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# SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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**Bacteriophage  $\lambda$  DNA** cleaved by *Hind* III restriction endonuclease and subsequently labeled [ $^3\text{H}$ ]

Six fragments, MW in daltons:

15.1x10 <sup>6</sup>	2.7x10 <sup>6</sup>
6.2x10 <sup>6</sup>	1.4x10 <sup>6</sup>
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0.1-1.5mCi/mg DNA

Packaged in 10mM Tris-HCl (pH 8.0), 1.0mM EDTA, 100 $\mu\text{g}/\text{ml}$  yeast tRNA carrier, in silanized combi-vial, dry ice.

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NET-639 1 $\mu\text{Ci}$  5x1 $\mu\text{Ci}$

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7.01x10 <sup>5</sup>	1.52x10 <sup>5</sup>
5.67x10 <sup>5</sup>	1.26x10 <sup>5</sup>
3.92x10 <sup>5</sup>	0.767x10 <sup>5</sup>
2.02x10 <sup>5</sup>	0.468x10 <sup>5</sup>
1.81x10 <sup>5</sup>	

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ISSN 0036-8075  
23 May 1980  
Volume 208, No. 4446

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Edited by Philip H. Abelson and Mary Dorfman

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## COVER

Ribbon of metallic glass that was cast directly from liquid alloy at a speed of approximately 900 meters per minute, and an average quenching rate close to  $10^6$  °C per second. The ribbon's nominal composition is  $\text{Ni}_{70}\text{Cr}_6\text{Fe}_2\text{Si}_8\text{B}_{14}$  (atomic percent). It is 2.5 centimeters wide by 25 micrometers thick. Unlike the crystalline form of the same composition, it is ductile. Such ribbons are useful for brazing pieces of stainless steel together. [Courtesy of Allied Chemical Corporation, Morristown, New Jersey]

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.



# Scientists and engineers computer systems powerful analyzing data.

## Why?

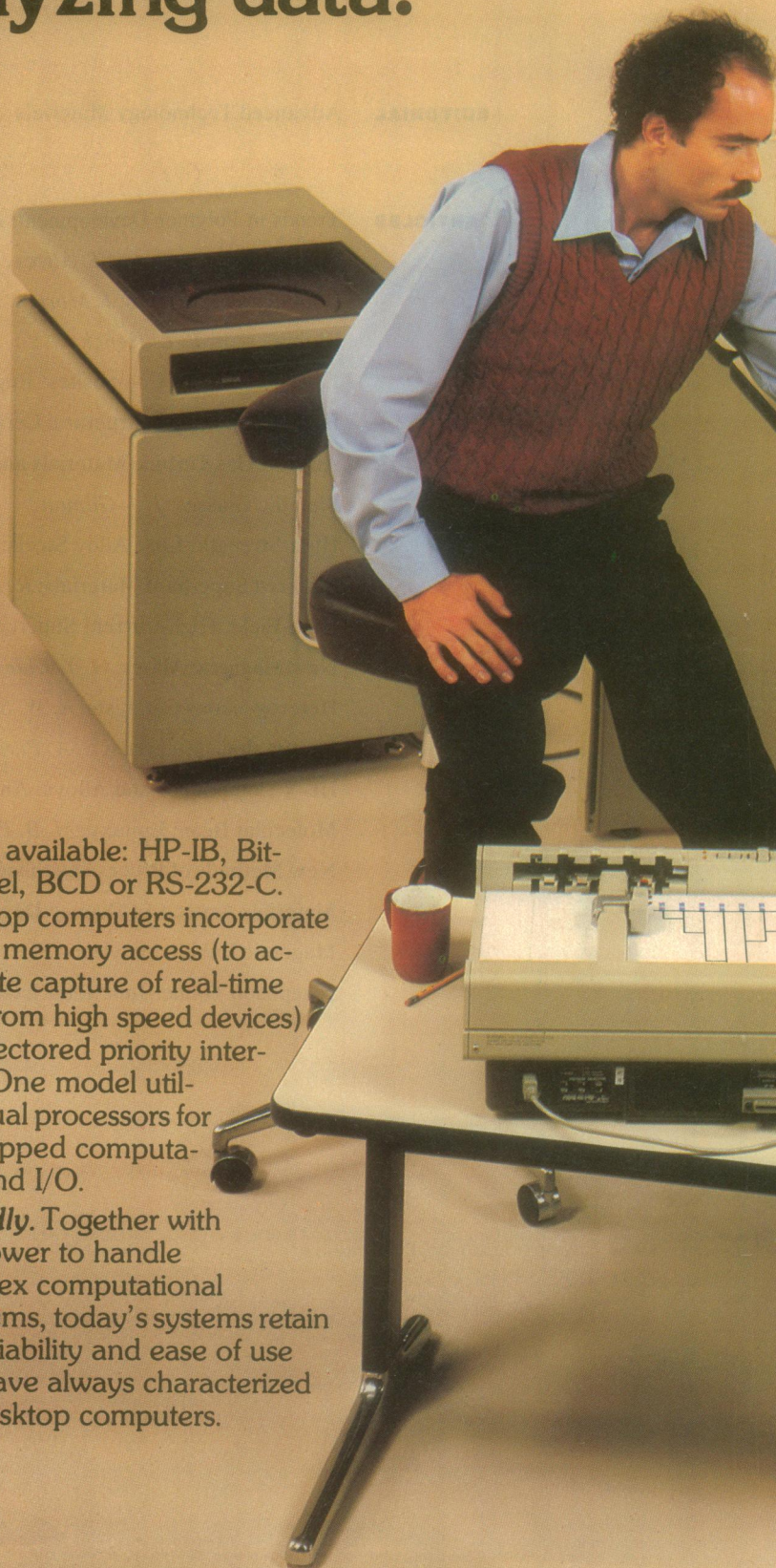
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**Friendly.** Together with the power to handle complex computational problems, today's systems retain the reliability and ease of use that have always characterized HP desktop computers.



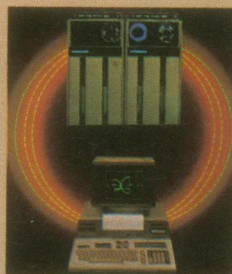


# find today's desktop tools for

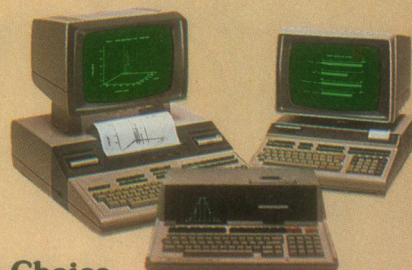
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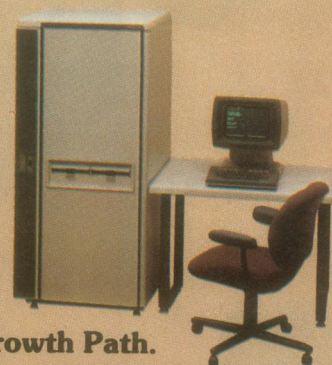


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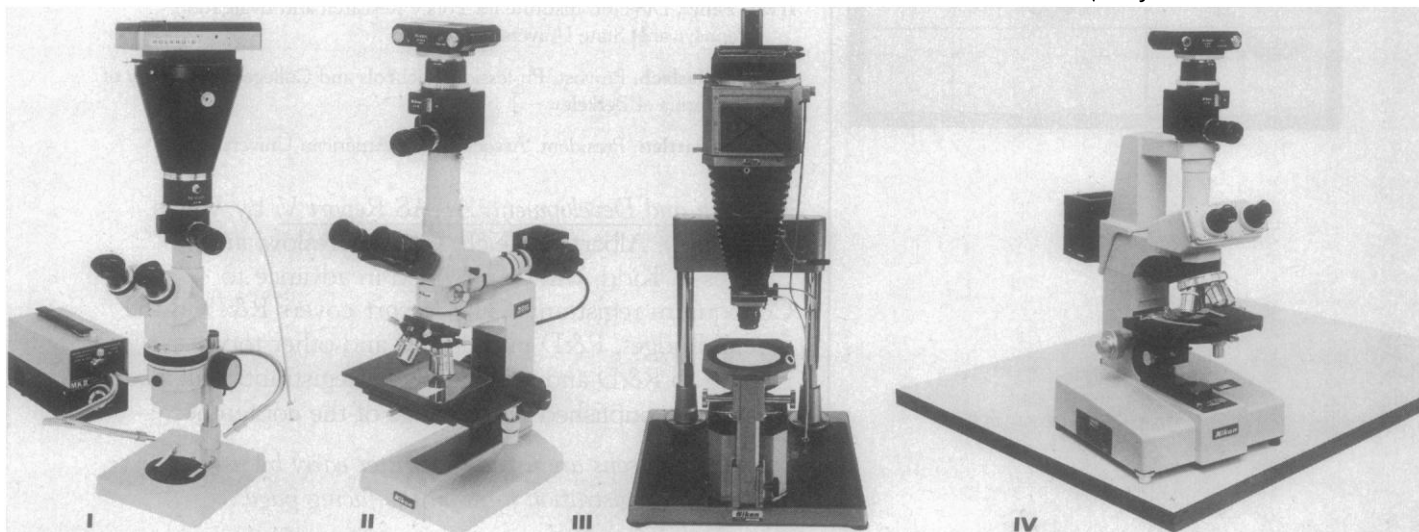
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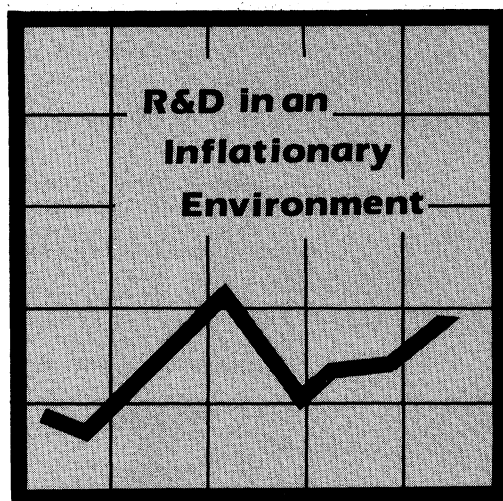
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*Announcing the 5th Annual*

# AAAS Colloquium on R&D Policy

**19-20 June 1980**

*The Shoreham Hotel  
2500 Calvert Street, NW  
Washington, DC*



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## Colloquium Topics

- *Federal R&D Issues in the FY 1981 Budget* • The original FY 1981 budget and the budget revision • Federal policies on R&D • Outlook for FY 1982 and the future • Impact of inflation
- *Industry R&D and the Economy* • Problems of R&D in industry • Implementing federal policies on innovation • Coping with inflation • Impacts on economic outlook of federal and industry R&D policies
- *Science and Research at Universities* • Outlook for federal funding of research at universities • Impact of demographic changes on university needs and capabilities • Impact of federal policies and priorities • Public accountability vs. excessive paperwork
- *State and Local Interests in R&D* • State and local funding of R&D • Federal R&D and state and local needs • Technology transfer and building state and local science and technology capabilities

## Colloquium Speakers

Speakers at the Colloquium will include:

**Frank Press**, Director, Office of Science and Technology Policy, Executive Office of the President

**W. Bowman Cutter**, Executive Associate Director for Budget, Office of Management and Budget

**The Honorable Robert N. Giaimo**, Chairman, Committee on Budget, U. S. House of Representatives

**John H. Gibbons**, Director, Office of Technology Assessment, U. S. Congress

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**George Maslach**, Provost, Professional Schools and Colleges, University of California at Berkeley

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*Research and Development: AAAS Report V*, by Willis H. Shapley, Albert H. Teich, Gail J. Breslow, and Charles V. Kidd, will be provided in advance to Colloquium registrants. The *Report* covers R&D in the federal budget, R&D in industry, and other topics relating to R&D and public policy. Registrants will also receive the published proceedings of the conference.

