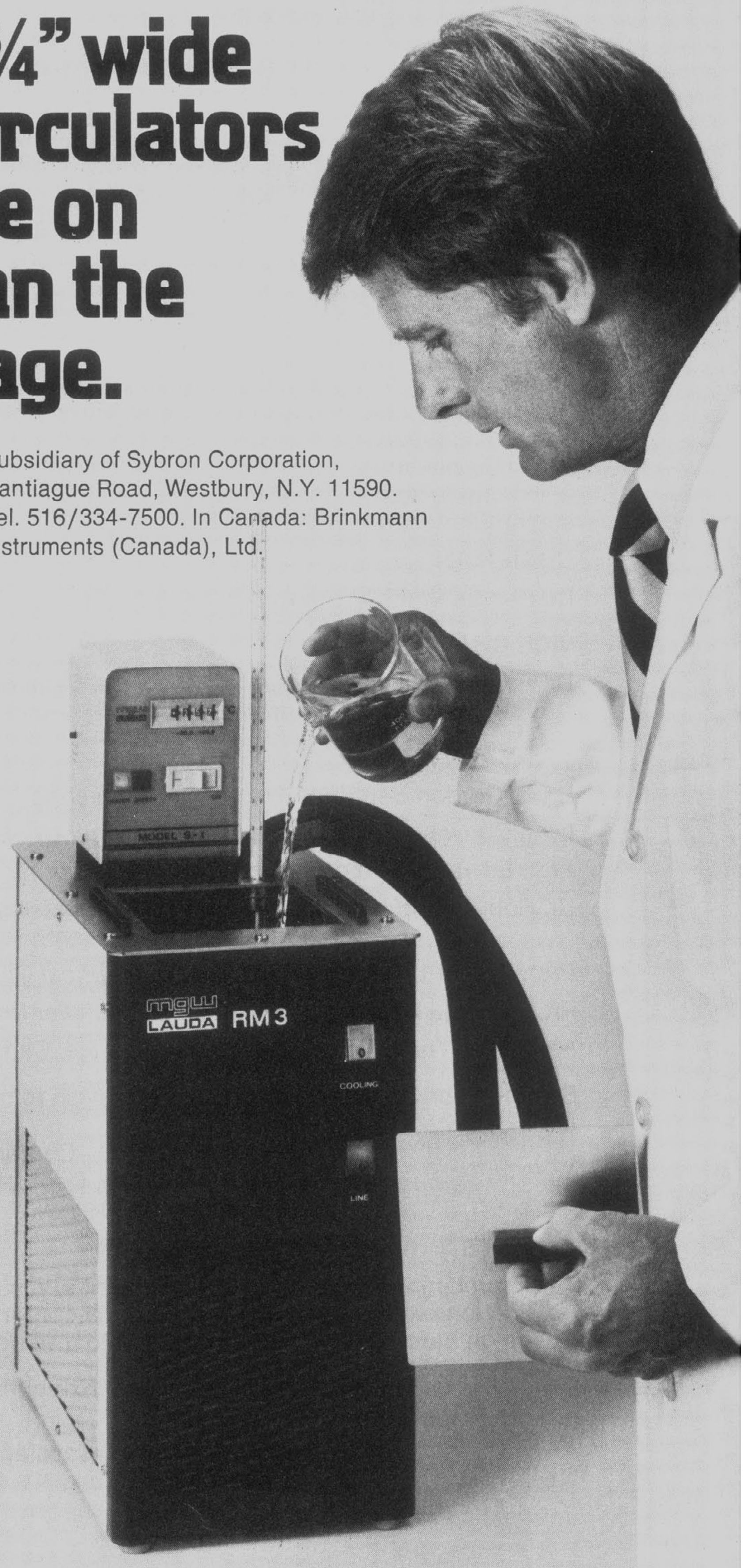
Lauda's new 7¾" wide refrigerated circulators need less space on your bench than the width of this page.

