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20 February 1976, Volume 191, No. 4228

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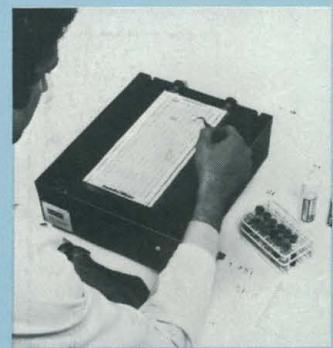
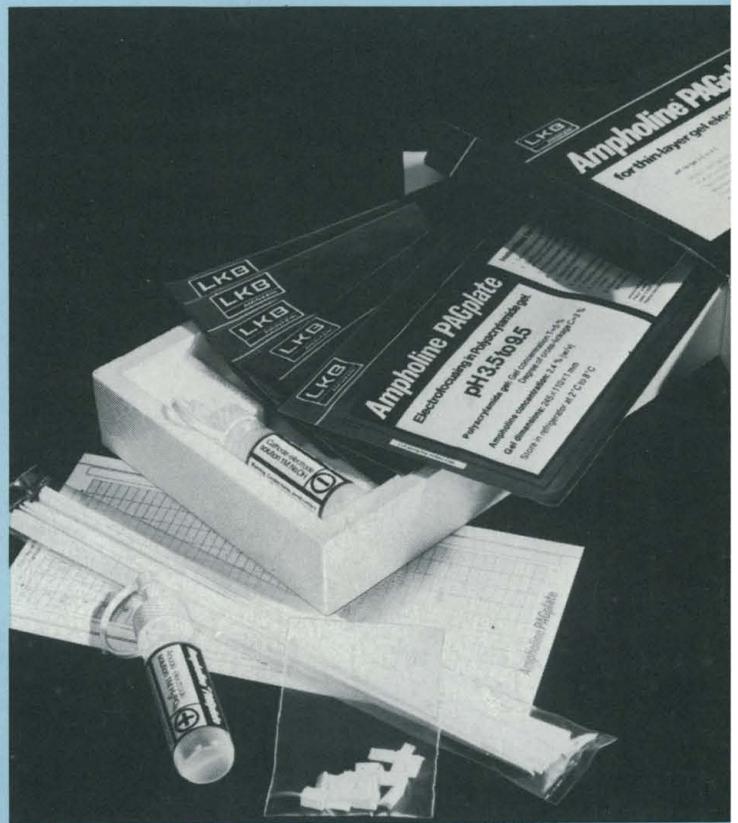
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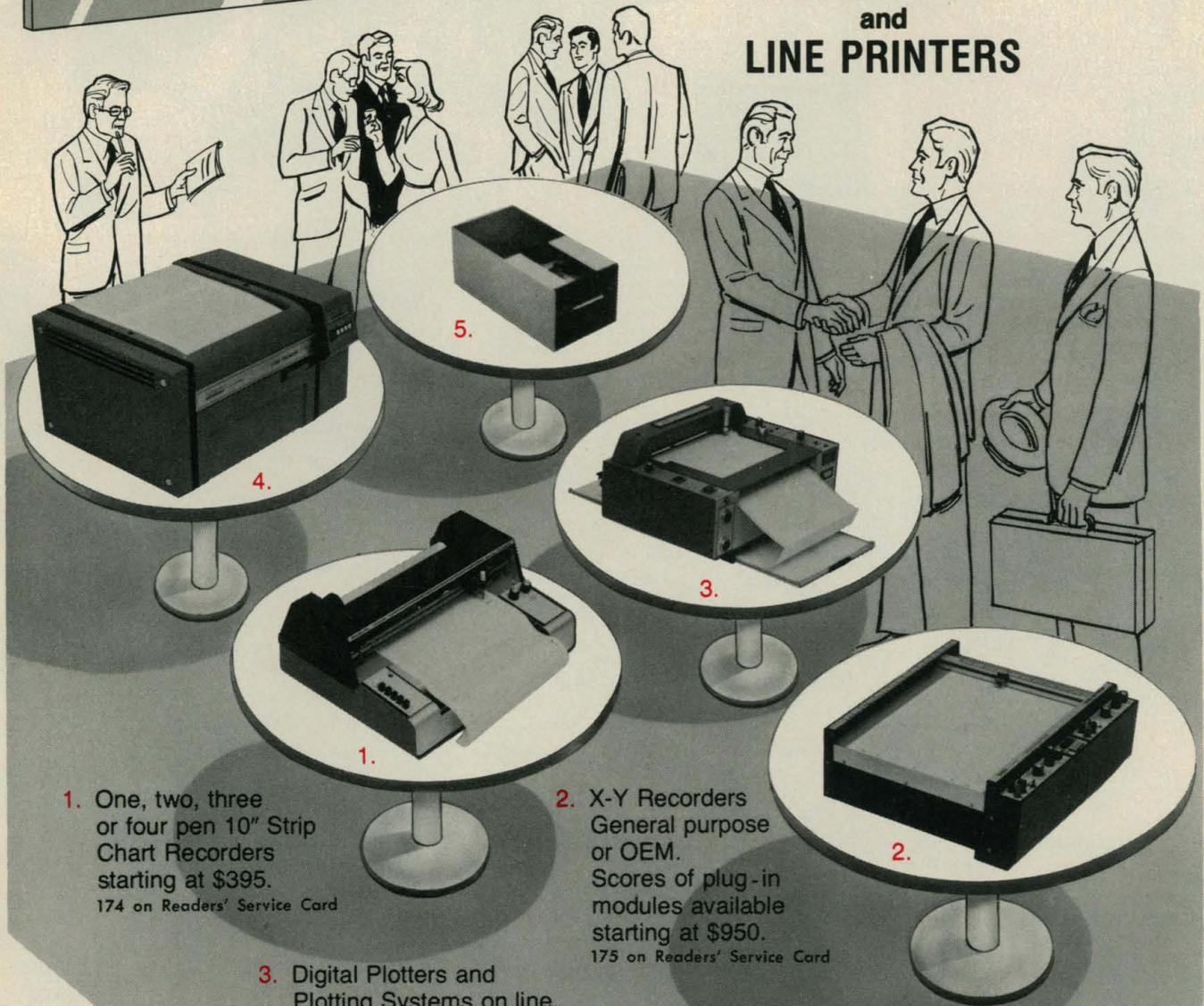
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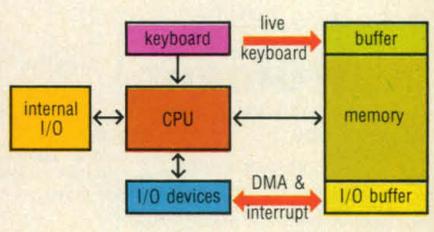
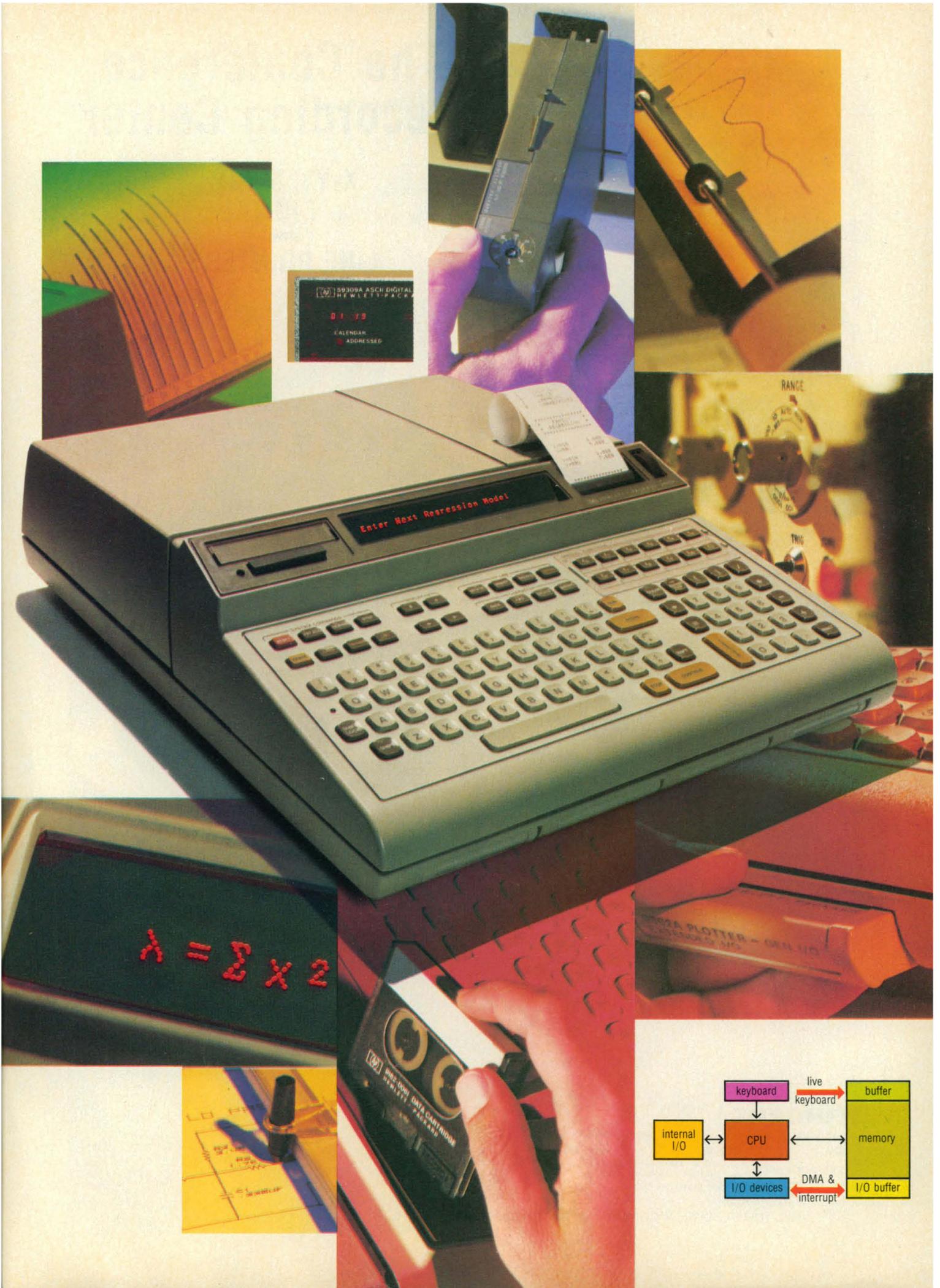
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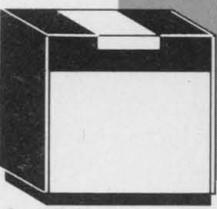