*Interested persons are urged to register early by using the Colloquium registration form on the facing page.*

---





## 5th R&D Colloquium

## Washington 19-20 June 1980

The fifth AAAS R&D Policy Colloquium will be held on Thursday and Friday, 19 and 20 June 1980 at THE SHOREHAM HOTEL, 2500 Calvert St., NW, Washington, DC 20008.

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☐ Proc. 79 Col.; ☐ Proc. 78 Col.; ☐ Proc. 77 Col.; ☐ Proc. 76 Col.

**Program, badge, meal tickets, and R&D: FY 81 Report will be sent about 9 June. Registrations received after 9 June will be held at the AAAS Registration Desk at The Shoreham Hotel. Previous reports ordered will be sent as soon as possible. Proceedings of 80 Colloquium will be sent as soon as available.**

**Registrant's Name** \_\_\_\_\_

(last name)

(first and initial)

**Affiliation** \_\_\_\_\_

**Address** \_\_\_\_\_

(street and number)

(city)

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(Reservations received after 16 May cannot be guaranteed)

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\*Plus 8% D.C. sales tax; and 80¢ occupancy tax.

**Arrival:** Date \_\_\_\_\_ Time \_\_\_\_\_

**Departure:** Date \_\_\_\_\_ Time \_\_\_\_\_

*Be sure to list definite arrival and departure date and time. Hotel reservations will be held only until 6 p.m. unless otherwise specified. Check out time is 1:00 p.m.*

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Name \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Please indicate any special

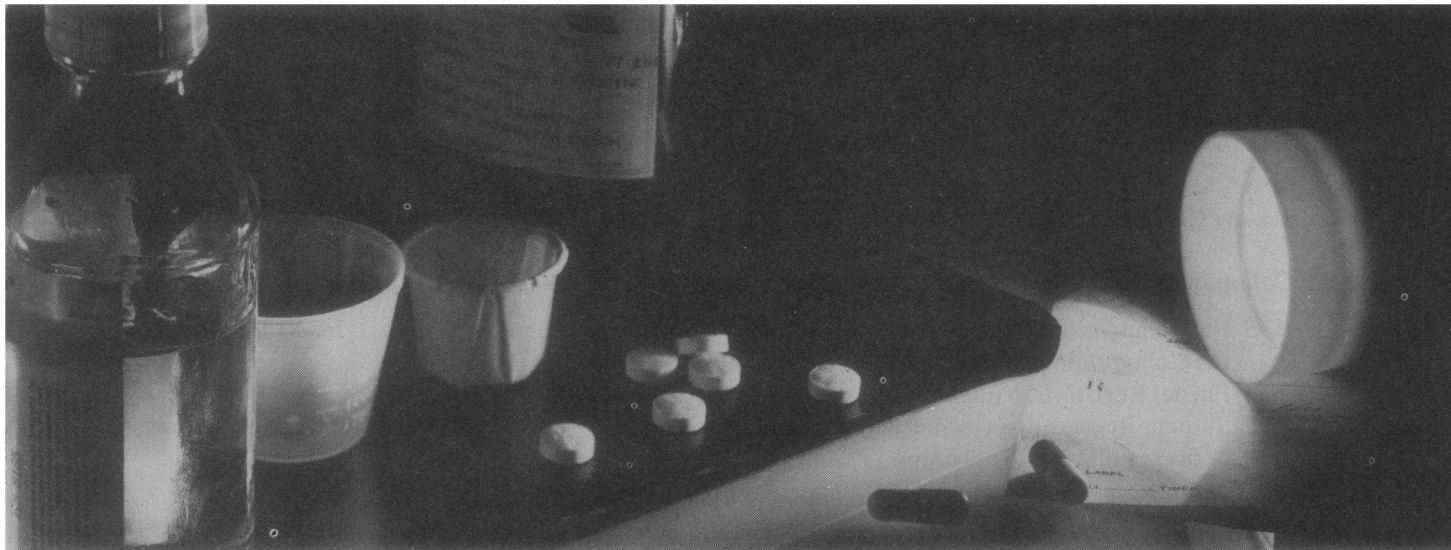
housing needs due to a handicap \_\_\_\_\_

Please enclose separate check, made out to **Shoreham Hotel**, for first night's room charge *or* indicate major credit card No.

Card name \_\_\_\_\_ Number \_\_\_\_\_ Expires \_\_\_\_\_

Cardholder's signature \_\_\_\_\_

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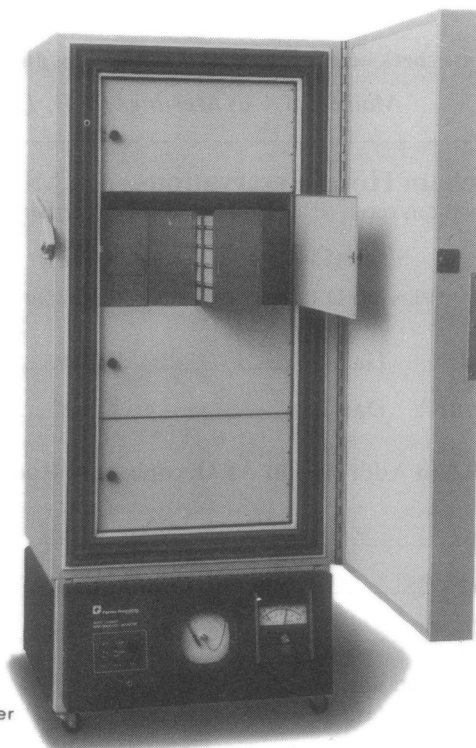


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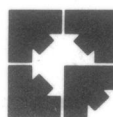
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American Society of Biological Chemists in New Orleans, June 2-5

ASMT in St. Louis, June 23-25

**Where technology begins with imagination.**

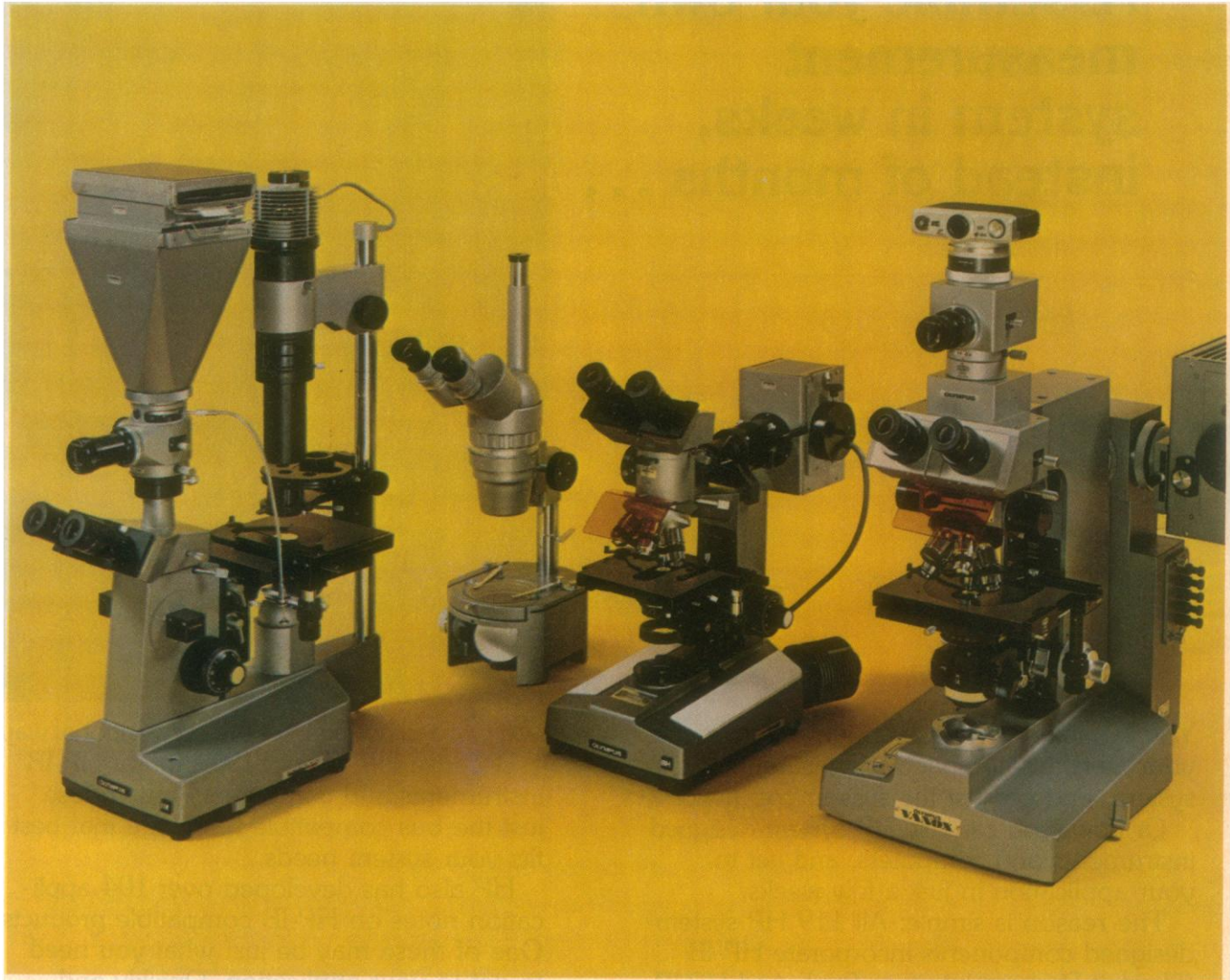
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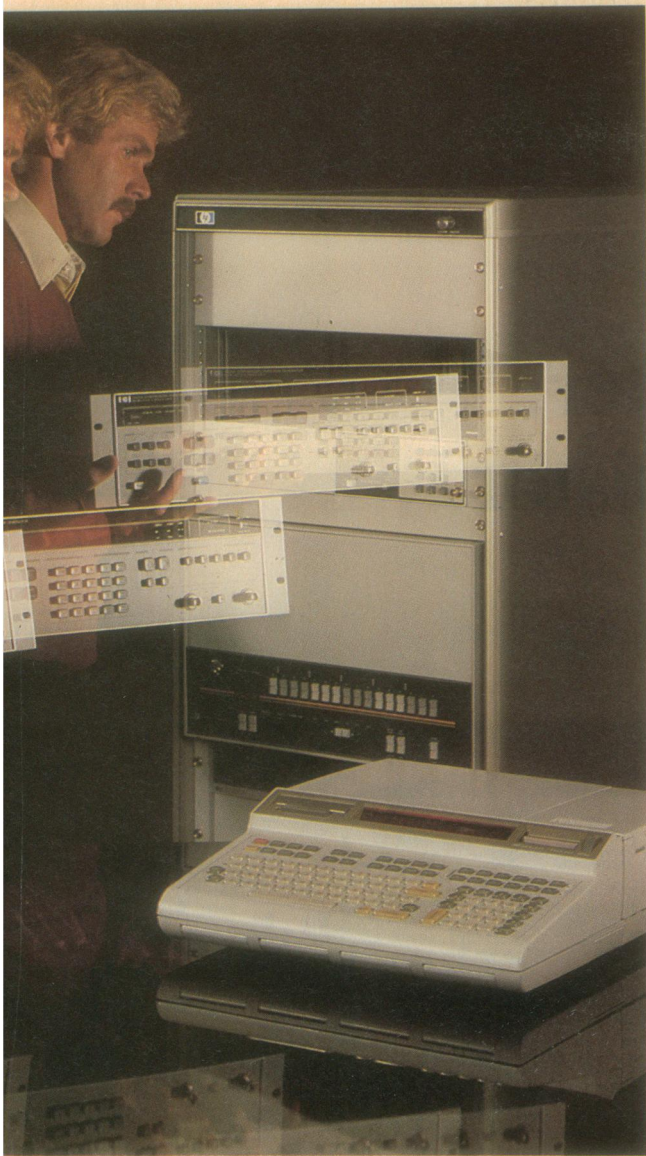
For that matter, every HP-IB compatible product comes with complete and comprehensive documentation. Many of our computers feature high-level I/O language that eliminates the need for an I/O driver.

