

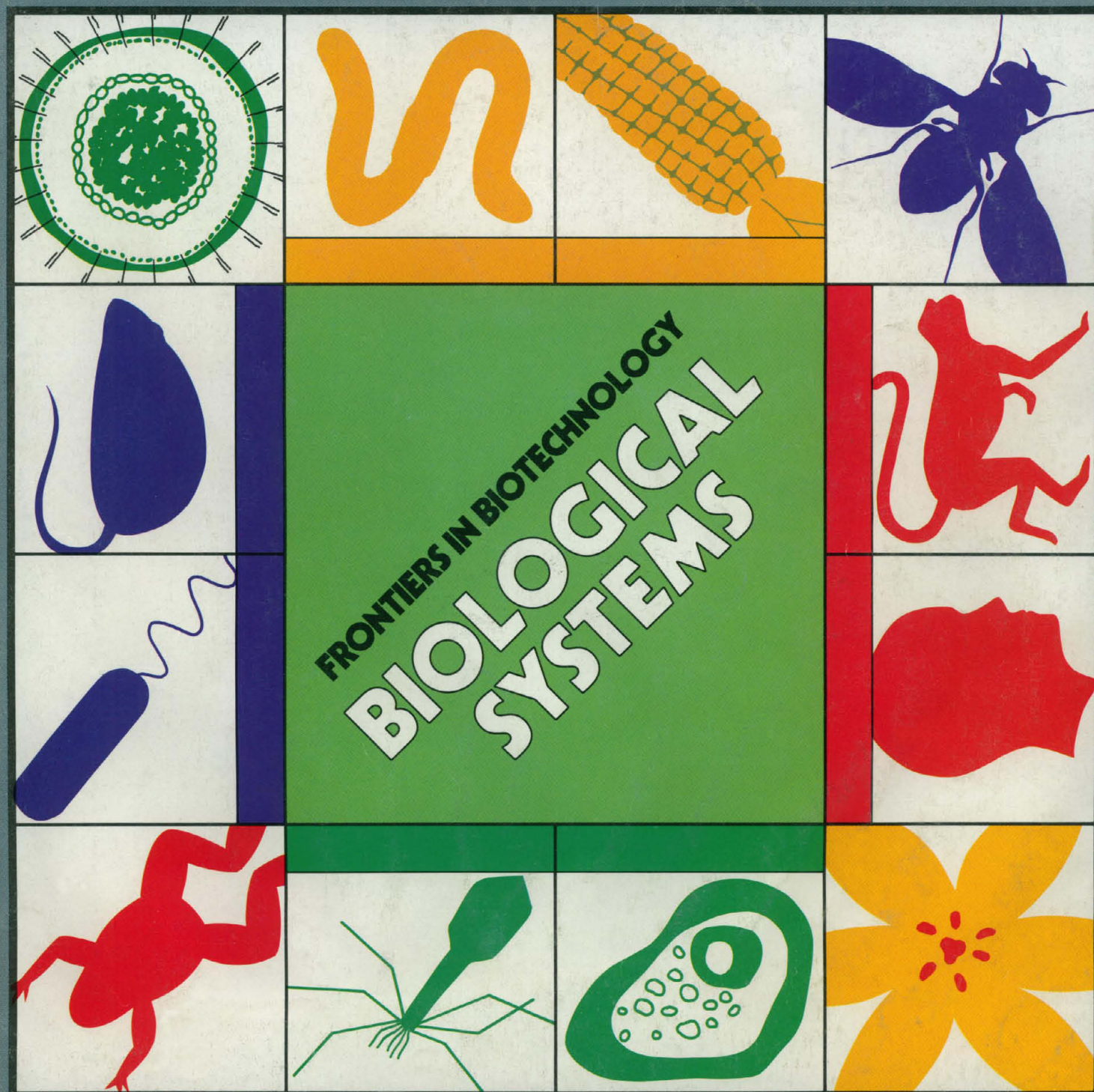
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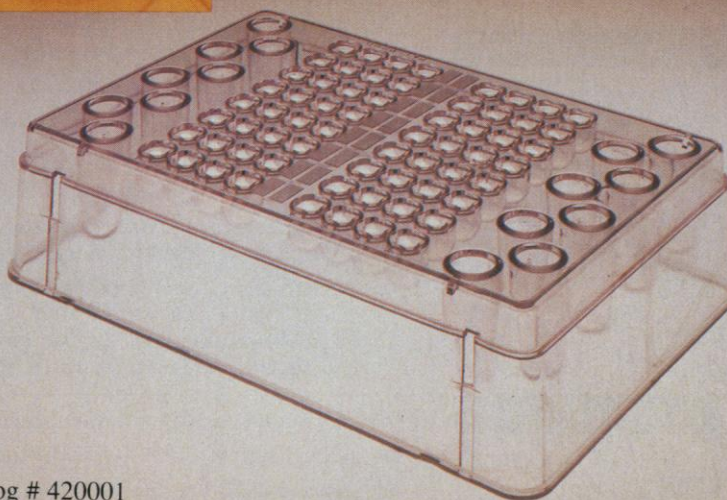
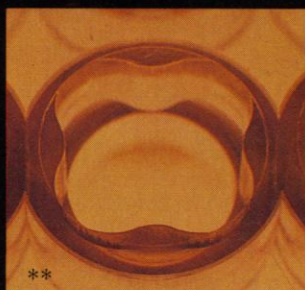
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**COVER** No single organism has a monopoly in science. This issue of *Science* focuses on the reasons why scientists choose to do their investigations in particular biological systems. See page 1427. [Cover design by Sharon Wolfgang, Washington, DC]