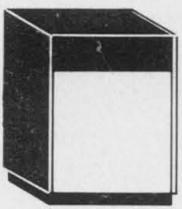
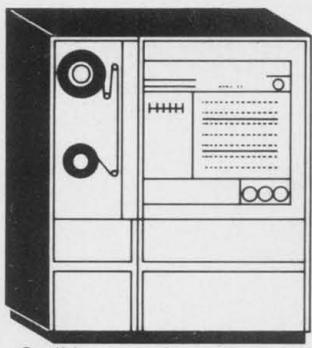
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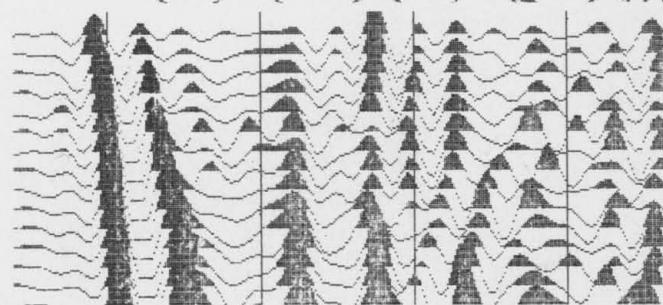
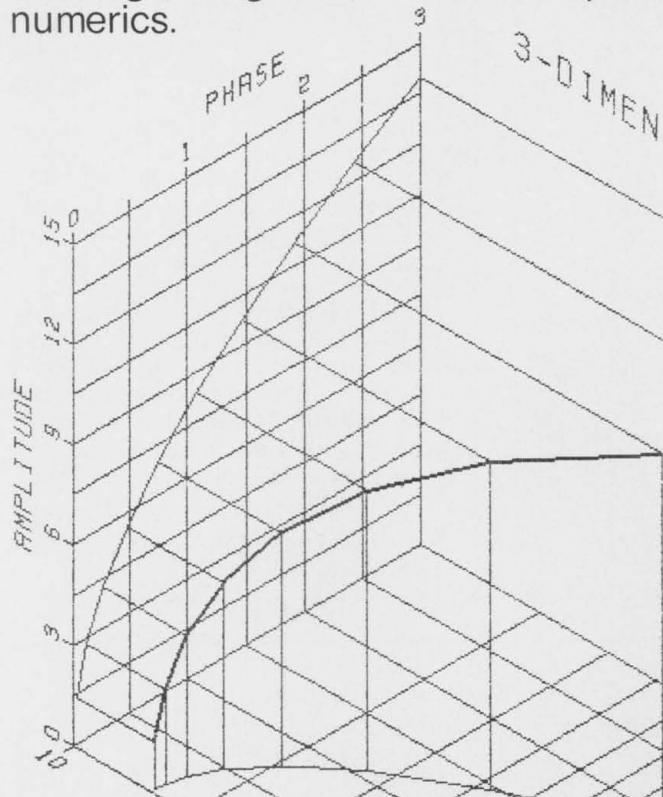
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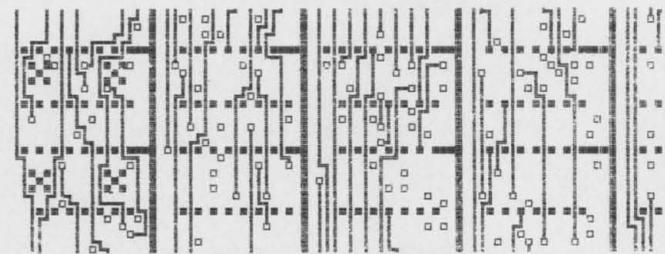
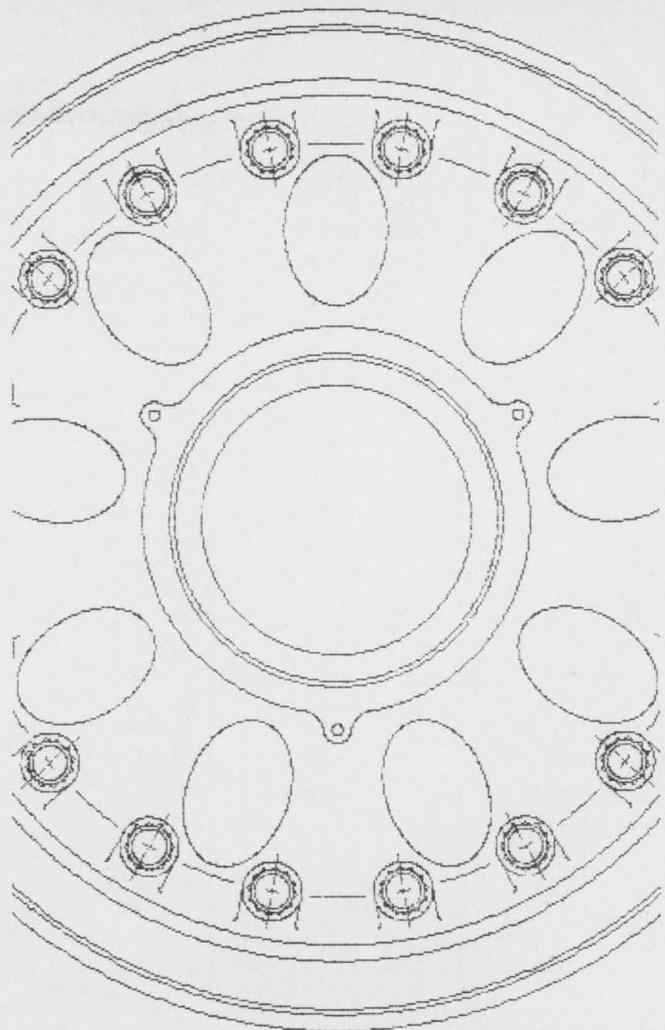
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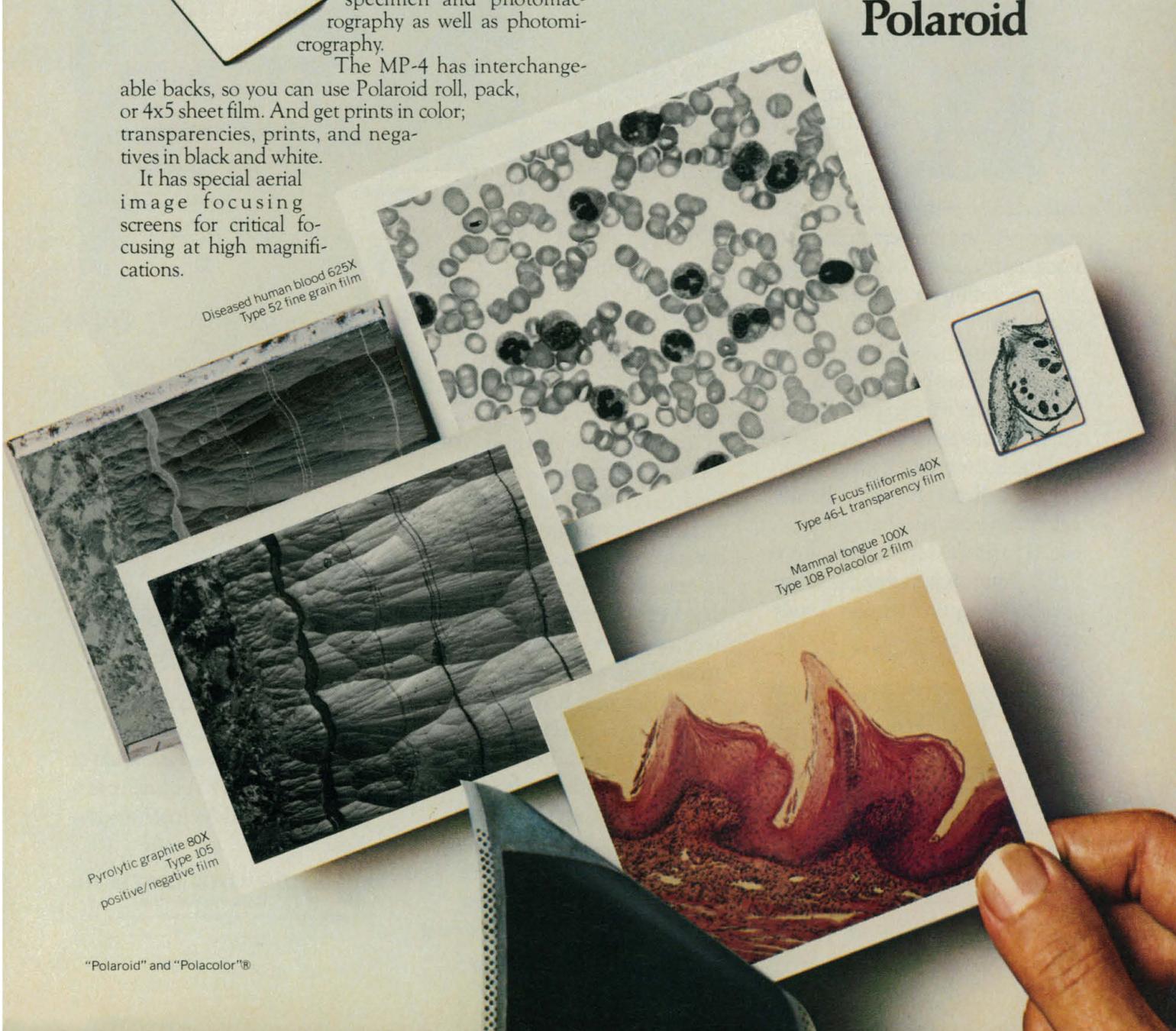
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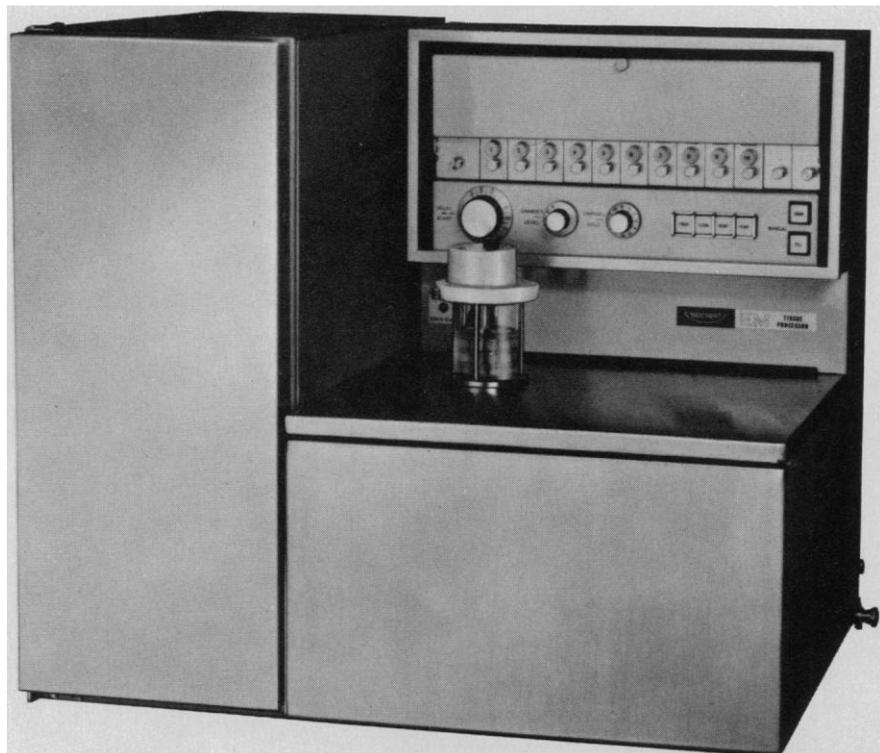
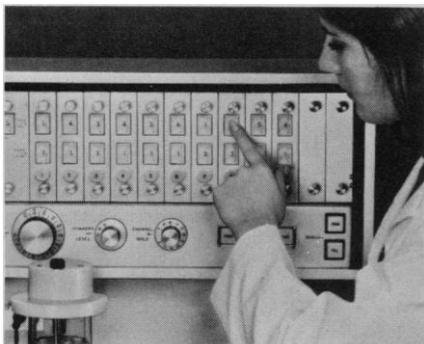