You wouldn't think a refrigerated constant temperature circulator could fit into bench space narrower than this page, but it's true. The new Lauda RM-3S and RM-3T are only 7¾ inches wide (and only 15 inches deep).

Despite their space-saving dimensions, these circulators provide all the features of full-size models. That makes them ideal for circulating liquid to jacketed glassware and other instruments (spectrophotometers, chromatography columns, electrophoresis equipment), as well as for applications requiring direct immersion.

Model RM-3S offers the convenience of digital temperature control; a flick of the finger dials in any temperature from −20° to 99.9°C. A platinum resistance sensor insures an accuracy of ±0.01° of the set temperature. A second, less accurate model, RM-3T, is equipped with a single temperature adjustment dial, and the temperature is controlled thermostatically to an accuracy of ±0.2° within the operating range of −20° to 100°C. Both models have 1,000 watt heaters, a 3-liter bath capacity, all stainless steel components contacting liquid, and are supplied with a bath cover and reading thermometer.

For literature on the compact RM-3 and the complete line of Lauda Circulators, write or call: Brinkmann Instruments, Inc., Subsidiary of Sybron Corporation, Cantiague Road, Westbury, N.Y. 11590. Tel. 516/334-7500. In Canada: Brinkmann Instruments (Canada), Ltd.



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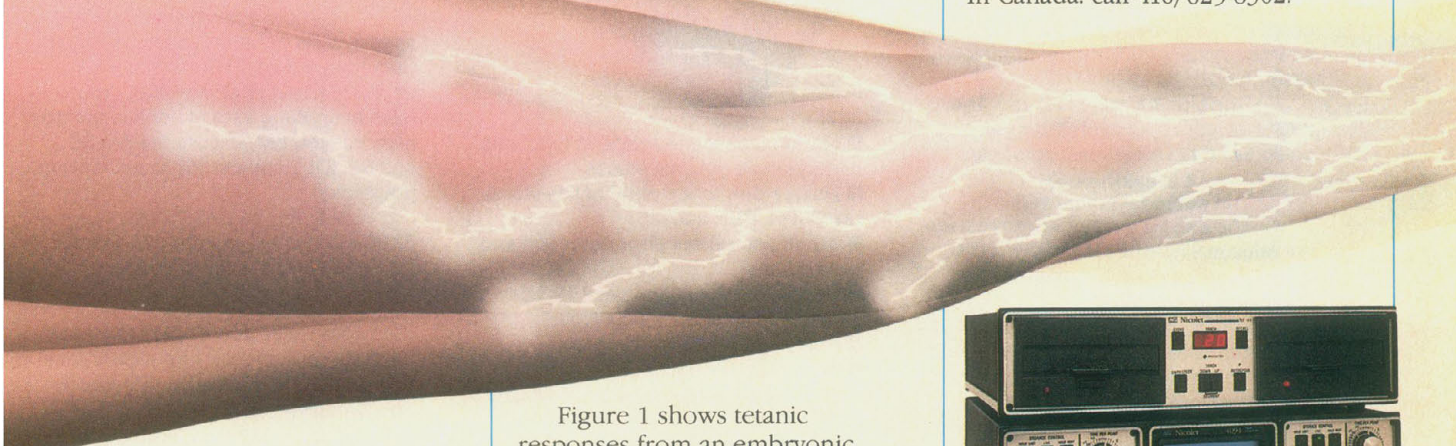
Digital Precision and the Analog Animal

The study of physiological phenomena in laboratory animals has developed into a precise science involving exacting test techniques. Until recently however, the experimentalist has been severely limited by available instrumentation. Whether studying a transient muscle twitch or repetitive heart pulse, the analog oscilloscope and chart recorder have been the standard tools. Recording of data on such instruments is, at best, a rough and



ready technique. Today, Nicolet digital oscilloscopes offer a total solution to your measurement problems. They are extremely accurate and easy-to-use. Signals

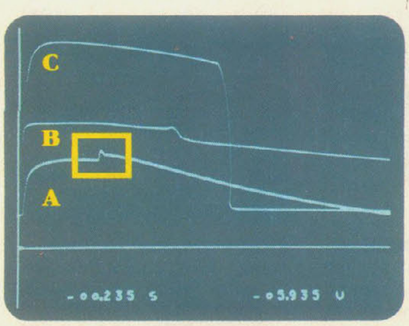


Fig. 1—Tetanic response in avian embryonic muscle after 15 days (A), 17 days (B), and 19 days (C) in ovo.