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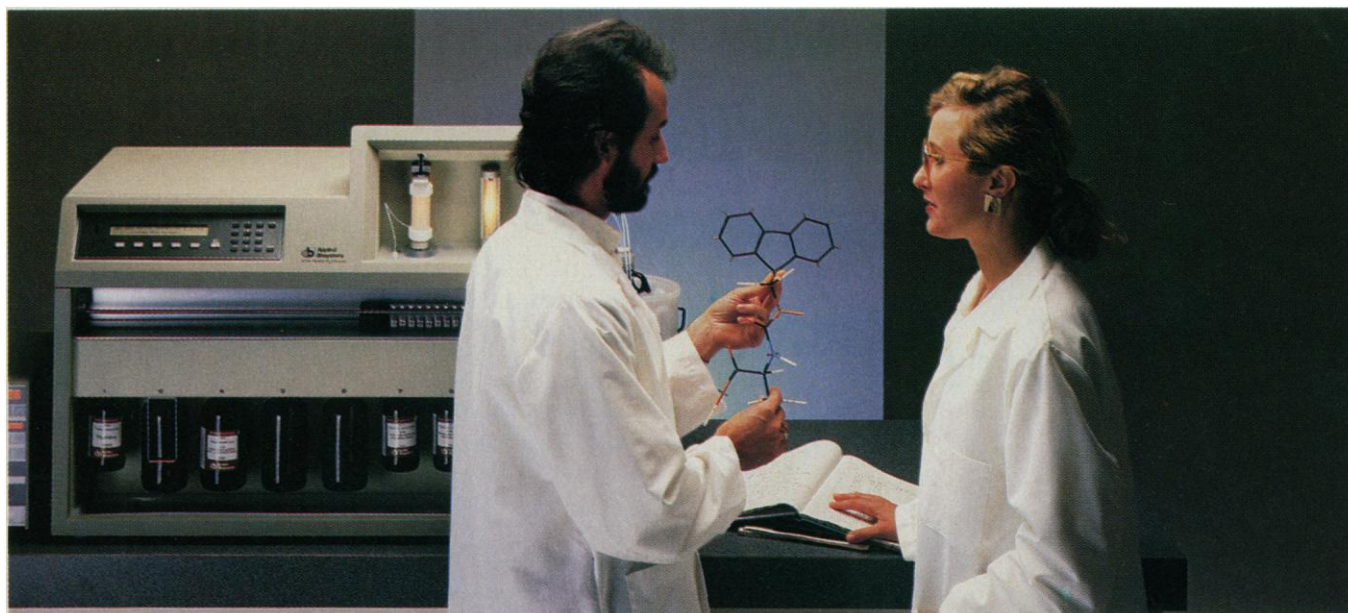
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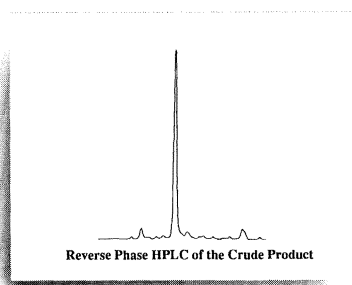
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## This Week in SCIENCE