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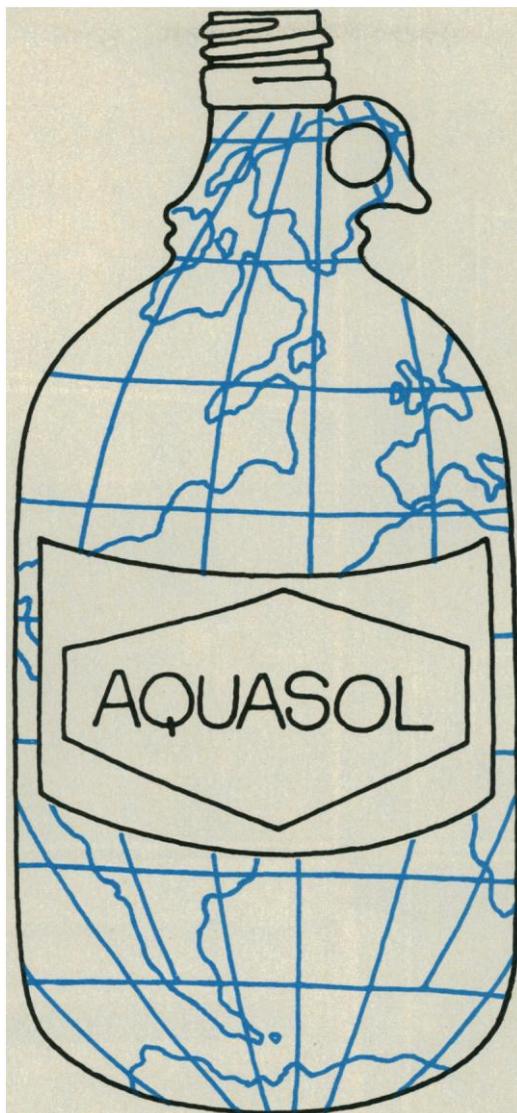


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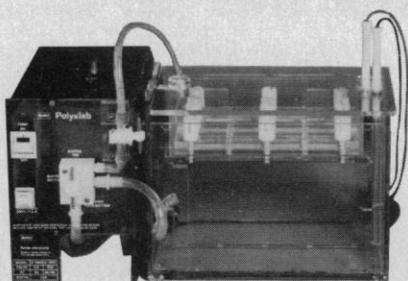
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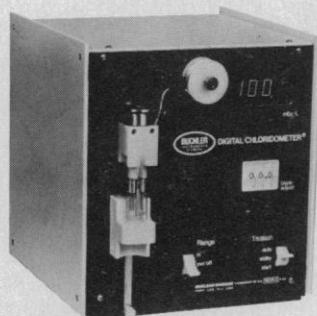
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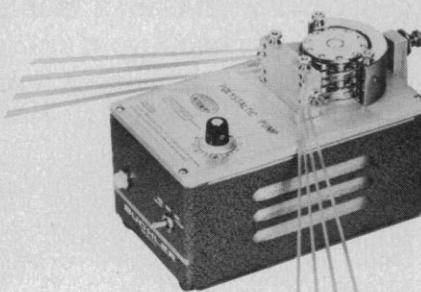


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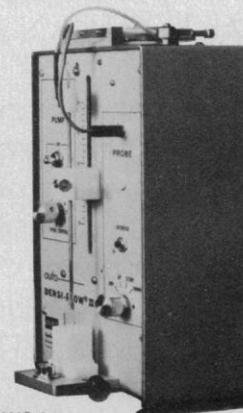
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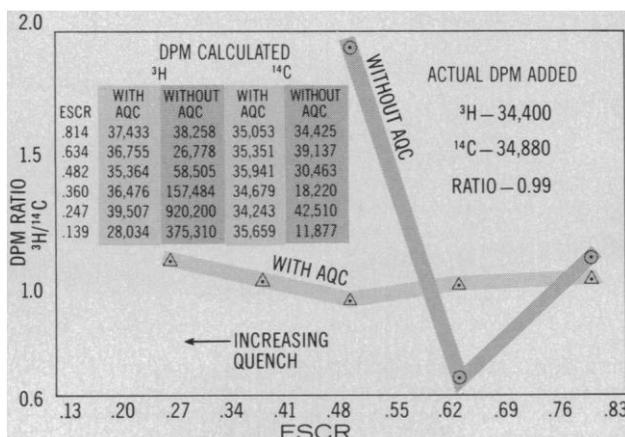
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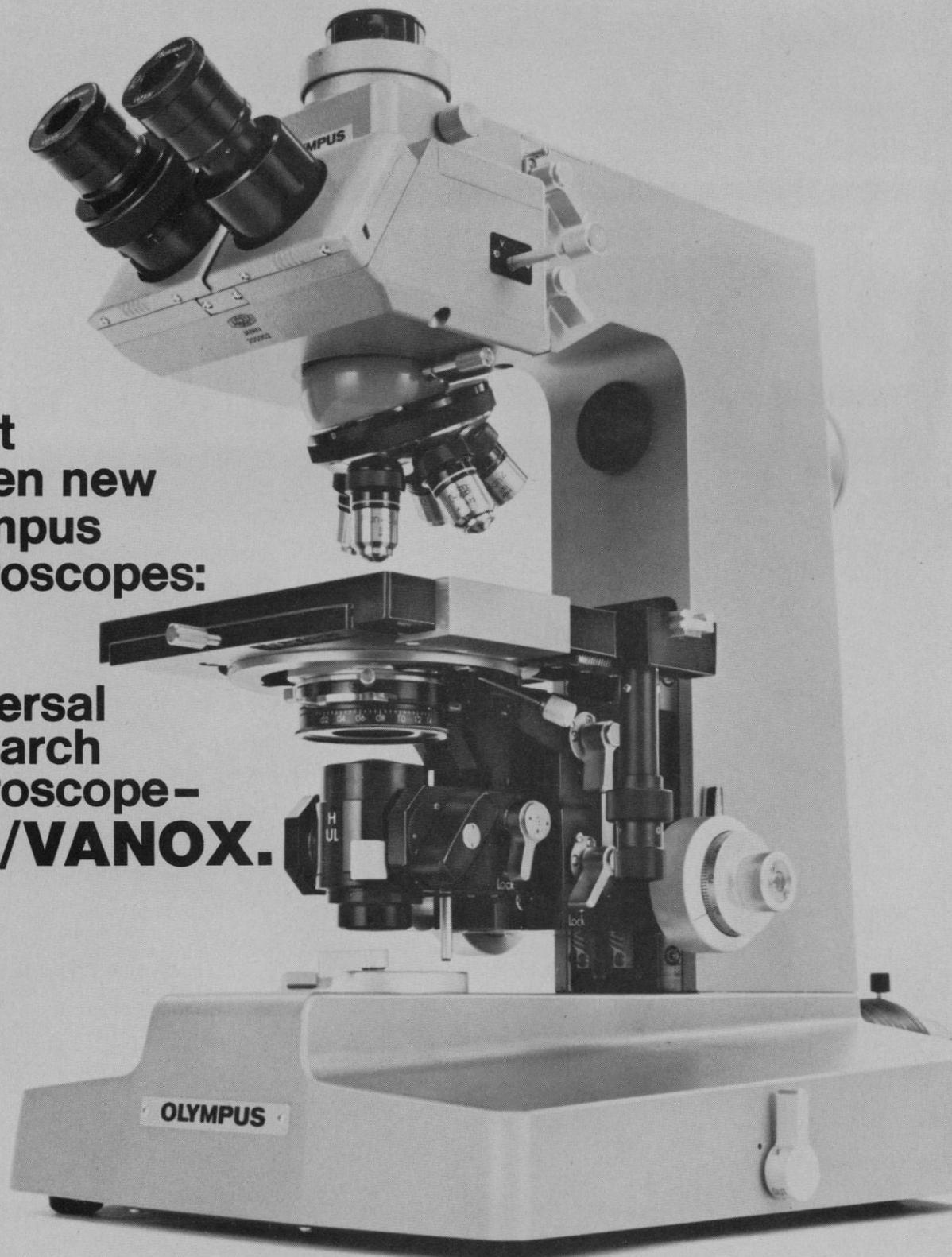
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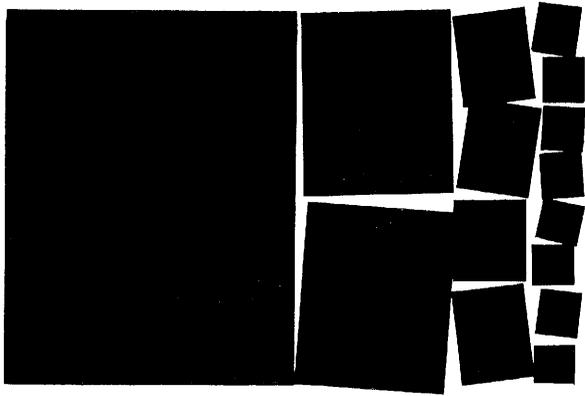
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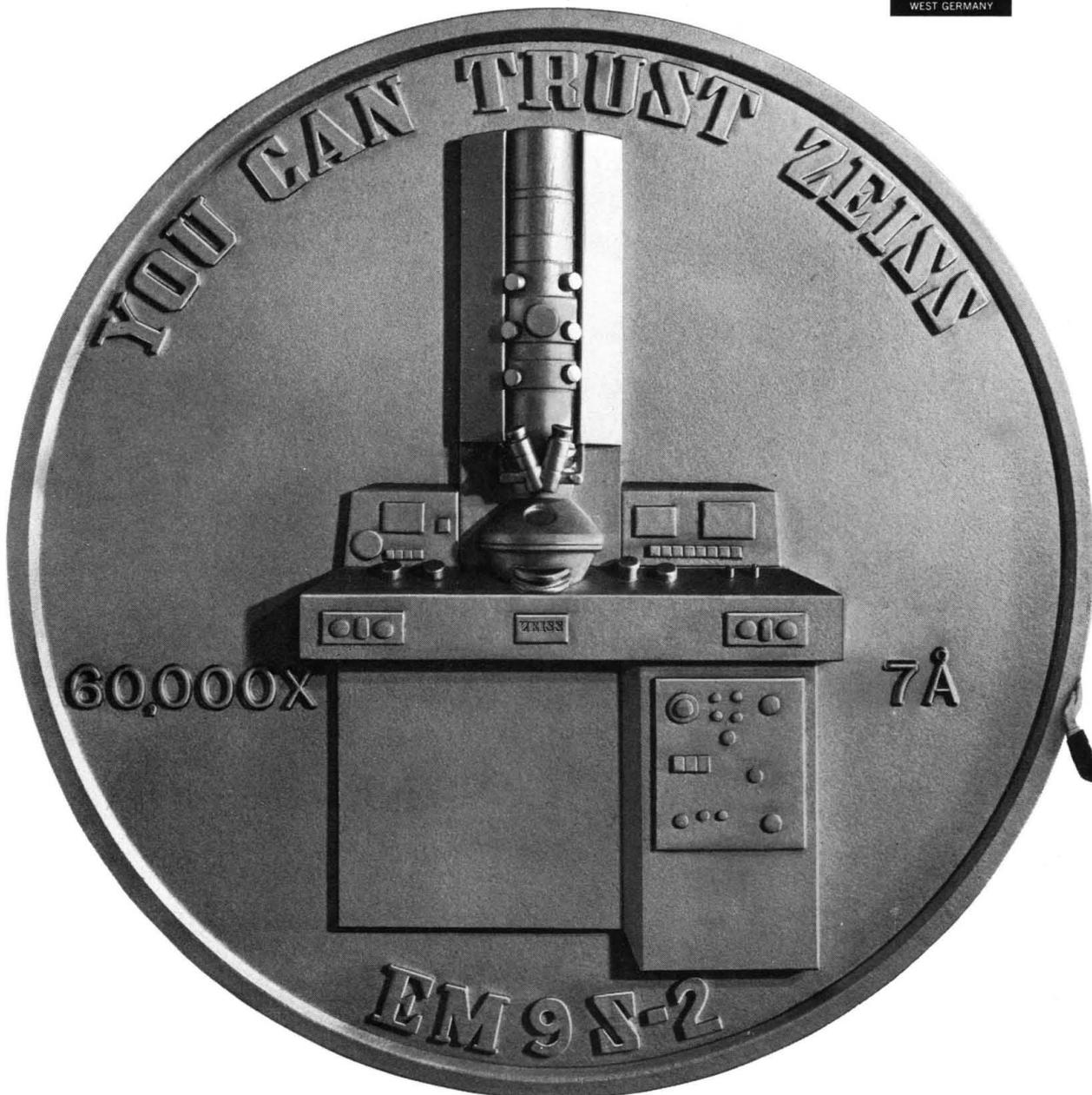
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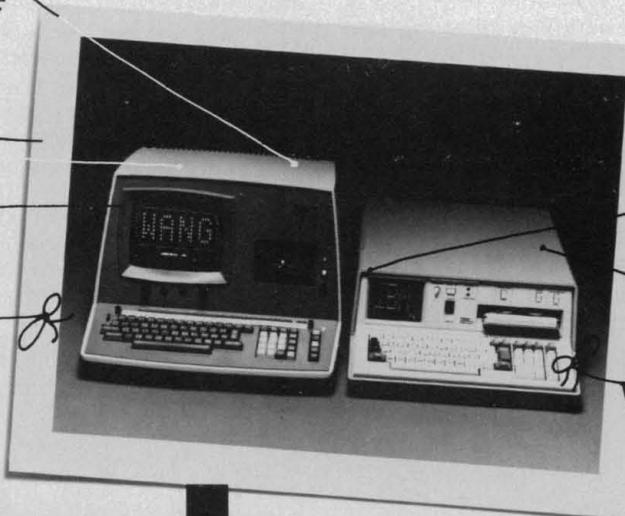