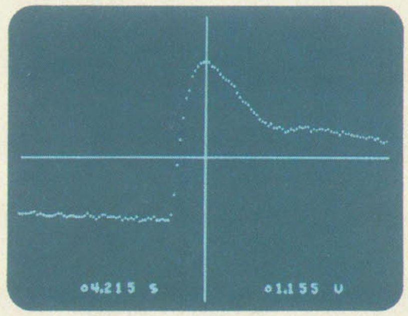


Fig. 2—Expansion of selected area for detailed analysis (up to X 256)

can be viewed live, compared to a reference waveform or stored in both report-ready and computer-compatible formats.

Figure 1 shows tetanic responses from an embryonic chicken muscle after 15, 17 and 19 days in ovo. These responses were captured and stored on a Nicolet digital oscilloscope then recombined on the screen for comparison. The high resolution and expansion capabilities allow detailed examination of small changes as shown in Figure 2. Cursor-interactive coordinate display eliminates the need to estimate amplitude or latency values of a waveform feature. 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.

Consider the savings in dollars and people.

Nicolet digital oscilloscopes can replace your analog instrumentation and eliminate much of the human effort between the experiment and the final result.

To find out how Nicolet can help you solve your measurement problems, simply circle the reader service card or call 608/271-3333. Or write, Nicolet Instrument Corporation, Oscilloscope Division, 5225 Verona Road, Madison, Wisconsin 53711.
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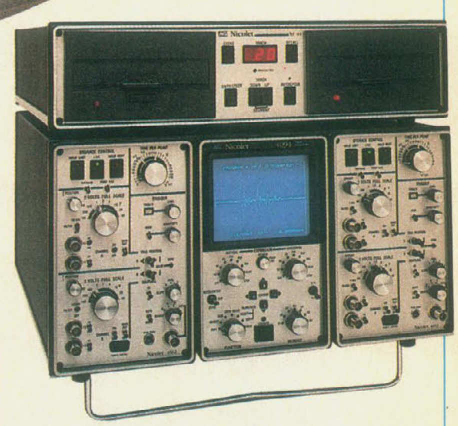

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Introducing the Sinclair ZX81

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The new Sinclair ZX81 is the most powerful, yet easy-to-use computer ever offered for anywhere near the price: only $149.95* completely assembled.

Don't let the price fool you. The ZX81 has just about everything you could ask for in a personal computer.

A breakthrough in personal computers

The ZX81 is a major advance over the original Sinclair ZX80—the world's largest selling personal computer and the first for under $200.

In fact, the ZX81's new 8K Extended BASIC offers features found only on computers costing two or three times as much.

Just look at what you get:

- Continuous display, including moving graphics
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- Unique one-touch entry of key words like PRINT, RUN and LIST
- Automatic syntax error detection and easy editing
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- Built-in interface for ZX Printer
- 1K of memory expandable to 16K

The ZX81 is also very convenient to use. It hooks up to any television set to produce a clear 32-column by 24-line display. And you can use a regular cassette recorder to store and recall programs by name.

*Plus shipping and handling. Price includes connectors for TV and cassette, AC adaptor, and FREE manual.

If you already own a ZX80

The 8K Extended BASIC chip used in the ZX81 is available as a plug-in replacement for your ZX80 for only $39.95, plus shipping and handling—complete with new keyboard overlay and the ZX81 manual.