### Biological systems

**T**HE discovery of the Rh factor of blood on which successes in transfusions and pregnancies depend, development of vaccines against polio, rubella, measles, hepatitis B, and other infectious diseases, improved understanding and management of Parkinson's disease, and strategies for teaching symbolic language skills to retarded children are perhaps some of the best known biomedical and behavioral advances that have come from research on nonhuman primates (page 1475). About 30 primate species are presently used in research; their close evolutionary relations to humans—for example, 98% of human DNA is found in the genome of chimpanzees—make them at times the best, at times the worst, and at times the only suitable animal models for studying normal and aberrant biology and behavior in the primate lineage. In reviewing primate research, King *et al.* point out that primates represent only a small percentage (3.5%) of all experimental animals used in U.S. laboratories (rodents make up about 90%). Other model systems used in biologic research are described in the feature articles in this week's special issue (pages 1427 to 1488; see also pages 1385 and 1386).

### Weather patterns

**I**N the southeastern United States periods of drought have been alternating with wet periods roughly every 30 years for at least the past 1600 years (page 1517). The weather oscillations are reflected in the width of tree rings of bald cypress trees growing in a swamp along the Black River of southeastern North Carolina; the trees, some more than 1600 years old, are the oldest trees known in the eastern United States. Stahle *et al.* bored cores through the trunks and used recent meteorologic data (post-1887) to calibrate the tree-ring record. Although there have been these 60-year irregular climate swings through most of the period studied, prominent prolonged droughts oc-

curred between 1000 and 1300 (the Medieval Warm Epoch) and long wet periods occurred between 1300 and 1600 (the early Little Ice Age). One of the worst droughts of the 1600-year period occurred recently (1985 to 1986). If it is possible to anticipate and prepare for the alternating weather regimes, economic and environmental gains may follow, because the shifting wet periods and droughts take their toll on agriculture, energy sources, and water supplies.

### Attenuated HIV viruses

**T**wo unusual HIV-2 human immunodeficiency viruses have been isolated; unlike other HIV-2 and HIV-1 (AIDS) viruses, they do not kill the cells in which they are growing (pages 1522 and 1525). Evans *et al.* characterized HIV-2<sub>UC1</sub> which was isolated from a patient from the Ivory Coast; despite the patient's neurologic symptoms (dementia and ataxia), bowel parasites, fever, and eventual death, normal numbers of T cells were present in his blood. Kong *et al.* isolated and cloned HIV-2<sub>ST</sub> from a healthy prostitute from Senegal. Both isolates grew in many types of cultured cells, but, in a further departure from other HIV-1 and HIV-2 isolates, HIV-2<sub>UC1</sub> did not reduce expression of the CD4 antigen (a surface component that helps the virus enter the host cell). HIV-2 infections appear to be widespread in West Africa where they may be associated with immunodeficiencies that are less severe than HIV-1-induced AIDS. Molecular differences among these new HIV-2 isolates and virulent HIV strains might help explain how CD4 antigens participate in HIV infections and how related viruses cause disease and might be controlled.

### Biolistic missiles

**F**OR some time, researchers have gone gunning for a way to carry out molecular genetic studies of the DNA in cellular organelles (pages

1534 and 1538). Now, microprojectiles coated with DNA have been used to introduce genes into two organelles, chloroplasts and mitochondria. Boynton *et al.* and Johnston *et al.* describe how missing pieces of DNA are shot into organelles on tungsten microprojectiles. Both photosynthetic capacity of defective green algae and respiratory capacity of defective yeast were restored and, in each case, evidence was obtained that the inserted cloned DNA directly replaced the defective DNA in the organelle. Restored functioning was then inherited by progeny algae and yeast. Molecular genetic studies of organelles, comparable to the studies that for years have been done with nuclear DNA, are now within range.

### Antisense oligonucleotides

**S**YNTHETIC oligonucleotides patterned on the antisense strand of a gene but not those patterned on the sense strand (the one from which RNA is transcribed) are able to block the expression of that gene within a cell (page 1544). This phenomenon has been used to study the action of the gene for PCNA (proliferation cell nuclear antigen). When PCNA gene expression was blocked and PCNA levels dropped in the nucleus, the cell stopped making DNA and stopped dividing. Thus PCNA acts in a regulatory capacity as the cell progresses through its cycle, halting the cycle either just before or early in the DNA synthetic phase. Jaskulski *et al.* suggest that antisense oligonucleotides may work by blocking RNA translation or by inhibiting RNA synthesis.