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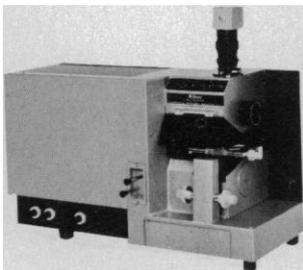
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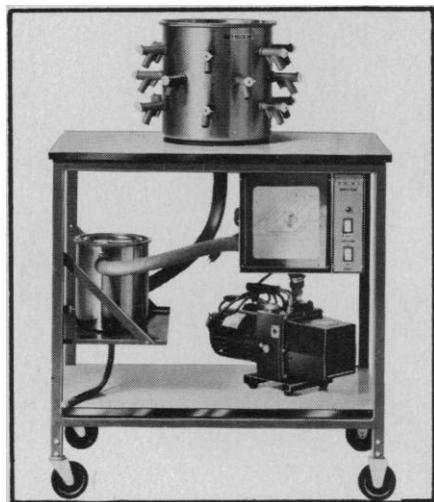
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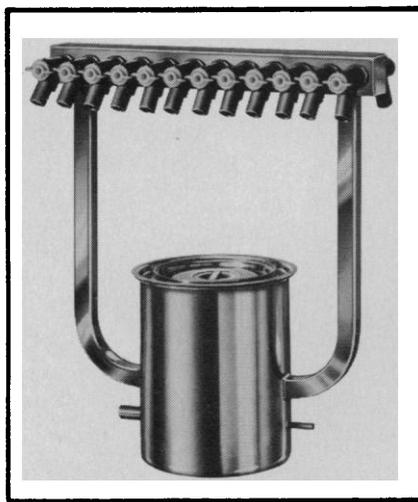
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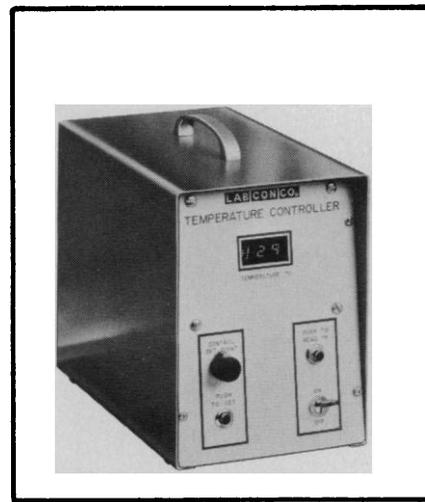
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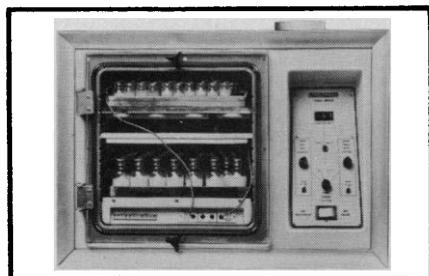
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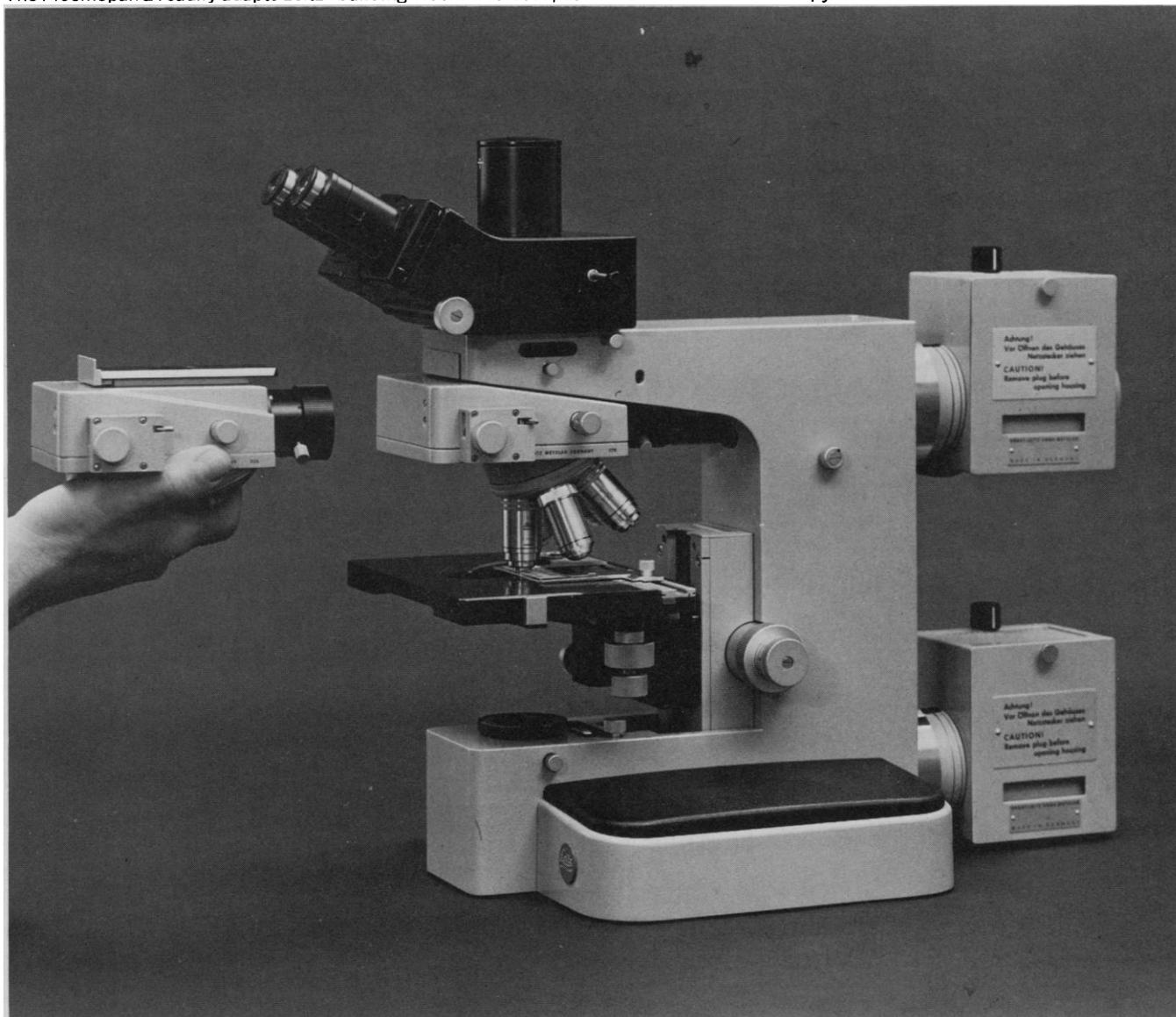
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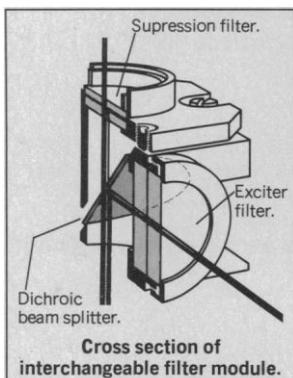
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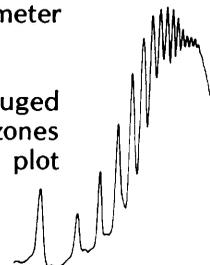
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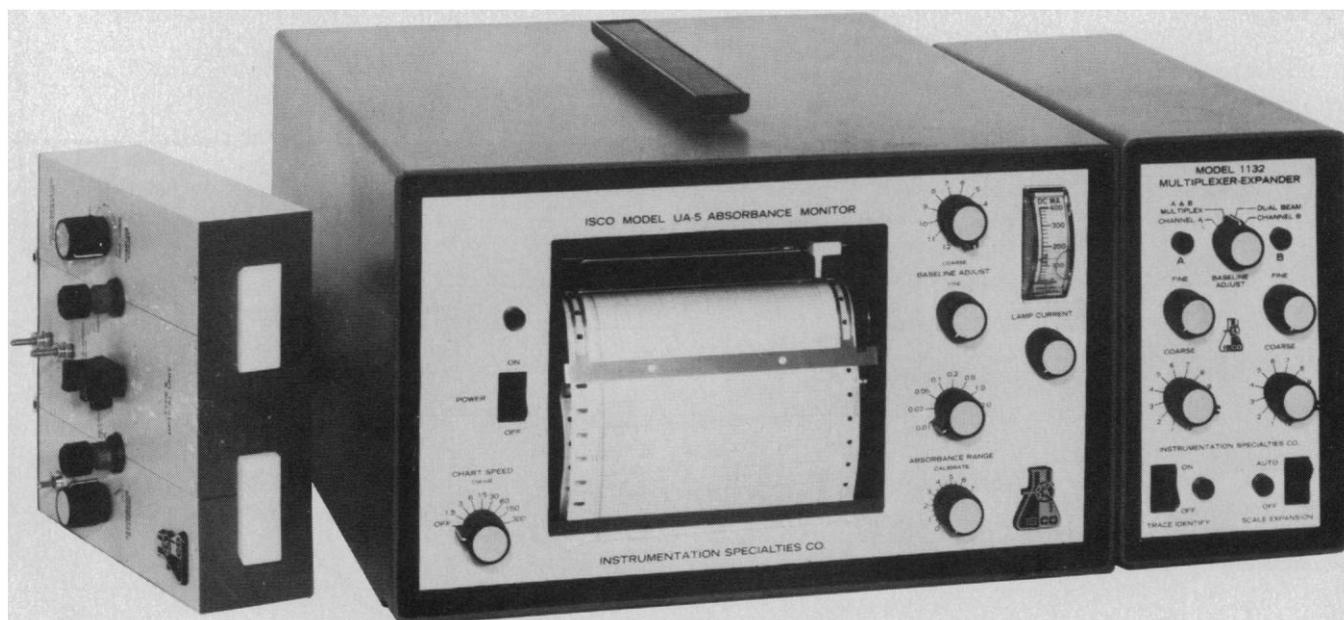
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Renewable and Nonrenewable Resources