So in just a few minutes, with no special skills or tools required, you can upgrade your ZX80 to have all the powerful features of the ZX81. (You'll have everything except continuous display, but you can still use the PAUSE and SCROLL commands to get moving graphics.)

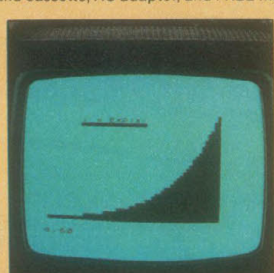
With the 8K BASIC chip, your ZX80 will also be equipped to use the ZX Printer and Sinclair software.

Order at no risk**

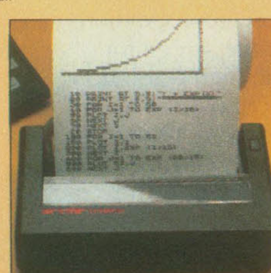
We'll give you 10 days to try out the ZX81. If you're not completely satisfied, just return it to Sinclair Research and we'll give you a full refund.

And if you have a problem with your ZX81, send it to Sinclair Research within 90 days and we'll repair or replace it at no charge.

**Does not apply to ZX81 kits.

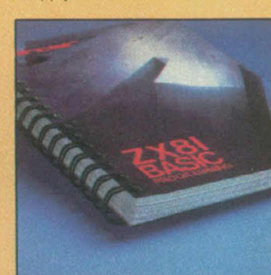


NEW SOFTWARE: Sinclair has published pre-recorded programs on cassettes for your ZX81, or ZX80 with 8K BASIC. We're constantly coming out with new programs, so we'll send you our latest software catalog with your computer.



ZX PRINTER: The Sinclair ZX Printer will work with your ZX81, or ZX80 with 8K BASIC. It will be available in the near future and will cost less than $100.

16K MEMORY MODULE: Like any powerful, full fledged computer, the ZX81 is expandable. Sinclair's 16K memory module plugs right onto the back of your ZX81 (or ZX80, with or without 8K BASIC). Cost is $99.95, plus shipping and handling.



ZX81 MANUAL: The ZX81 comes with a comprehensive 164-page programming guide and operating manual designed for both beginners and experienced computer users. A $10.95 value, it's yours free with the ZX81.

The $99.95 personal computer.

Introducing the ZX81 kit

If you really want to save money, and you enjoy building electronic kits, you can order the ZX81 in kit form for the incredible price of just $99.95.* It's the same, full-featured computer, only you put it together yourself. We'll send complete, easy-to-follow instructions on how you can assemble your ZX81 in just a few hours. All you have to supply is the soldering iron.

How to order

Sinclair Research is the world's largest manufacturer of personal computers.

The ZX81 represents the latest technology in microelectronics, and it picks up right where the ZX80 left off. Thousands are selling every week.

We urge you to place your order for the new ZX81 today. The sooner you order, the sooner you can start enjoying your own computer.

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AD CODE 02NC12	PRICE†	QTY.	AMOUNT
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ZX81 Kit	99.95		
8K BASIC chip (for ZX80)	39.95		
16K Memory Module (for ZX81 or ZX80)	99.95		
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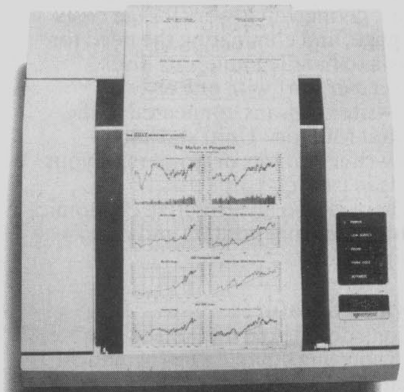

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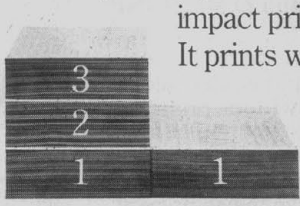

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V-80 plots graphics, maps, even halftone pictures, with resolution of 40,000 points per square inch. A simultaneous print/plot feature allows you to generate reports that combine words and pictures without cutting and pasting. And no matter how complex the plot, each page is produced in just seven seconds.