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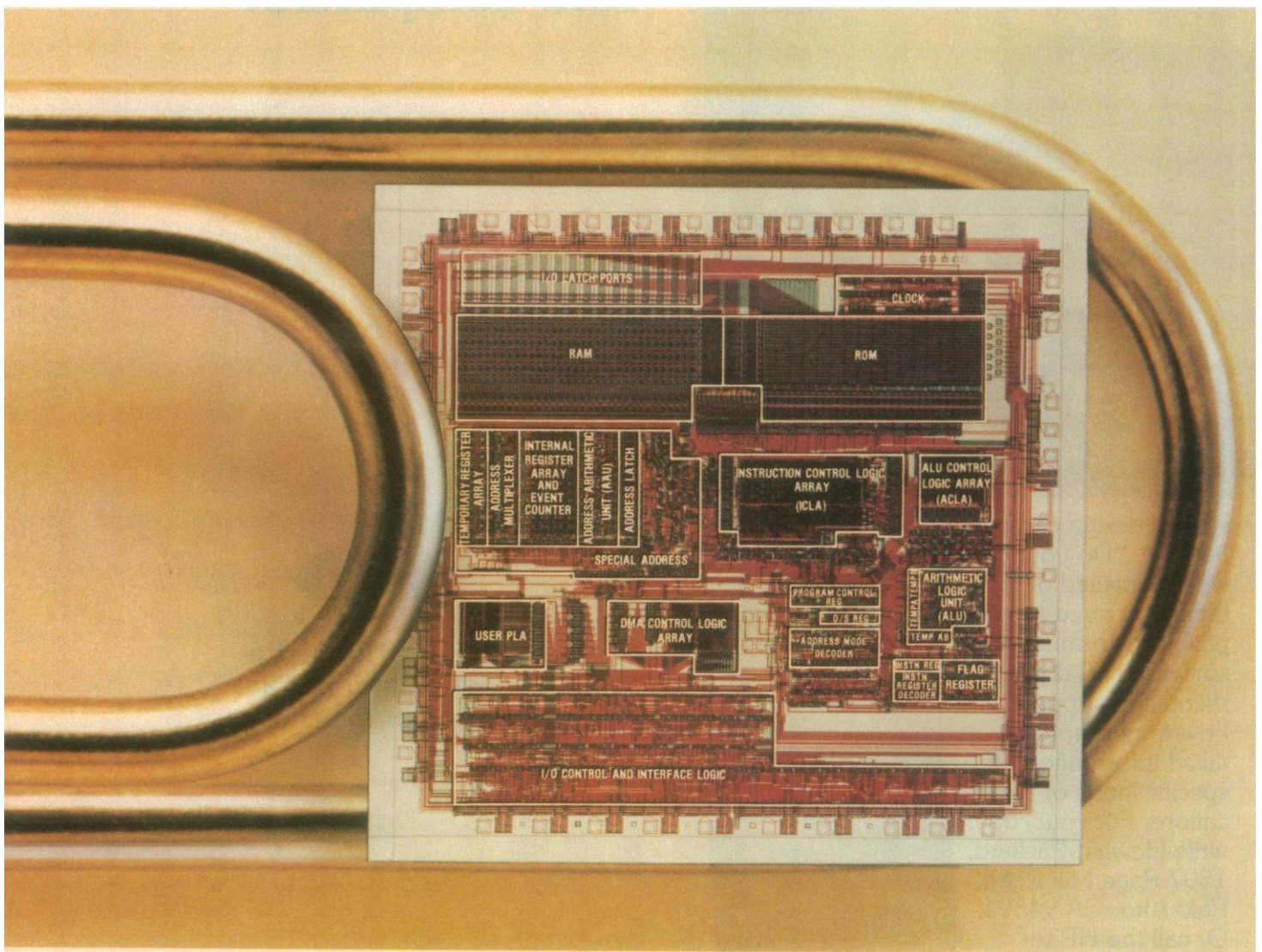


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# The one-chip computer: offspring of the transistor



The MAC-4 one-chip computer, developed for a variety of telecommunications applications, is compared to a standard-sized paper clip. The chip's numerous functional areas are labeled.



One of the transistor's latest descendants is the Bell System's 30,000-element MAC-4 "computer-on-a-chip." It's another in a long line of microelectronic developments that have come from Bell Laboratories.

The MAC-4 is so efficient that a program written on it takes 25 percent less storage space than that required by most other microcomputers. Its assembler language, C, also developed at Bell Labs, has features that make MAC-4 easier to program, debug and maintain. And the MAC-4 can handle anything from nibbles to bytes to words with its 4-, 8-, 12-, and 16-bit operations capacity.

Like other one-chip computers, the MAC-4 has sufficient memory to support its varied tasks—3000 nibbles of read-only memory and 200 nibbles of random access memory coupled to 34 input/output ports.

Fabricated with the latest CMOS technology, the MAC-4 needs little power. Thus it is well matched to a variety of telecommunications applications.

#### **It started with the transistor**

MAC-4 is just one current example of the many microelectronic devices to come from Bell Labs since we started the

solid-state revolution with the invention of the transistor in 1947.

Over the past three decades, our advances in materials, processing, and devices have been vital to solid-state technology. These include:

- The Junction Transistor
- Crystal Pulling
- Zone Refining
- Field-Effect Transistor
- Diffusion
- Solar Cell
- Oxide Masking
- Thermocompression Bonding
- Photolithography
- Epitaxial Film Process
- Magnetic Bubble Memory
- Charge-Coupled Device
- Semiconductor Heterostructure
- Laser Used in Lightwave Communications
- Electron-Beam Exposure System

#### **Today and tomorrow**

Today, we continue to make important contributions to solid-state technology. For example, we've developed a rugged 65,536-bit RAM that can tolerate processing faults. Corrections can be made on the chip itself, so we can get more usable chips out of each manufacturing batch—and thus lower unit costs.

In materials processing, we've

developed a technique for precisely controlling the growth of successive atomic layers of single crystal materials. This "molecular beam epitaxy" process is finding increasing use within Bell Labs and elsewhere in the electronics industry. We've used it to fabricate a device that permits us to double the speed of electrons by channeling them into crystal layers where they meet less resistance.

Other advances, in X-ray lithography and new resist materials, for example, promise to help place more elements on microelectronic devices and thus enhance their ability to perform important tasks.

As the solid-state revolution continues, these and other developments from Bell Labs will play an important part in it. What's important to us is the promise these advances offer for new telecommunications products and services. Like the transistor, MAC-4 and its solid-state relatives will find more and more applications in the nationwide telecommunications network.

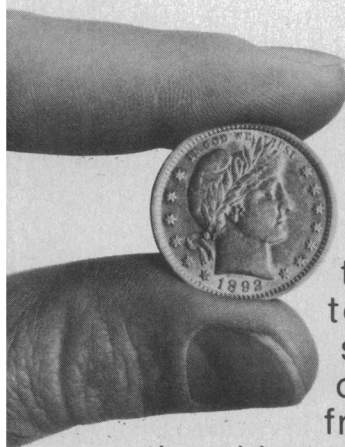
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The heart of the CU-70 system is the revolutionary SX-70 Sonar Landcamera—the amazing camera that automatically and precisely focuses every picture you take using sound waves. A Polatronic flash unit and precision close-up attachments are included in the lightweight, rugged CU-70 carrying case.

You don't have to be a photographic genius to use the CU-70 system. To take close-ups at life-size, 2x and 3x, just select the proper color-coded attachment, frame the subject and shoot. The SX-70 Sonar camera does the rest. There's no focusing, no complicated settings to fumble with or lighting to adjust.