The current issue of *Science*, devoted to materials, is the third in a series of special issues that have provided extensive discussion of topics of enduring consequence. The first two subjects treated were energy* and food*. How the various peoples deal with these three matters in the future will go far to shape their living patterns and their destinies. *Science* has also published a large number of individual articles on topics related to population. Many of these have been gathered together and republished in a compendium entitled *Population: Dynamics, Ethics, and Policy**.

In these publications the perspective is future-oriented, and one is given the benefit of the visions provided by about one hundred of America's leading scholars. Most readers, of course, will see or have seen in the articles reinforcement for already held beliefs, but few can peruse the total without encountering new ideas. In addition to covering scientific and technological aspects, the articles treat economic and political factors, including some international issues.

If we focus on the United States, the future picture at first sight looks favorable. The country has much in the way of potential energy sources, it is the major granary of the world, and it is well fixed with some, though not all, materials resources. It could fill reasonable future needs for energy, food, and materials while safeguarding the environment. Population increase goes on, but at not so dangerous a rate as in many other countries. If one concentrates on scientific and technological aspects, one can be quite optimistic. Until recently we have been quite wasteful with respect to energy and materials. It is now evident that many functions could be performed using half or less of the previous standard amounts of these items. In addition, as Chynoweth points out in this issue, we have not begun to exhaust the potentialities of electronics in conserving energy and materials.

But when one examines economic, political, and sociological aspects in relation to energy, food, materials, and population, the picture is not so bright. For example, science, medicine, and technology have provided a variety of contraceptive devices and methods. These can and will be improved and supplemented. But to what extent will they be used? Behavior of the government in handling energy matters has been disquieting. Can politicians, necessarily governed by a short-term vision, be depended on to make good long-term decisions in highly complex technological matters? The recent indication is that the answer is No! If we are to have anything approaching energy independence, huge investments must be made either by government or by industry. Congress is deathly afraid of passing legislation that might enable industry to make a profit from developing new energy sources, such as by liquefaction of coal, but at the same time Congress is reluctant to set up a government corporation to do the job.

In the materials field much new legislation has been enacted that has severely restricted the mining and processing of minerals. Our forests constitute one of the great potentials for materials for the future, but government has, if anything, impeded rather than facilitated constructive developments.

As for the other countries, their peoples face differing constraints and opportunities. To a considerable degree the world's knowledge is accessible to them. They differ, of course, in available resources, but there are few countries in which performance comes close to matching technological opportunities. This is true with respect to energy, food, and materials. It is especially true with respect to population control. Countries continue to experience a 3 percent annual population growth that guarantees future miseries. Some of these countries have been making increasingly strident demands on the developed countries, whose response to their requests has been diminishing. Many people would like to be helpful and constructive, but despair of a situation in which nations do little to help themselves. Science and technology hold great potentials for humanity, but they are not effective in the absence of appropriate institutional arrangements.—PHILIP H. ABELSON

*For further information see page 612.