Interfaces and intelligent controllers for all popular computers and display terminals. Supported by the world's largest electrostatic printer/plotter sales and service network. Circle our readers' service number for a free full-color brochure.

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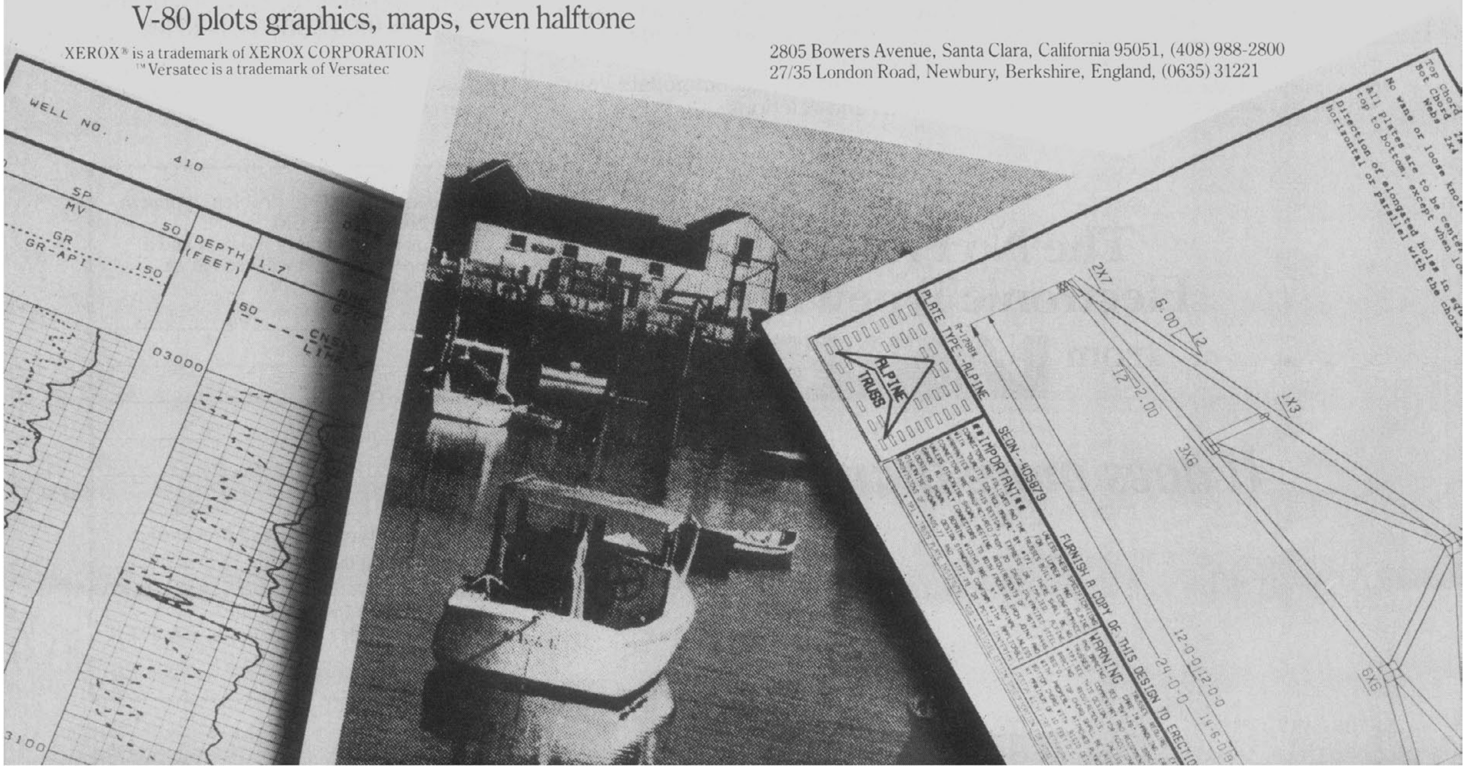

concern for the monkeys under Taub's care and unconnected with efforts to disrupt biomedical research on animals, even though "the issues in the trial all had to do with animal care."