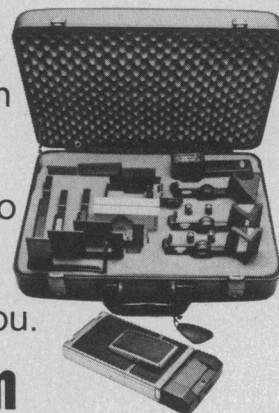
And the CU-70 is ideal for a wide variety of uses: QC documentation, medical/biological recording, insurance records, forensic and evidence photos, and records of collections of all kinds: like stamps, coins and objets d'art. It's invaluable



anytime you need to take a closer look.

So if you'd like more information about our new CU-70 Photographic System contact your local Polaroid photographic dealer. For the name of the CU-70 dealer nearest you, please write: Polaroid Corporation, Dept. A464, 575 Technology Square, Cambridge, Mass. 02139. Or call toll free in the continental U.S.: 800-225-1618. (In Massachusetts you can call collect: 617-547-5177.)

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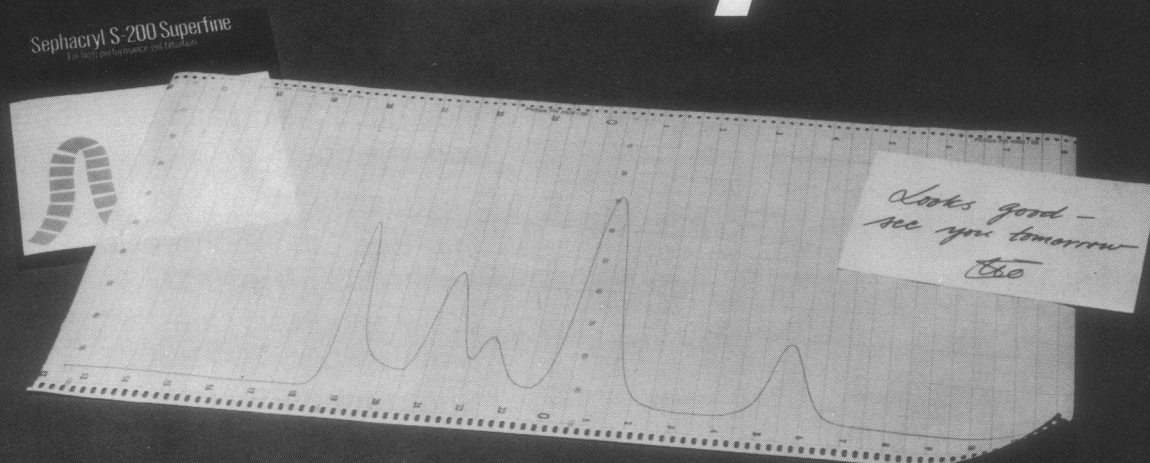