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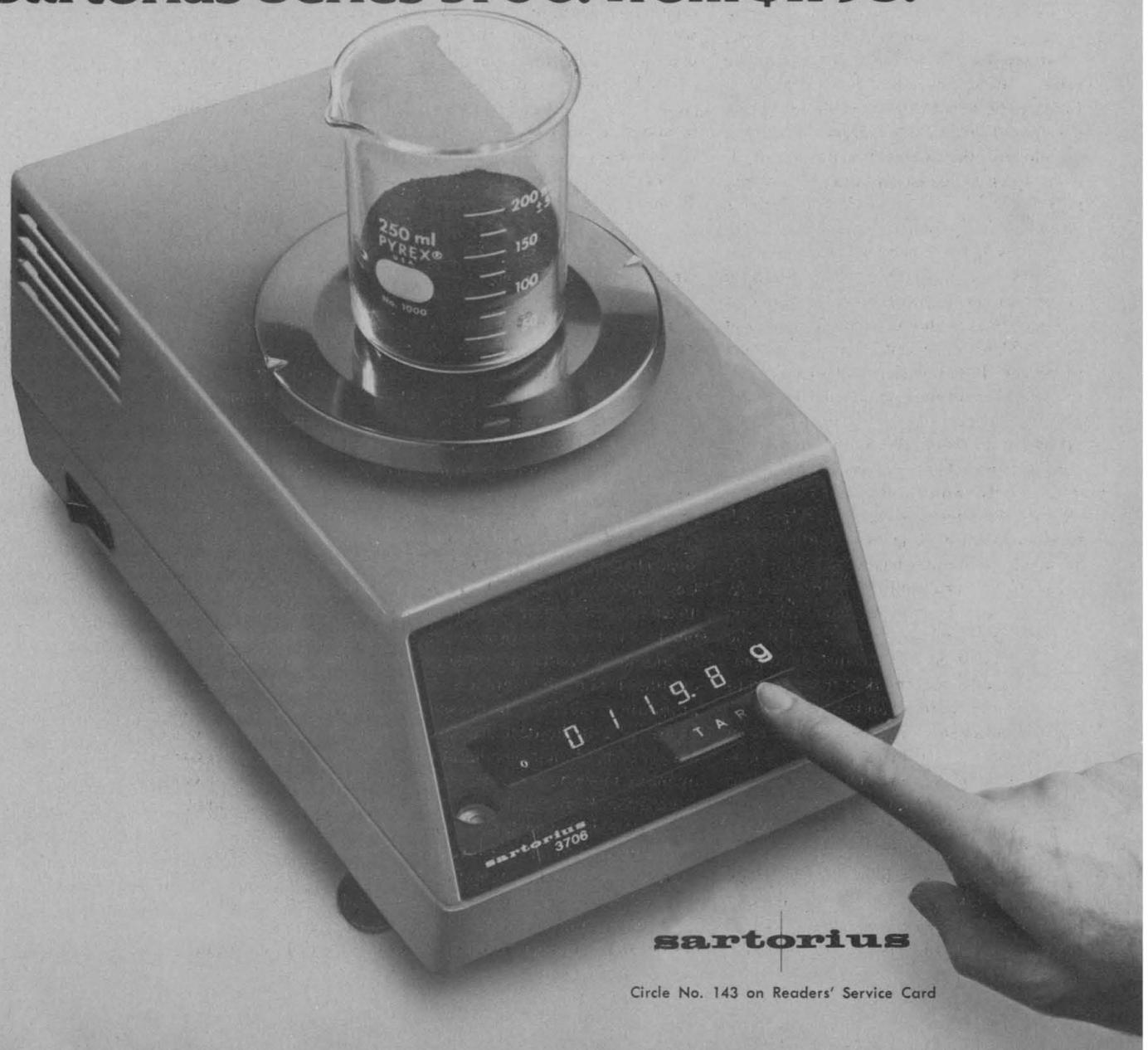
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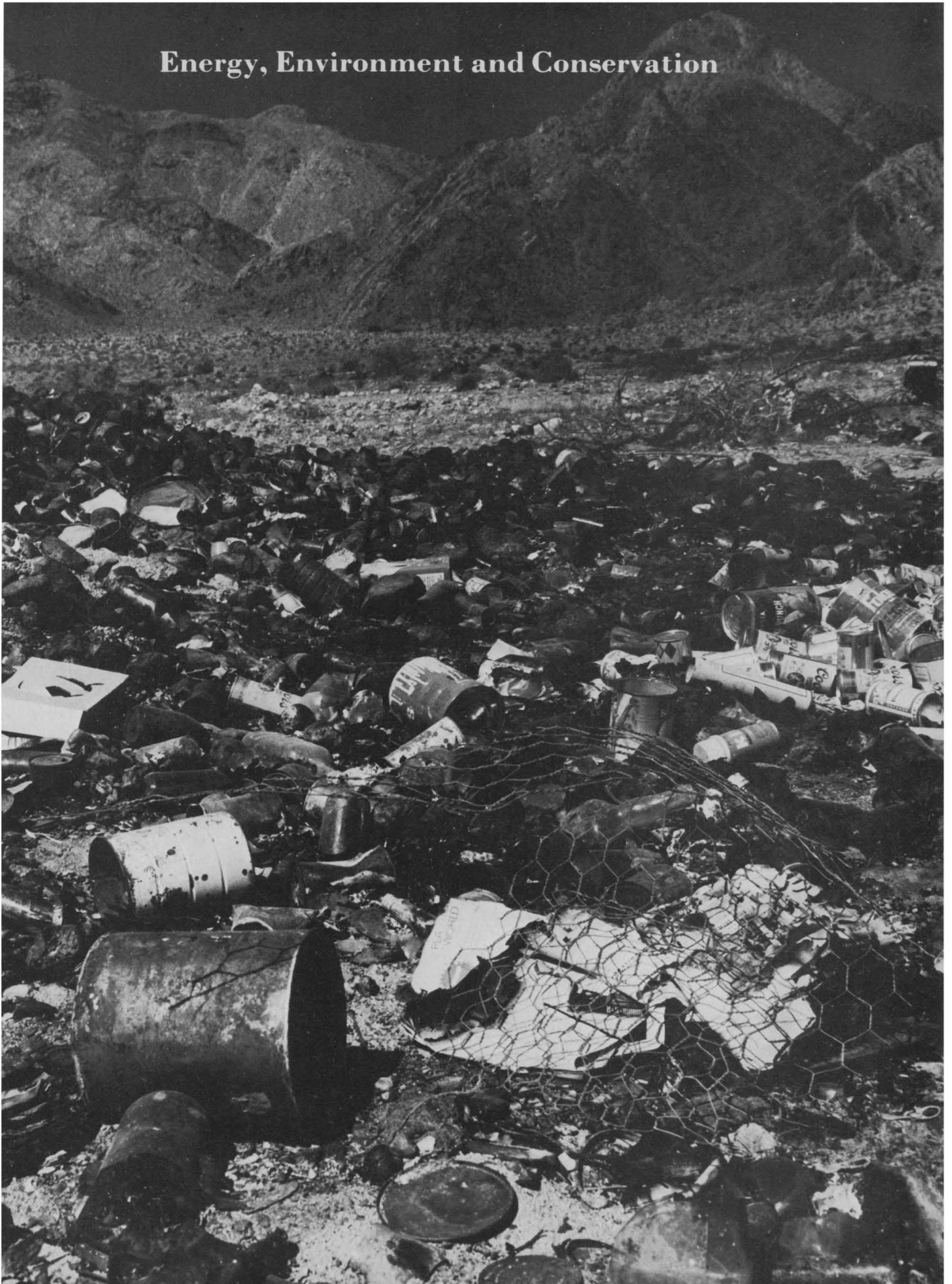
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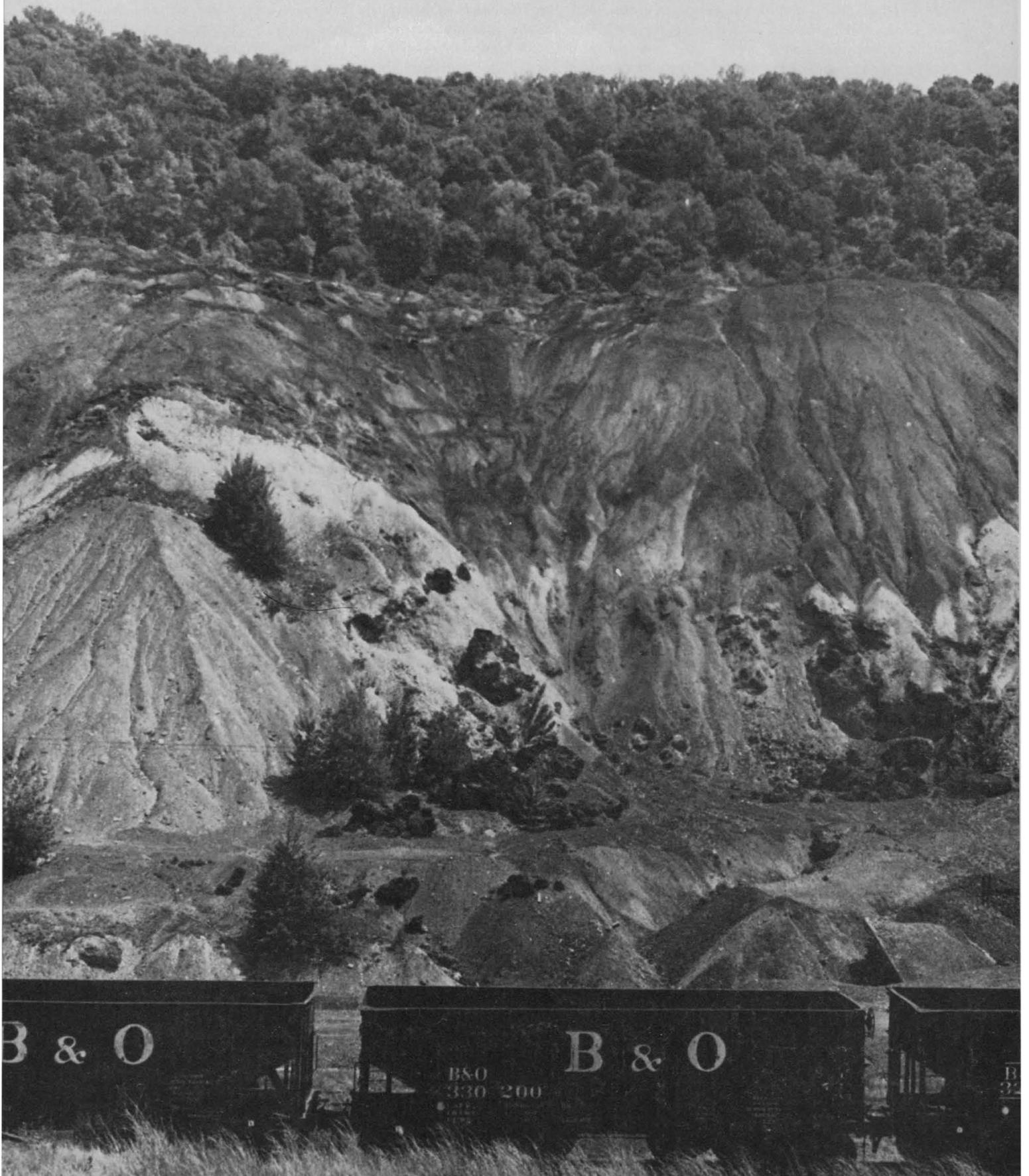
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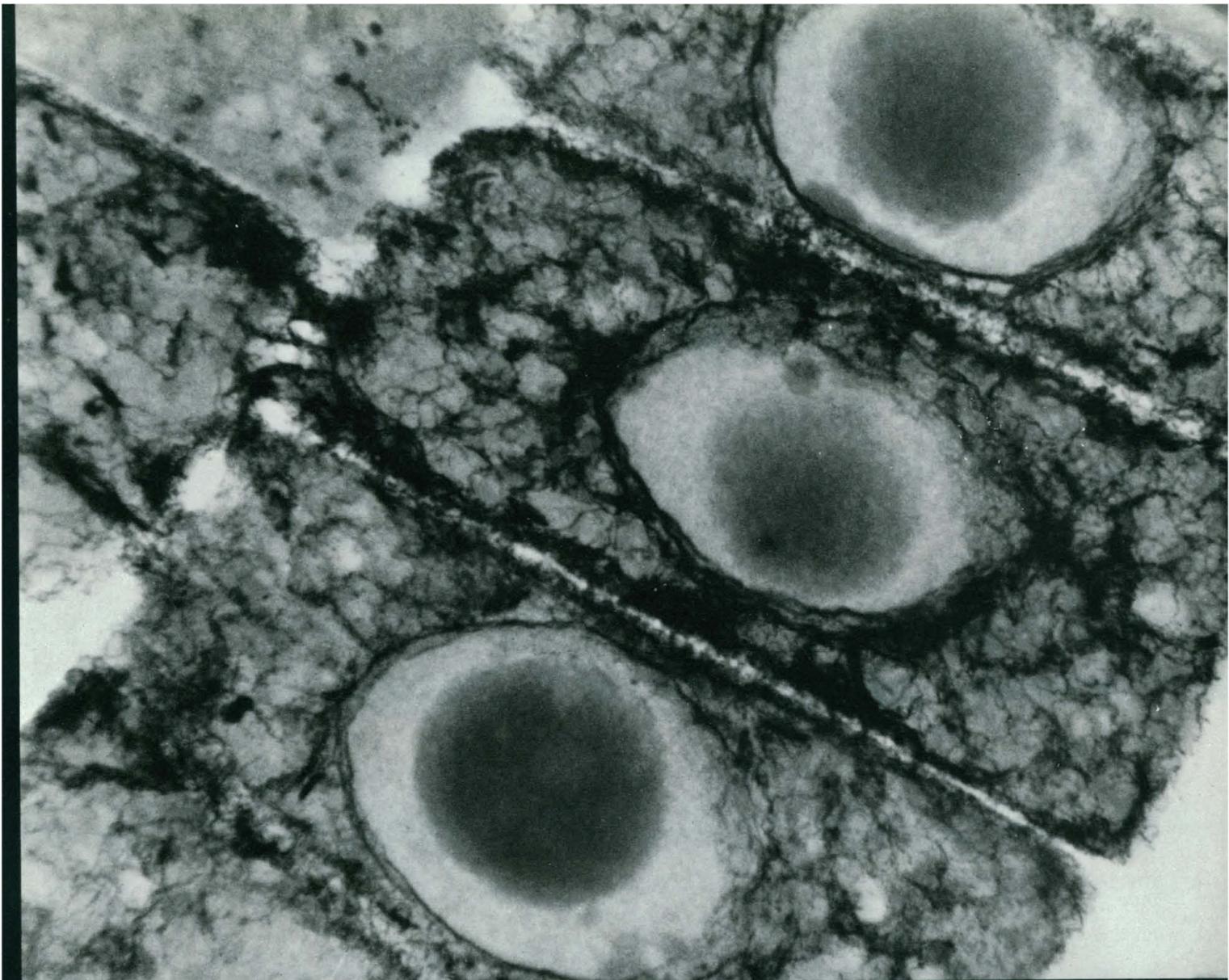
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Energy, Environment and Conservation