ADRIAN R. MORRISON
PETER J. HAND
Department of Animal Biology, School of Veterinary Medicine, University of Pennsylvania, Philadelphia 19104

A number of recent events have focussed on welfare concerns for experimental animals. Holden's excellent account "Scientist convicted for monkey neglect" describes the lack of veterinary care provided to 17 surgically treated monkeys that led to the suspension of funds from the National Institutes of Health (NIH) and a court conviction under the state anticruelty laws. At the 13 and 14 October congressional hearings of the subcommittee on science, research, and technology, this monkey case was discussed in some detail. Subcommittee chairman Douglas Walgren called for suggestions for measures that would improve humane standards for laboratory animals. The conference of the Scientists Center for Animal Welfare, held from 11 to 13 November, addressed the responsibilities of scientists toward experimental animals and analyzed the review procedure currently used.

The following ten recommendations are proposed. They are based, in part, on recommendations from the conference of the Scientists Center for Animal Welfare and, in part, on my personal convictions.

Inasmuch as there is general agreement that proper care and use of experimental animals is desirable, it is recommended:

1) That public and private funding agencies use consultants with expertise in animal issues to review selected grant proposals that pose special concerns;

2) That funding agencies require investigators applying for grants to specifically address animal issues;

3) That accreditation of institutions by the American Association for the Accreditation of Laboratory Animal Care be fostered;

4) That more funds be allocated by public and private sources for upgrading animal facilities;

5) That training courses be provided to scientists to increase their sensitivity and knowledge about animal care policies;

6) That institutional animal care committees be composed of members with broad representation of viewpoints and who have no conflict of interest;

7) That inspection and review procedures by the federal government be improved;

8) That a central office be established within the federal government to coordinate federal activities affecting proper use and care of experimental animals;

9) That current policies be reassessed to see if additional requirements would be beneficial to ensuring high standards of humane animal care; and

10) That on a prospective basis, an evaluation be made of the peer review system for animal welfare concerns.

Given appropriate leadership and resources, I believe that support for most, if not all, of the above-listed recommendations would be forthcoming from the biomedical community. As a result, the quality of animal research would be enhanced and the accountability of scientists to the public would benefit.

F. BARBARA ORLANS
Scientists Center for Animal Welfare, Post Office Box 3755, Washington, D.C. 20007

Aspartame in Canadian Soft Drinks

Imagine my surprise, while swilling down a can of an aspartame-sweetened Tab, to read the following statement in R. Jeffrey Smith's article "Aspartame approved despite risks" (News and Comment, 28 Aug., p. 986). "The additive . . . will not be used in soft drinks because Searle has yet to find a way of keeping it stable for the duration of a soda's shelf life." How was the trick pulled off (one assumes) in Canada, where drinks sweetened with aspartame have already hit the market? Smith's interesting article could have been improved by consideration of such regulatory decisions in countries other than the United States.

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The impetus for putting aspartame in soft drinks was much greater in Canada, where saccharin is banned for such uses. A spokesman for Searle says that the shelf life issue requires additional study before aspartame can be introduced into sodas in the United States. Canadian soft drink manufacturers, who studied the issue independently, say no further study is needed and no problem exists.