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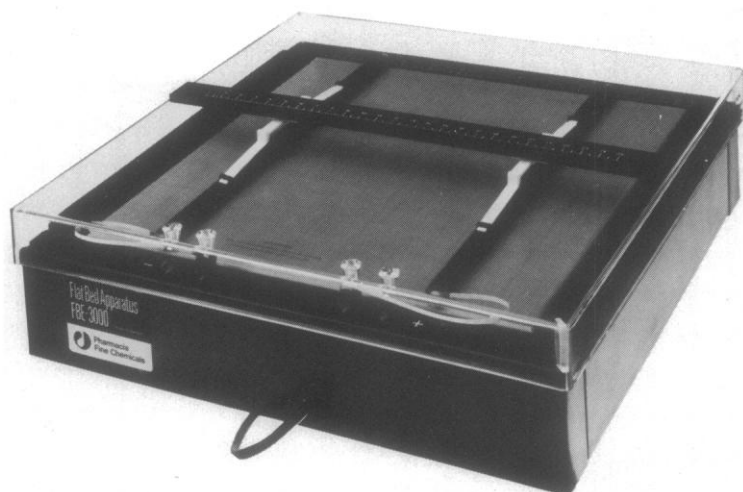
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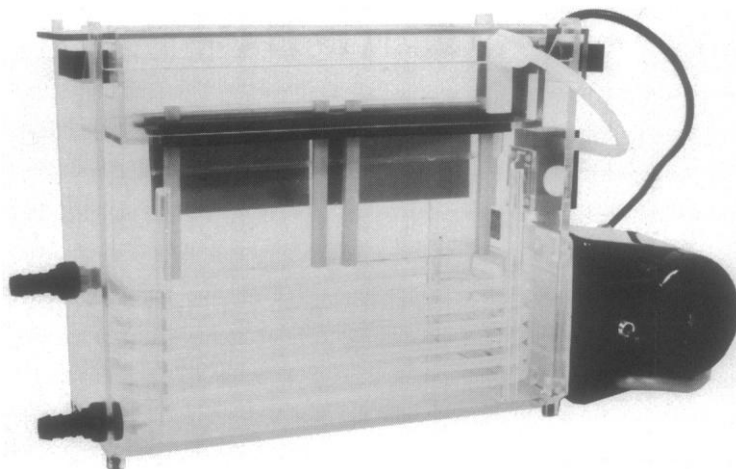
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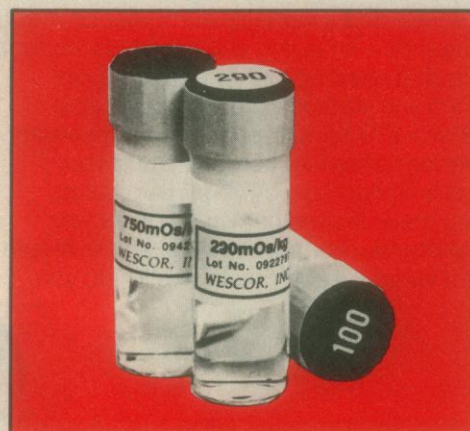
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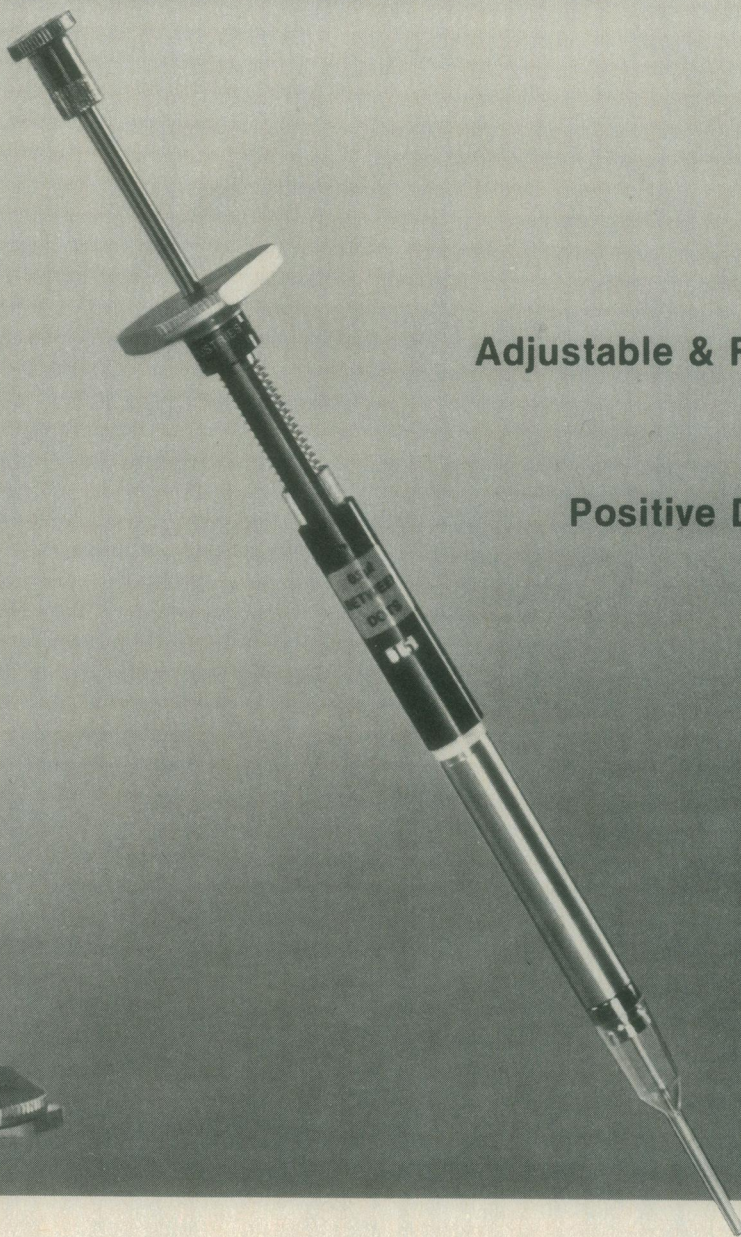
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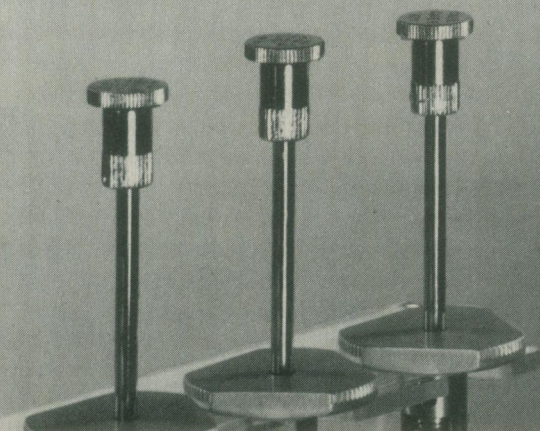
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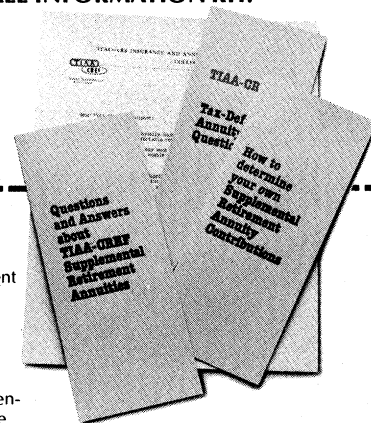
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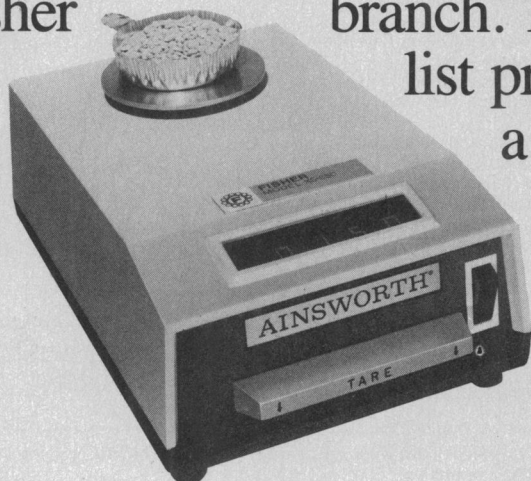
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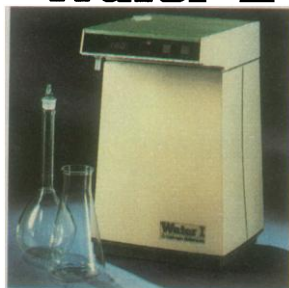
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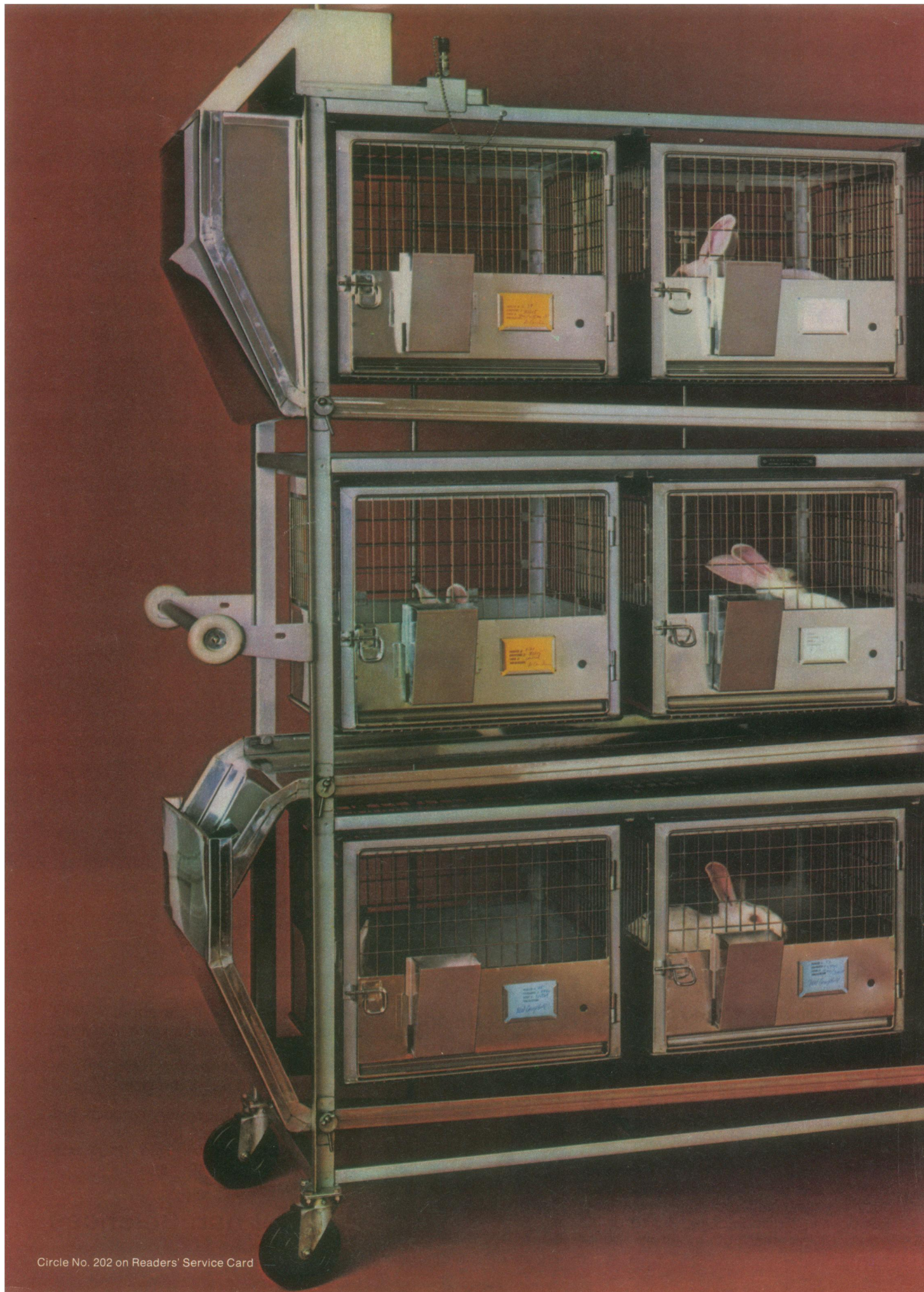
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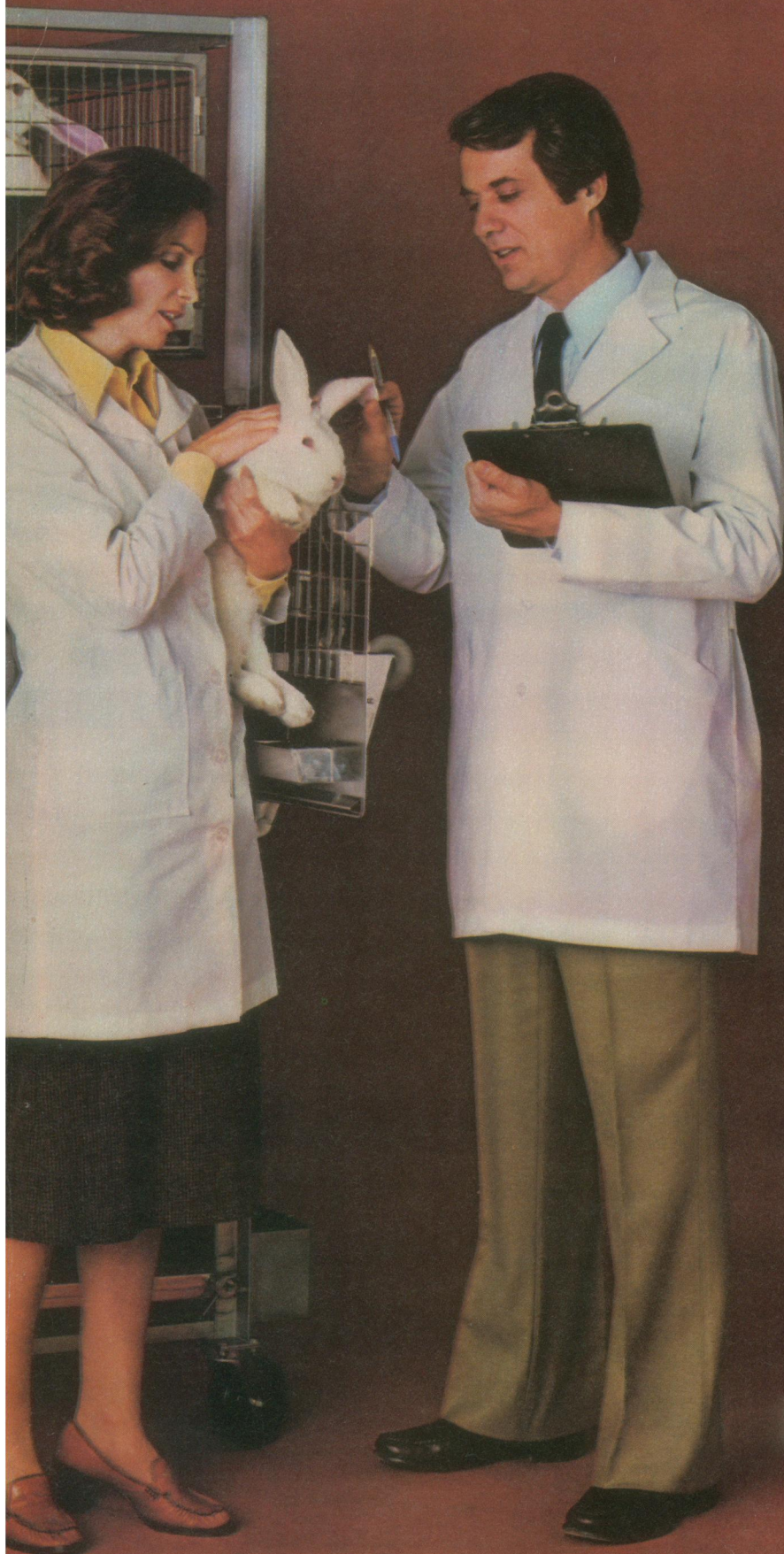
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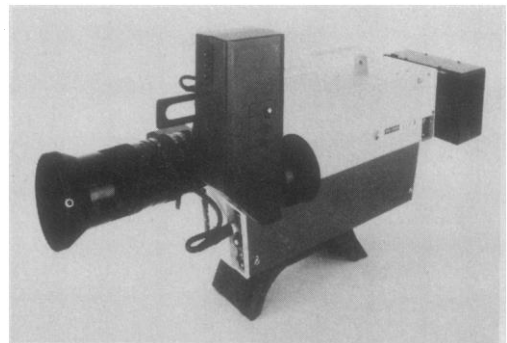
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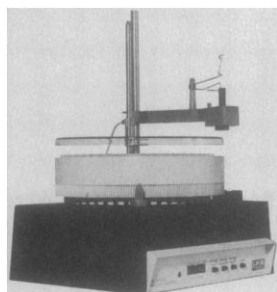


Gradient elution run on Hewlett Packard HPLC Model 1084A equipped with variable wavelength detector set at 254nm with attenuation of 0.01 AUFS and L.C. Terminal 79850A. Column is Waters C-18 Reverse Phase run at 30°C. Flow is 4ml/min. Solvent B is Fisher HPLC Grade Acetonitrile, catalog no. A-998, lot no. 700191. Solvent A is Fisher HPLC Grade Water, catalog no. W-5, lot no. 794709.