Perspectives on Needs and Supplies of Resources





EM400
Root of castor oil plant.
2 μ m thick section.
120kV

To make the invisible more accessible

Philips electron microscopy:

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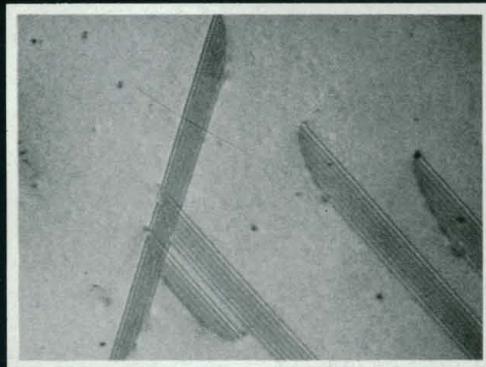
Pushbutton immediacy for selection of analytical method.

Independent control each of the 7 analytical methods: STEM... dark field, energy analysis micro-area analysis, X-ray analysis with (EDAX). SEM/STEM direct comparison; TEM/STEM direct comparison. SEM backscatter. TEM.ED.

*Scanning
Transmission
Reflection
Electron
Analytical
Microscope

1 STEM image contrast

Unambiguous detection of scattered electron fraction. The scattering distribution (diffraction pattern) is projected onto annular or disc detectors during scanning, due to unique electron optical system.



Two beam bright field image of stacking faults in silicon using disc detector. 100kV.

1 μ m

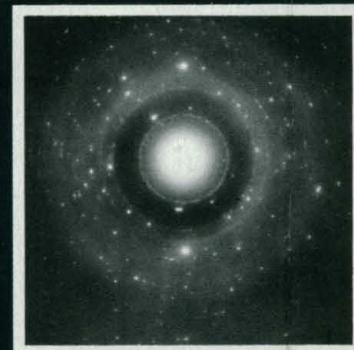
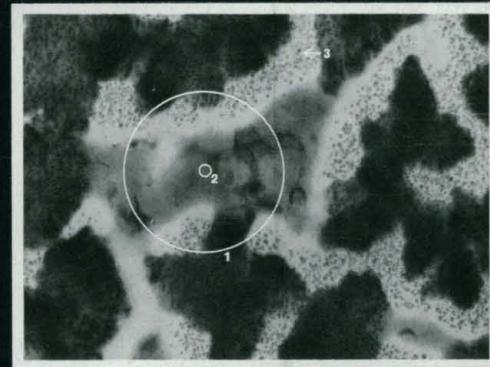


Dark field image of stressed polyethylene using annular detector. 100kV.

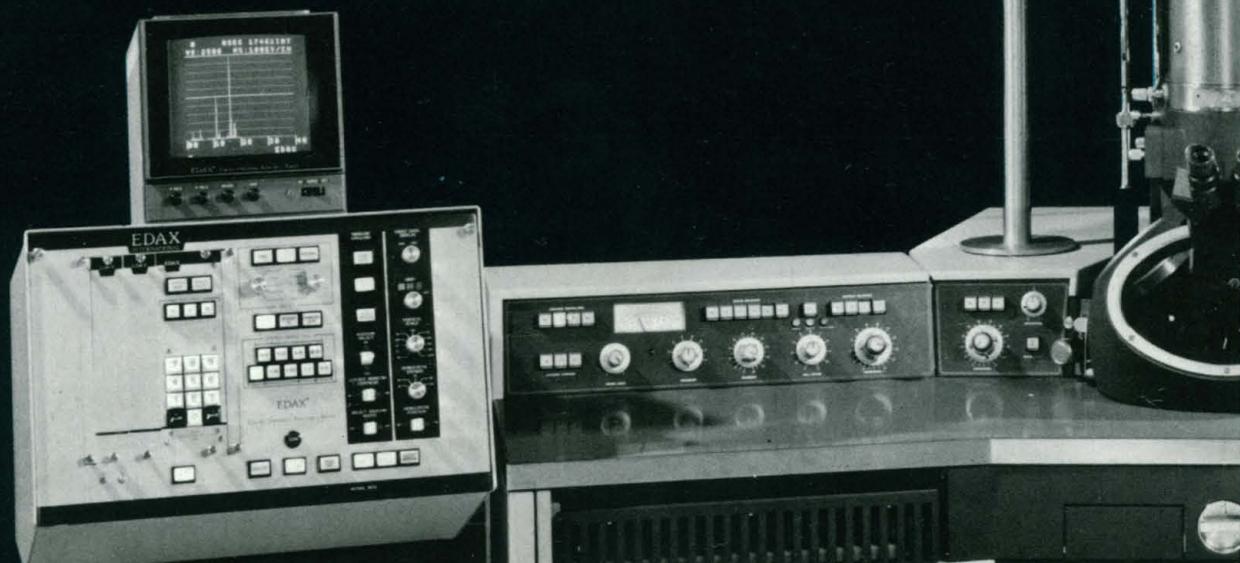
1 μ m

Minimum beam damage during imaging due to highly efficient detection.

2 SAD selected area diffraction analysis... multiple modes



1 SAD with 20 μ m diffraction aperture. Standard mode.



3 SEM image formation with reflected electrons



2 SAD by using STEM optics to produce an effective aperture of approximately $.5 \mu\text{m}$.



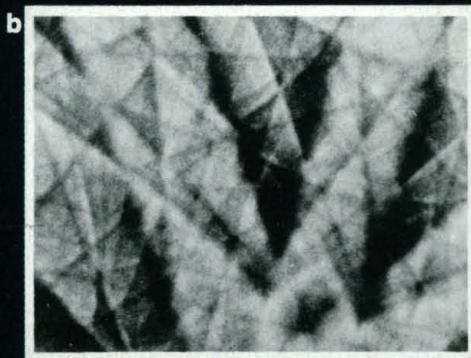
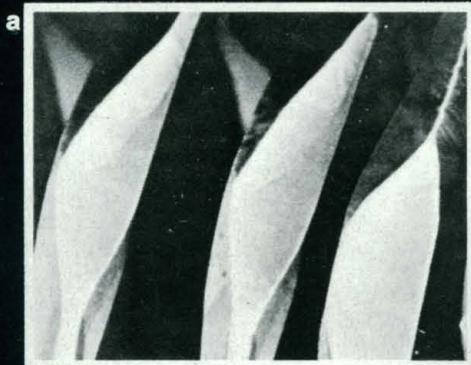
3 SAD using rocking beam mode. Effective aperture less than 50 \AA .



Backscattered image showing wall structure of fir tree seed (*Genothera Hookeri*). 20kV.

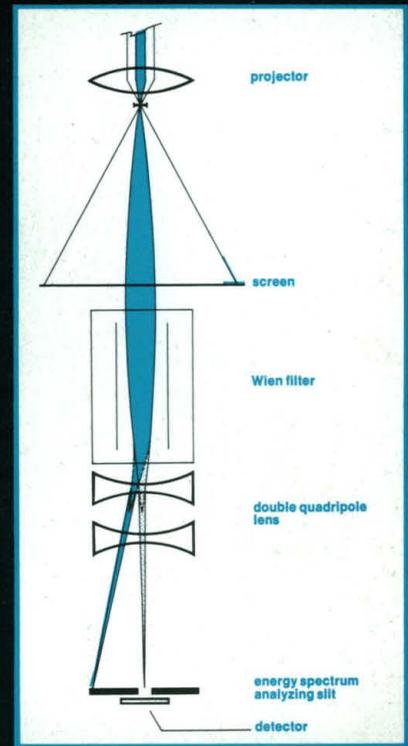
0.1 μm

Channeling pattern (b) from faceted grains in tungsten filament (a) imaged with reflected electrons.



Structural information from surface layers of bulk specimens, due to efficient electron detector and high voltage scanning electron beam.

4 ELECTRON ENERGY ANALYSIS



Possible in STEM mode (Crewe type microscopy) by applying high efficiency electron energy analyzer with high energy resolution.

Energy resolution 2 eV at 100kV.

Collection efficiency (acceptance angle at optimum energy resolution) 10^{-2} rad.

High resolution and high efficiency analysis is obtained by stationary imaging of scattering distribution and unique Wien filter analyzer design. This allows high order correction of analyzer aberrations.

Energy analyzer can work in energy selective and energy analyzing (spectrum) modes:

STEM for Crewe microscopy

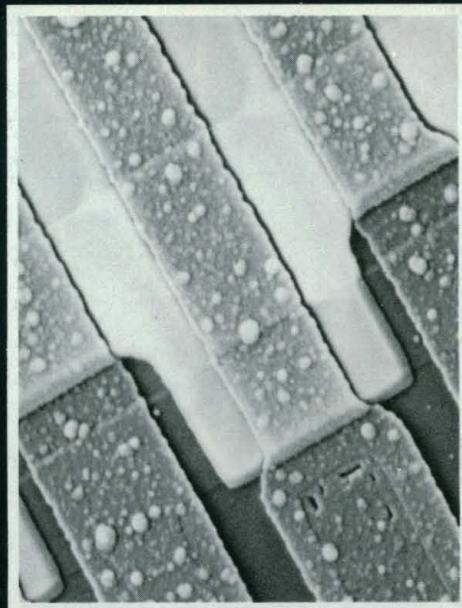
TEM for image and diffraction analysis.