—R. JEFFREY SMITH

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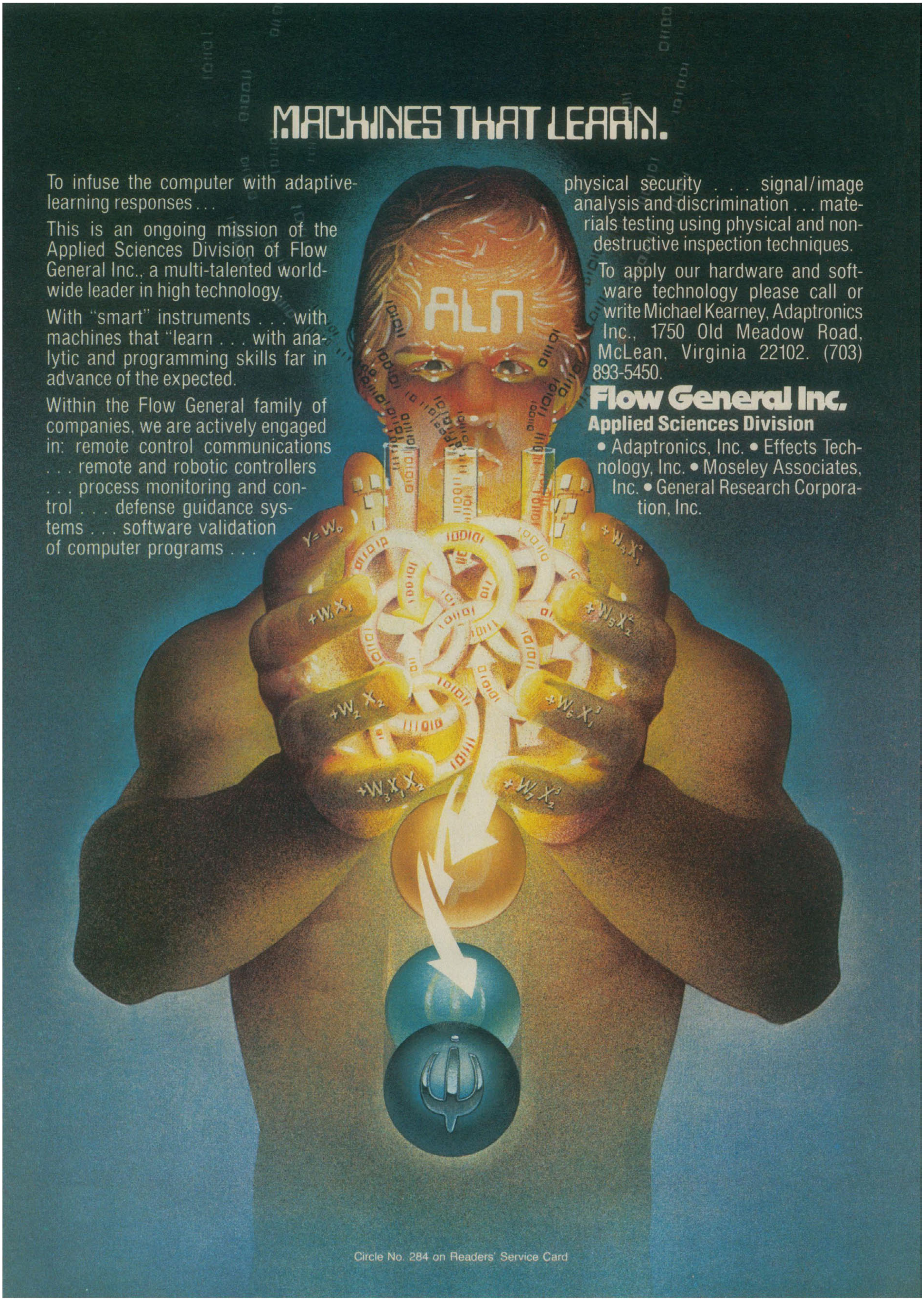
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12 February 1982, Volume 215, Number 4534 **SCIENCE**

Computers and Electronics

This special issue of *Science* is devoted to an assessment of the revolution in computers and electronics. Essays on topics of special relevance to the scientific, technical, and medical communities are included. The computer revolution has had profound effects on instrumentation and on the collection, analysis, and storage of data. Changes in modes of communication among scientists are occurring and more are in prospect.