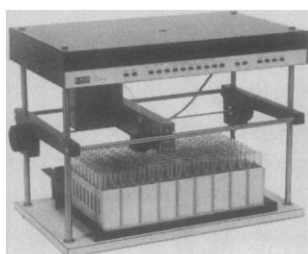
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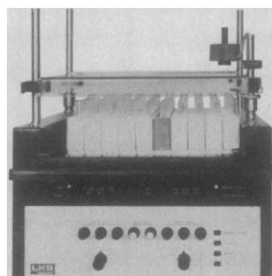
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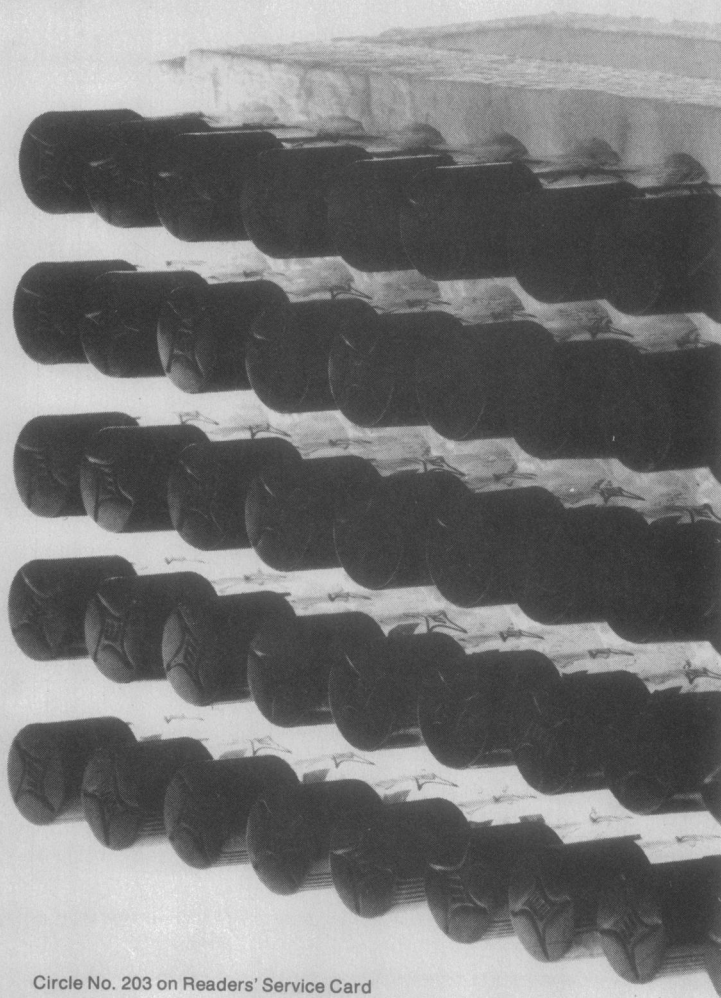
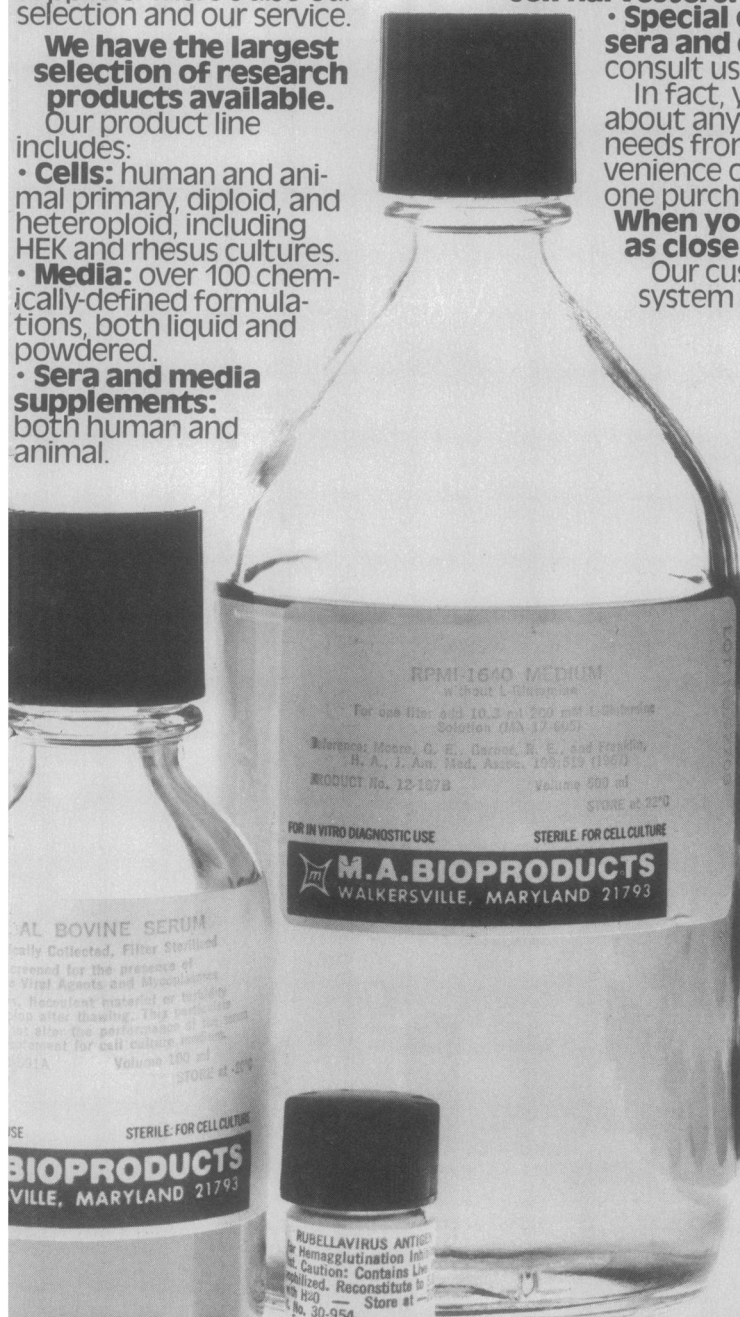
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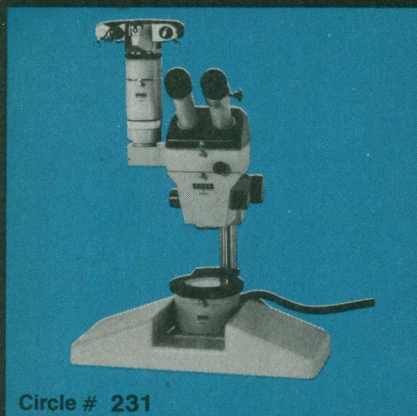
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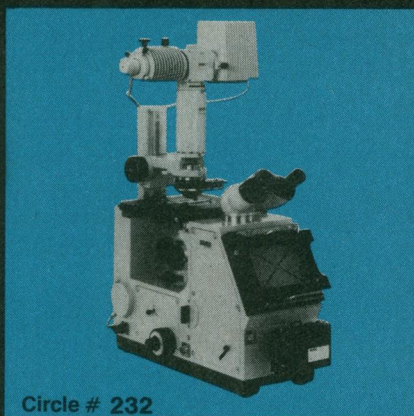
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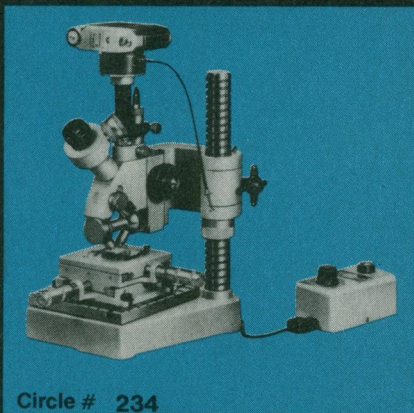
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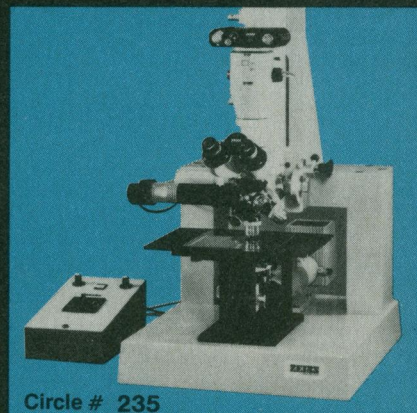
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2. Epi-Technoscope.



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5. Light-Section Microscope.



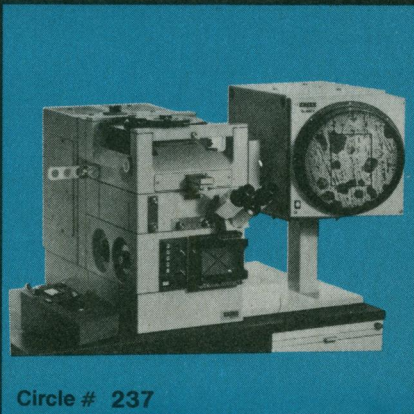
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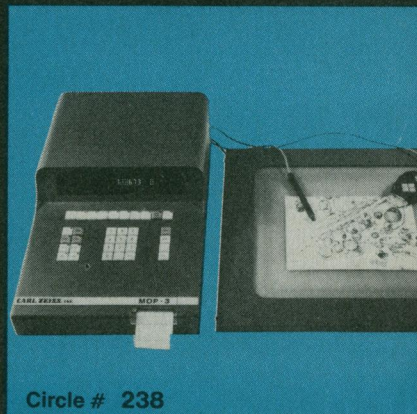
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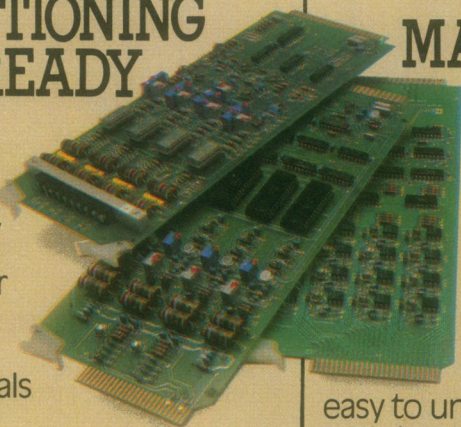
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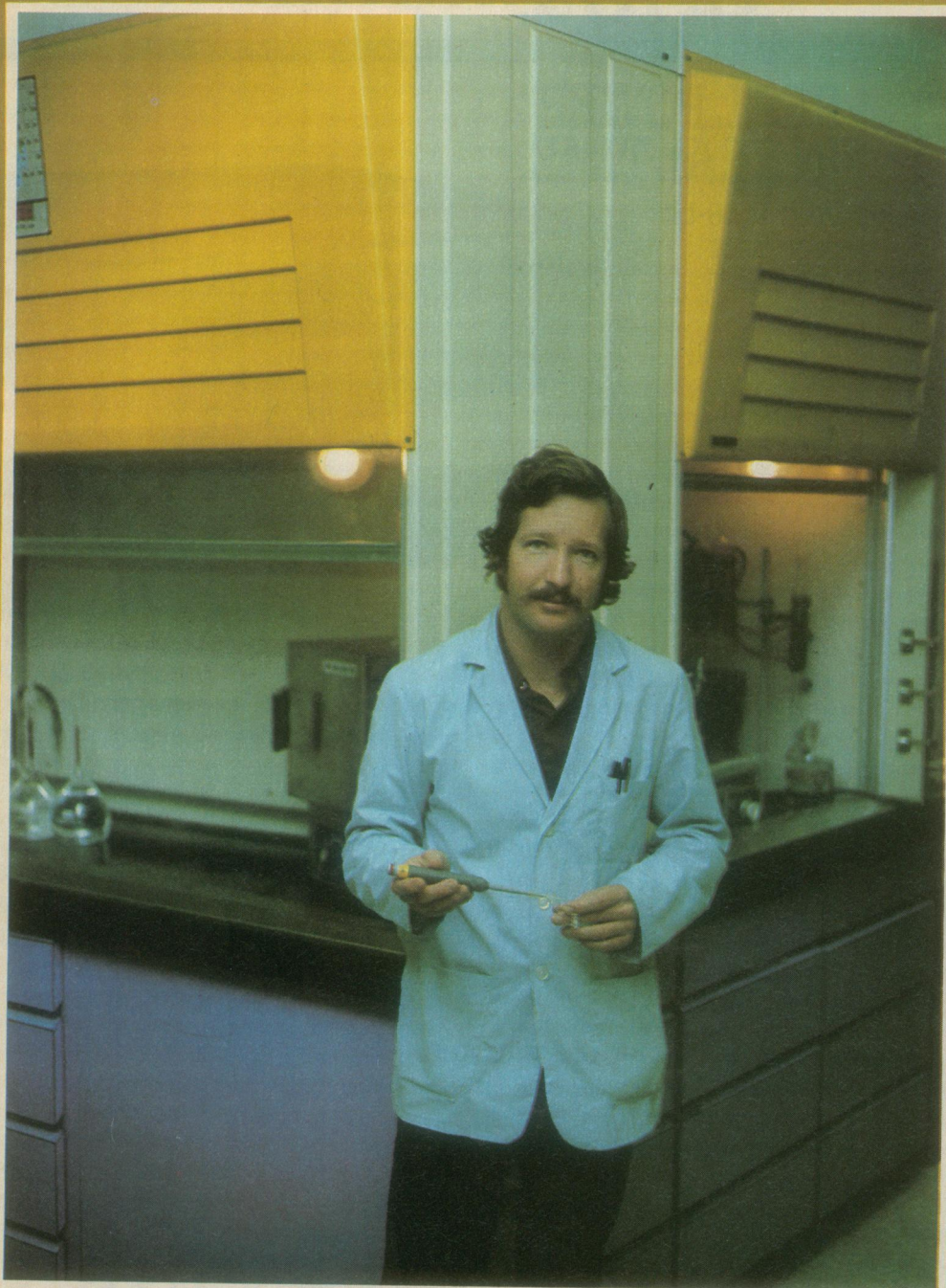