Knowing
more about
the specimen
than you've
ever known
before...



1.4 Å Gold Lattice



Integrated Circuit
6kV 1250x

EM400

See the specimen fast, at low intensities, yet with clearly preserved detail. Routine operations are automated to speed search and focus. Unprecedentedly low drift rates, improved wobbler effectiveness, permit lower beam intensities than heretofore. Resulting from all this is the capability for "blind search" of ultra-sensitive specimens.

There is virtual elimination of etching & contamination because the ultra-clean ion-pumped column gives a true 10^{-7} specimen vacuum—and with even lower partial pressures of HC and H₂O.

Single-switch control for magnification. Focus, zoom, compensations—all automatic.

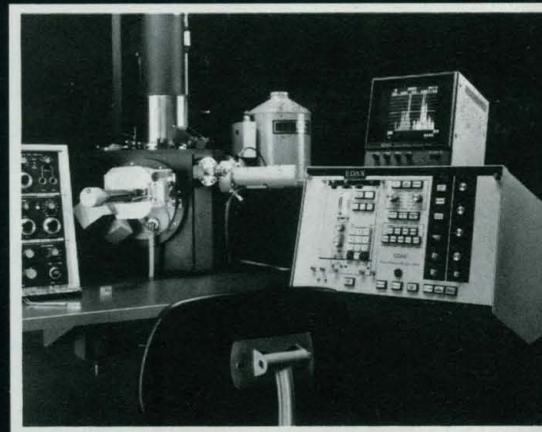
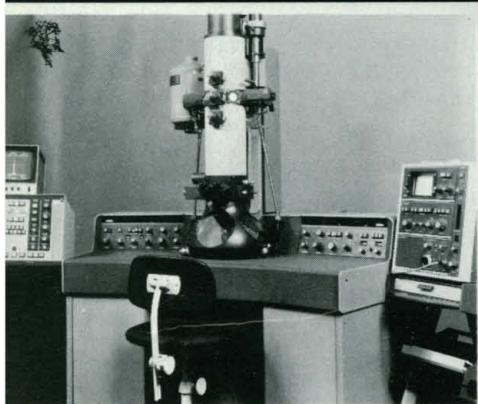
Computer compatible. Optional, quick, addition of systems for multi-parameter analysis (STREAM).

PSEM500

Return to any specimen location, exactly, rapidly. Eucentric goniometer (5 independent degrees of freedom) is stepping motor controlled for reproducible accuracy.

Set imaging parameters independently. Choose optimum beam characteristics for any specimen type.

Computer compatible. Use of stepping motors & optional digital interface allows computer control for special applications.

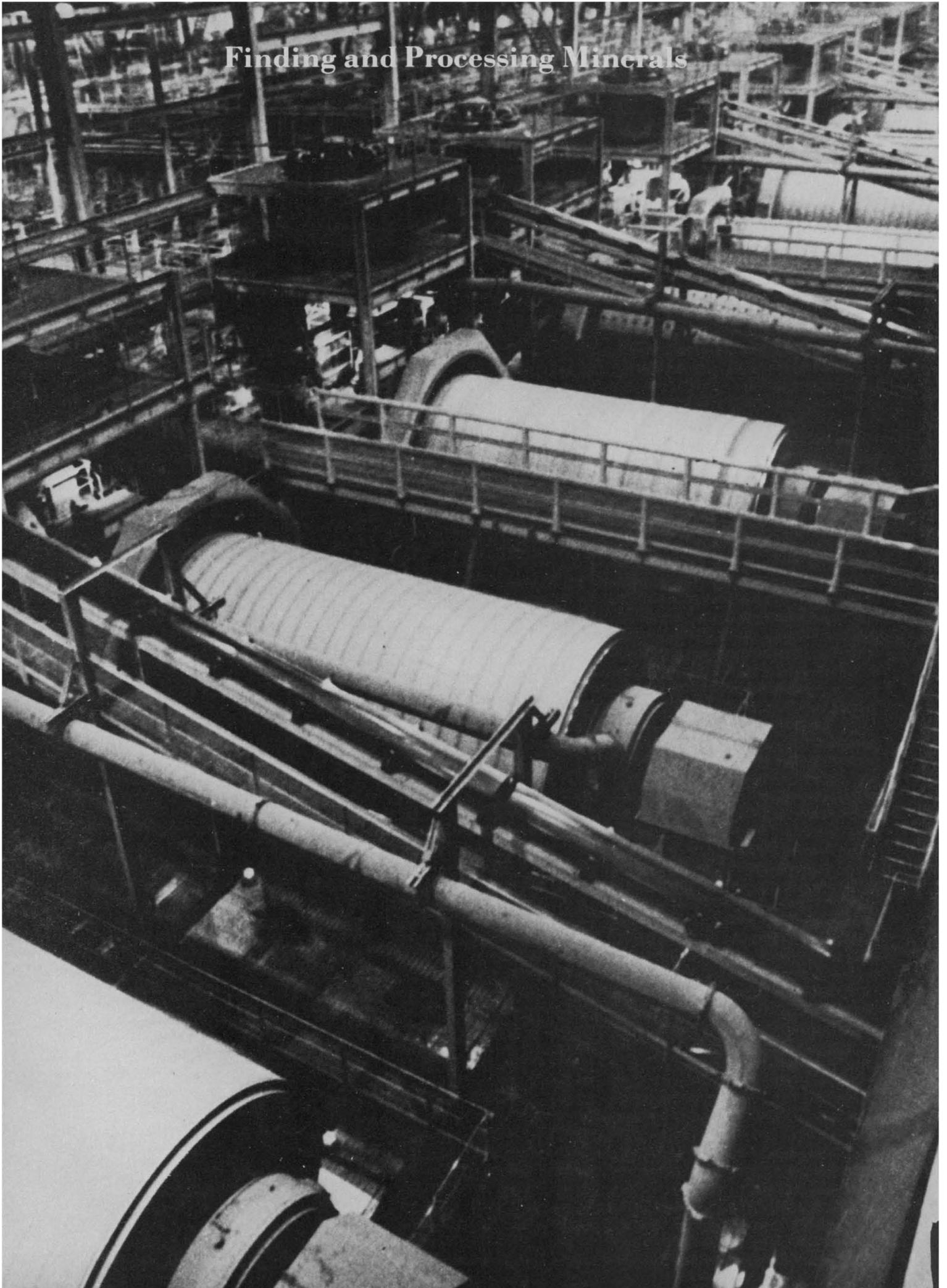


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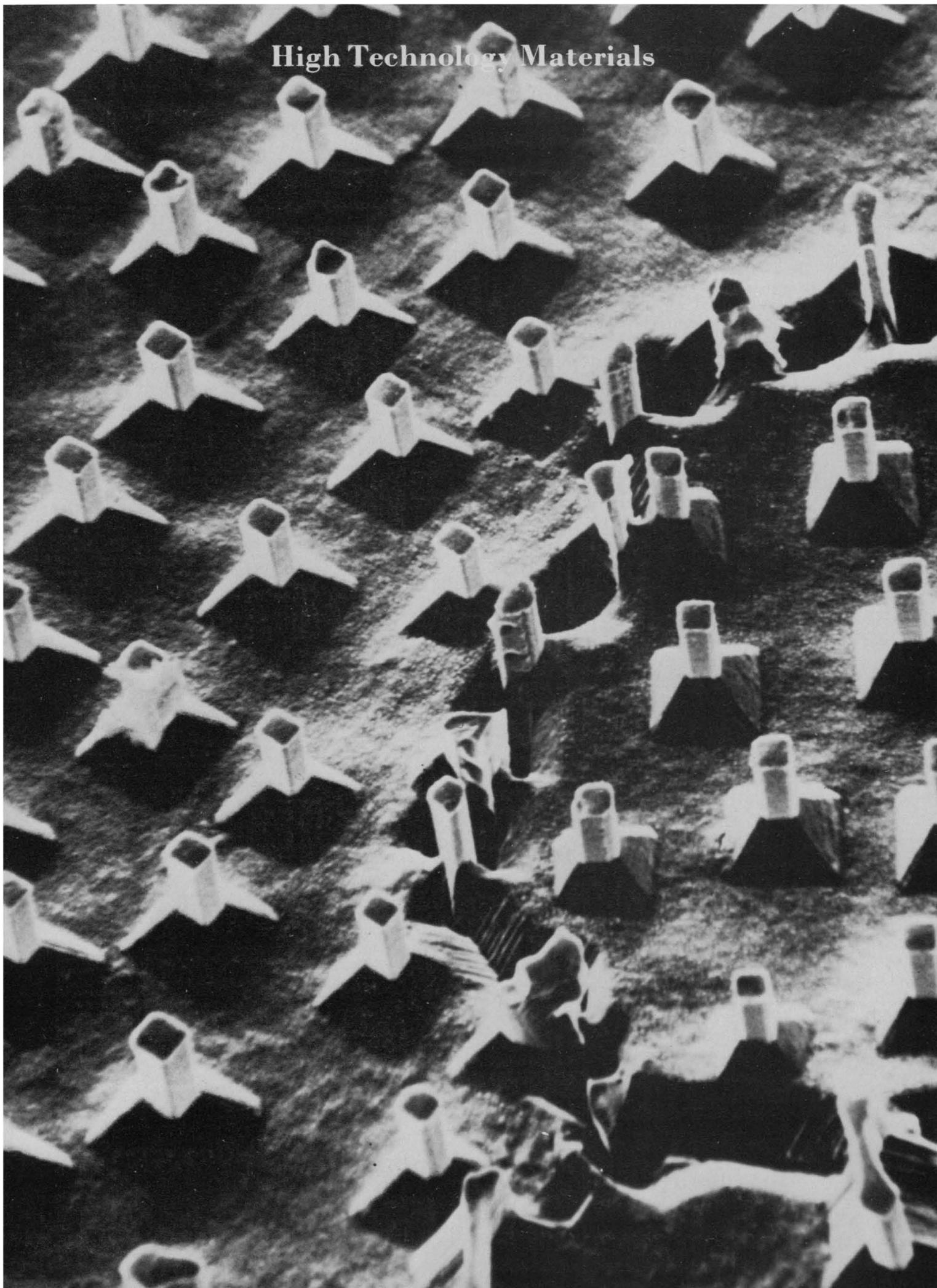
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