Scientific instrumentation evolved rapidly during the past two decades. In many instances, sensitivities increased by several orders of magnitude. It became possible to make new kinds of measurements, for example, in studies of phenomena that occur in 10^{-12} second or less. Instruments containing dedicated microcomputers became common. In this issue Enke points to potential avenues for further improvement. He discusses the use of the computer to free us from the limitations imposed when we must attempt to hold all variables except one constant during a measurement. The computer also frees us from the necessity of finding sensors that are linear in the quantity measured. Another example is the use of the computer to extend by a factor of 100 to 1000 the already great sensitivity of mass spectrometry. The mass spectrometer can be set by the computer to monitor a parent-daughter mass combination and disregard potentially interfering substances.

Present-day instrumentation can obtain and record enormous amounts of data. The volume of these data is so great that computers and associated memory devices have become essential in data management. There is a need for both on-line and archival storage. At present, wide use is made of magnetic disk storage systems. However, optical and video disk technologies that are under development promise enormous storage capabilities at extremely low costs per bit. Already video disks 12 inches in diameter are available that contain 54,000 frames. In this issue Goldstein tells of activities of many companies in developing optical disks, one of which is designed to store 200 billion bits of information or the equivalent of about 500,000 pages of text. Video and optical disks will have an important role in storage of scientific information, and they may provide a new publication mechanism.

A large fraction of the total number of scientists active in research or development have ready access to computers. Many have terminals near their desks, and increasing numbers have them at home. By using telephone or other linkage, it is possible for them to send electronic mail to distant colleagues and to tap into a very large number of databases. For the transfer of large amounts of data, special links are needed. Most of the databases available are bibliographic and nonscientific. An important example of one that is useful in biomedical research is the base maintained by the National Library of Medicine, which provides coverage of the world's medical literature. The development of scientific numerical databases has been slow, but they are being formed and they will be valuable.

A decade ago, the telephone was the crucial link between members of invisible colleges. Among those who are familiar with computers, there is the beginning of an evolution toward using computer networks as the crucial linkage. In this issue Newell and Sproull discuss conditions necessary for a successful computer network. The pioneering example was the ARPANET, which has served needs of computer scientists and given rise to electronic mail and valuable interaction among the participants. The network links a number of universities, national laboratories, and other installations. Another network is SUMEX-AIM (Stanford University Medical Experimental Computer–Artificial Intelligence in Medicine). It links a group of medical scientists distributed around the country who are concerned with computer applications in medicine. Recently, a group of geneticists formed a network (GENET) to make use of computers in work related to recombinant DNA. Other networks have been authorized or are being planned.

—PHILIP H. ABELSON

Captions for Divider Pages, Computers and Electronics

Computers and Electronics

Page 754—Portion of computer memory chip that can store 288,000 bits of information [IBM, Armonk, New York]

Graphics and Software

Page 766—Robot ant, an example of the high image quality needed in computer-generated effects for feature films. The ant, designed by Dick Lundin, is a 41st-century construction machine in "The Works," a feature-length computer-animated film in production at the New York Institute of Technology. [Dick Lundin and Lance Williams, New York Institute of Technology, New York]

Scientific Research and Medicine

Page 784—Positron emission tomograph depicting glucose metabolism (red), disruption of the blood-brain barrier (yellow), and normal scalp uptake of rubidium-82 in a patient with a brain tumor (green). [Donner Laboratory, University of California, Berkeley]

Business and Industry

Page 807—Two robots working in coordination to assemble relay. [Westinghouse Electric Corporation, Pittsburgh, Pennsylvania]

Communications and Personal Services

Page 830—Two microcomputers (at top, a packaged four-bit device and at right an unpackaged 32-bit device) and a wafer containing more than 100 microcomputer chips. The background suggests pulses of digital information. [Bell Laboratories, Short Hills, New Jersey]

Information Storage and Retrieval

Page 856—Pits in tellurium film used in preparing optical digital disks. [Philips Laboratories, North American Philips Corporation, Briarcliff Manor, New York]