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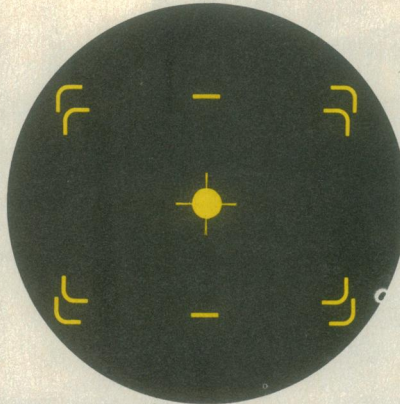
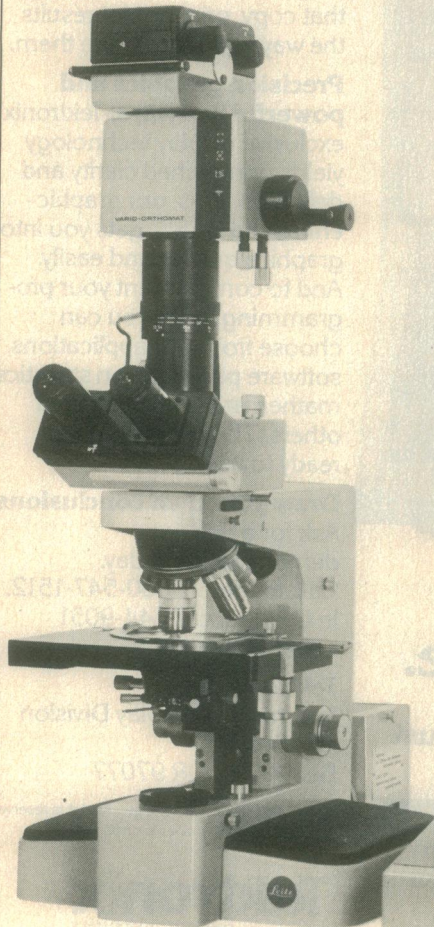


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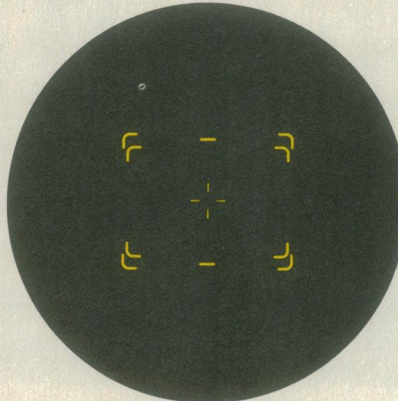
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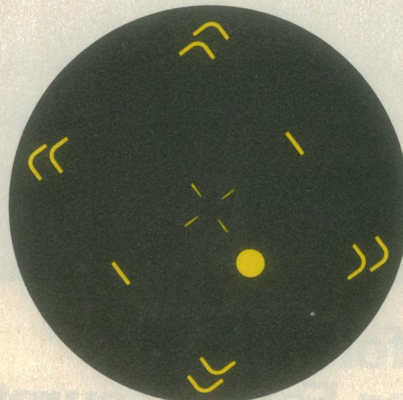
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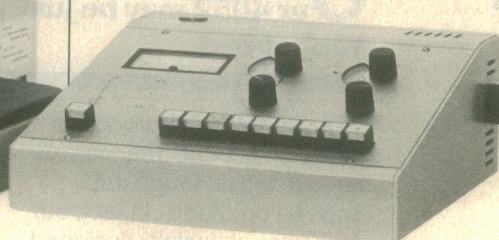
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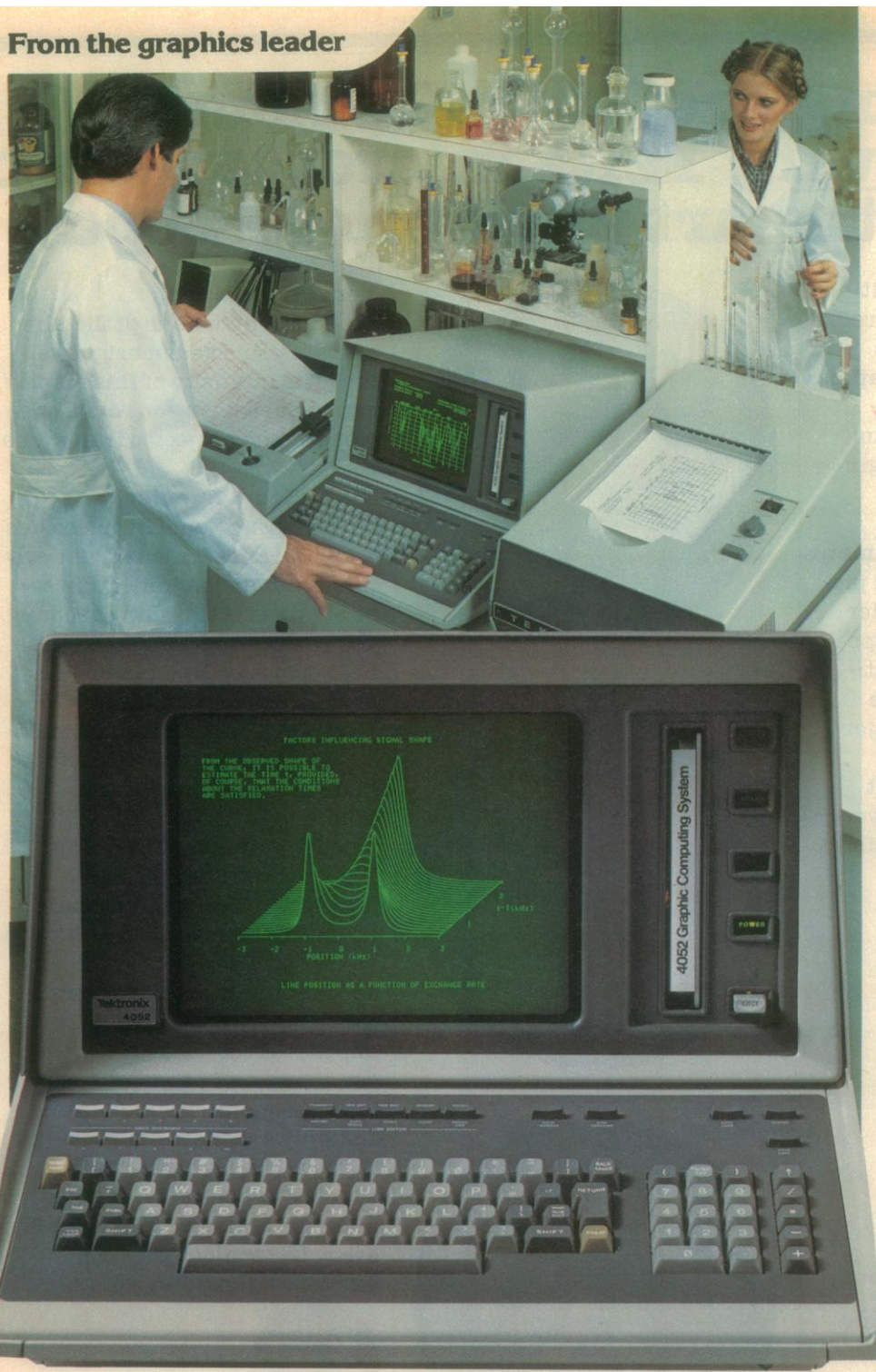
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Three general groups of materials are involved: (i) polymers, (ii) metals, alloys, oxides, and silicates, and (iii) electronic materials, primarily semiconductors. New kinds of polymers continue to be discovered having special properties such as great strength, high thermal and chemical stability, or electrical conductivity. Fundamental understanding of the behavior of polymers is being obtained by use of NMR and other experimental tools, which give quantitative guidance in efforts to formulate superior products. Major activity, though, is devoted to combining already available monomers and polymers to form objects with desired properties superior to those of a pure polymer. For example, combinations of layers of polymers can lead to containers that are tough, strong, and resistant to passage of oxygen. Mechanical properties can be greatly altered by incorporation of reinforcing fibers, inert materials, or gases. The new products are finding many uses in energy-saving applications.

In their studies of materials, chemists and physicists have roamed throughout the periodic table and have made countless combinations of elements and tested them in various proportions. Such work has led to new superconductors and to improved permanent magnets that require less imported cobalt than earlier types. Major advances are being made in improving the strength of materials. One method takes advantage of the fact that some crystals have great unidirectional strength. Another development is the creation of low-alloy, high-strength steels. Even more spectacular has been the development of glassy metals. When liquid mixtures are cooled very rapidly, the resultant solids may have strengths 15 times that of products cooled more slowly. At the same time, other properties such as magnetic permeability and freedom from corrosion may also be greatly improved. A research effort of great importance is the work to develop superior specific catalysts. This involves detailed understanding of the interactions among atoms at surfaces. Improvements of as much as a factor of  $10^{12}$  have been obtained in speeds of reaction. When combined with high specificity, such performance leads to major energy savings. The research effort on catalysts has also led to the development of zeolite cage structures capable of catalyzing the conversion of methanol to gasoline.

During the past decade the most dynamic area of technology has been in exploitation of the potential of semiconductors such as silicon. The electronics revolution continues with considerable emphasis on obtaining more transistors per chip and better, lower cost computer memories. But other frontiers are under scrutiny. Semiconductors such as GaAs (III-V compounds) may be the key to even faster, better computers. Such compounds have already proved useful for lasers and light-emitting diodes. A different approach to increasing the speed of computation is through the development of Josephson-type devices that function at cryogenic temperatures. Another activity is work to develop superior photovoltaic materials.

One of the fastest growing applications of new materials is in prosthetic devices. This year, between 2 million and 3 million such devices will be implanted in humans, creating an interesting set of interactions between living and nonliving substances.—PHILIP H. ABELSON



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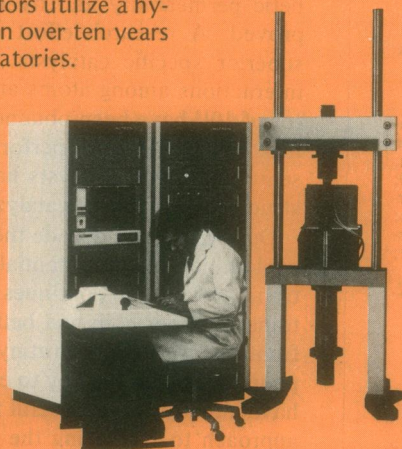
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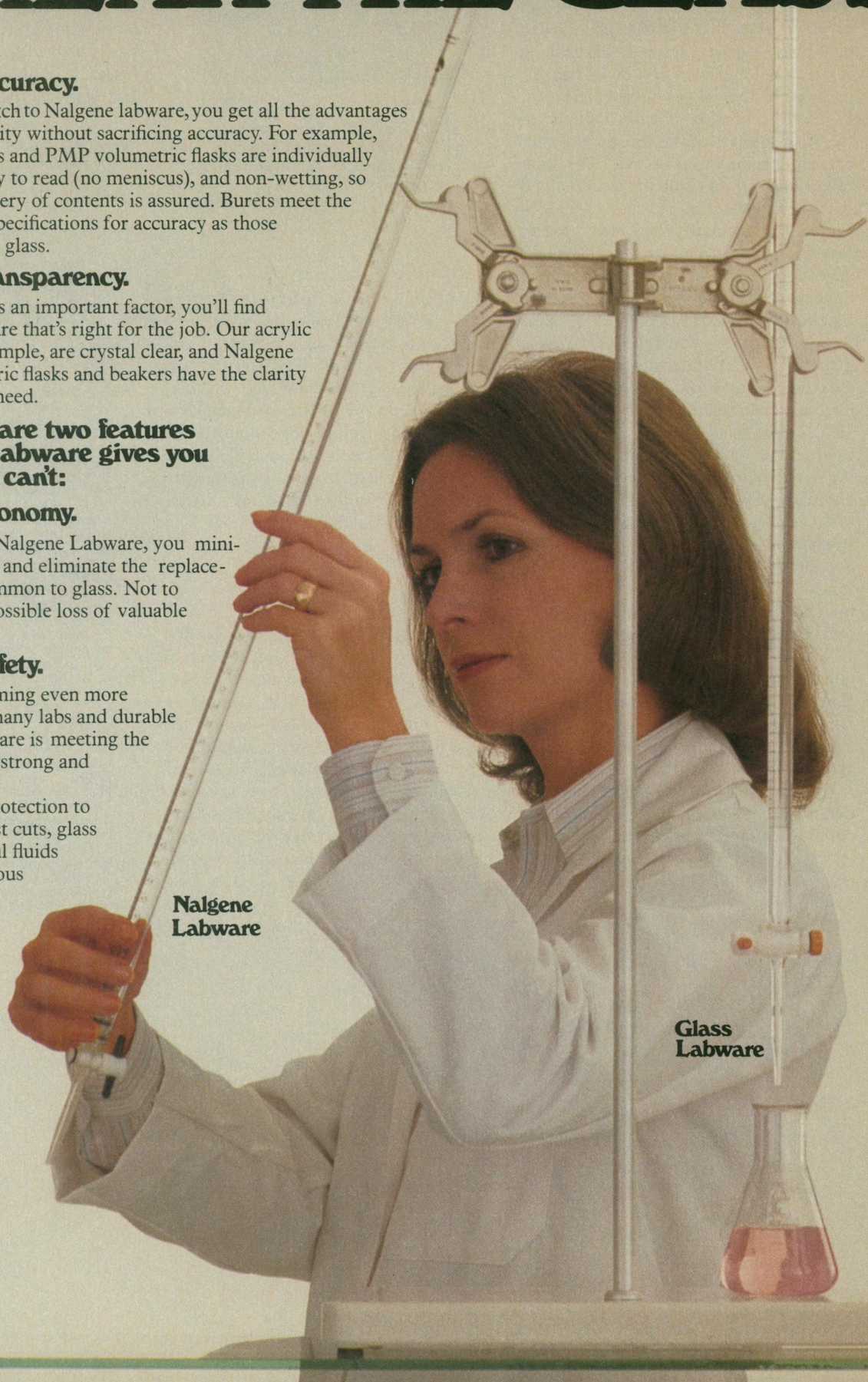
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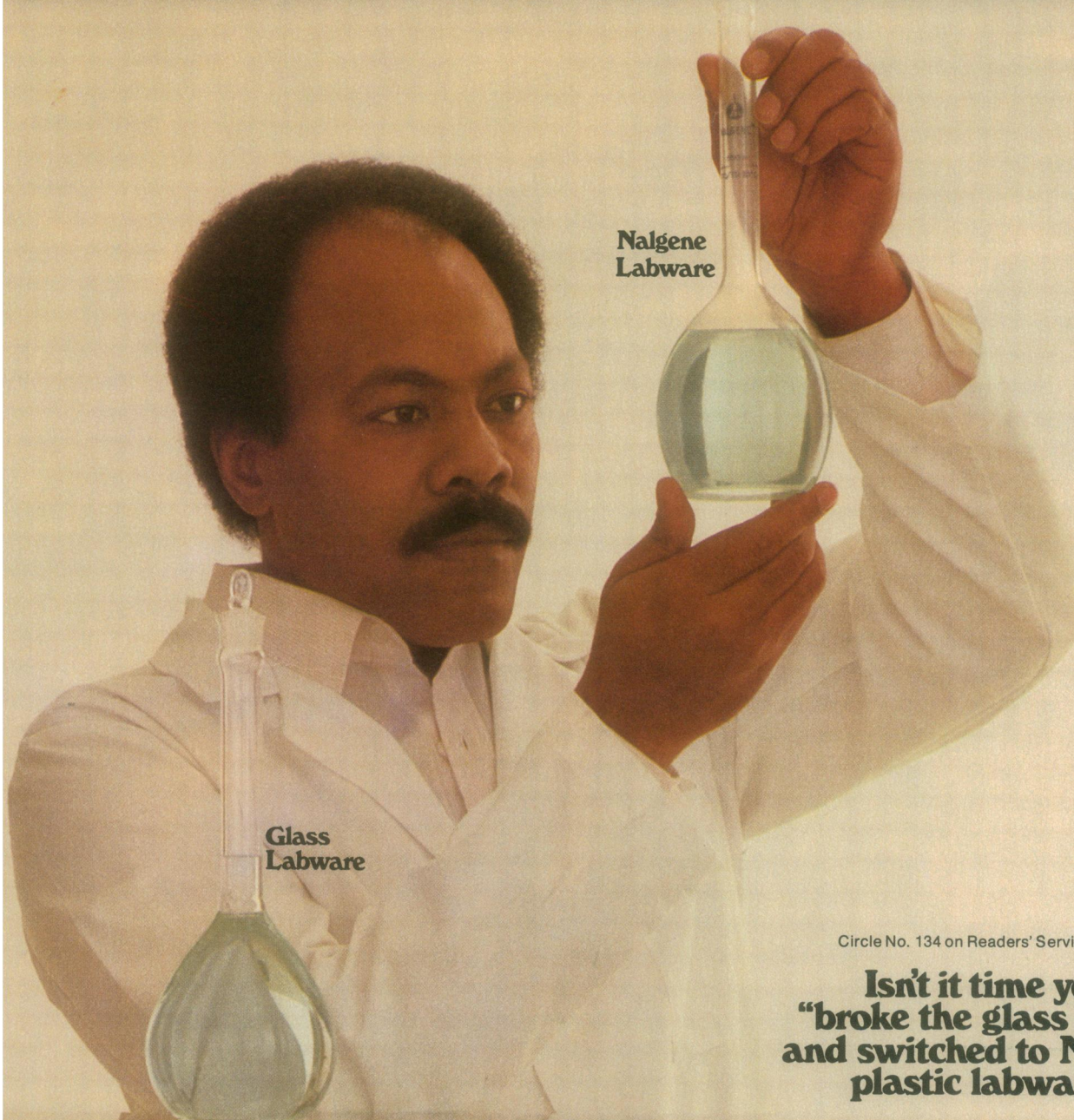
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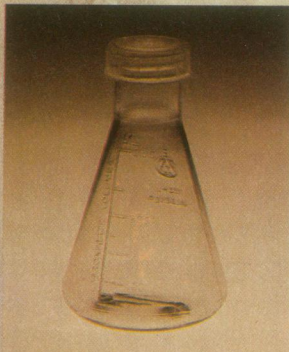
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