### The bottom lines

An alternative to the standard (Sanger and Maxam-Gilbert) chemical methods for sequencing nucleic acids uses relatively mild reaction conditions which may allow sequencing of nucleic acids that are interacting with proteins in complexes (page 1520).



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## Biological Systems

The proper study of mankind may well be the fly, the frog, the bacterium, and the nematode, as well as the rat, the ape, and mankind itself, because studies of specific biological systems have taken a central role in modern biology. This has not always been true; originally biology emphasized taxonomy and the diversity of species. As the number of identified species increased, the similarities among differing species were noted, and more in-depth studies of individual species were appropriate. Gradually certain systems became preferred models for biological systems in general, a tendency which has been accentuated as molecular approaches have become the lingua franca of modern biology.

The concept of selecting a common system for in-depth study emerged slowly. In some disciplines it was once considered poor etiquette to work on a colleague's system: if he or she used the toad, you used the frog. That practice led to great inefficiency, because the details of manipulating any system—how to grow the organism, the chemistry of the cell wall, mating habits—had to be worked out over and over again. Therefore, workers focused on a few systems such as *Escherichia coli*, *Drosophila melanogaster*, or inbred mice, in which many of the important housekeeping procedures had been elucidated. In this issue of *Science* some of the major experimental systems are described in terms of the state of the art, potential advantages, and possible disadvantages.

Of the systems outlined here, retroviruses, bacteria, and yeast are the simplest, most manipulatable, and most intensively delineated. Retroviruses (Varmus) are revealing per se as well as being useful tools for gene delivery into other systems. Magasanik, while pointing out the past triumphs of using bacteria to understand regulation, metabolism, and genetics, indicates there is much gold still to be mined and gives examples. Yeasts are essentially on a par with bacteria in ease of recombinant DNA manipulation, but—as indicated by Botstein and Fink—it is their complexity, as in cell compartments, cell cycle regulation, and protein sorting, that makes them valuable as eukaryotic models.

Higher on the evolutionary ladder, the nematode, the fly, and the frog have the advantage of complexity beyond the single cell, but represent far simpler species than mammals. Every cell can be identified in the nematode (Kenyon), which makes it ideal for cell lineage studies. Studies in *Drosophila* (Rubin) can now use recombinant DNA, genetic selection, and a history of neurologic and developmental information. The frog (Dawid and Sargent) is a historical system for studying development; the frog oocyte has become a major system for expression of foreign RNA and DNA. Plants have a special role (Goldberg) because of the importance of botanical species and because of their novel developmental processes, among them the capacity for mature cells to regenerate.

Eventually, one must have mammalian studies, and those of the rat, the ape, and the human are three of the most important. Transgenic animals (Jaenisch), particularly transgenic mice, have become major tools for studying the effects of individual genes on the whole animal and permit the generation of precise animal models for human genetic diseases. For understanding of many human responses, primates (King *et al.*) are clearly the best source, but dealing with these large and sophisticated animals makes them a court of last resort; it is always necessary to consider whether alternative systems are available.

Then, of course, there is mankind. Human beings are capable of describing emotional states as well as physical conditions such as pain, they can often provide generations of family history, and they can reveal multitudinous clinical data (White and Caskey). Defensive medicine may thus be an unexpected boon to research. In their Perspective, Sladek and Shoulson present views on the need for caution in attempting to realize the great potential of transplantation of fetal material for human therapy.

The assembly of a *Science* special issue involves the efforts of many, but one editor traditionally takes the lead. In this case, Barbara Jasny came close to editorial heroism in surmounting difficulties that arose in production; she played vital roles in the selection of topics, special assistance to authors, and the editing of final manuscripts.

It is our intention to add some of the systems that have been missed because of the limitations of space in this issue to a final volume on biological systems. We hope, however, that this initial set of articles will be useful to all our readers, from graduate students to research directors to general readers who seek a more thorough understanding of specialty systems.—DANIEL E. KOSHLAND, JR.

Duesberg has implicated what is euphemistically called life-style in the onset of the AIDS complex of diseases. This category includes drug abuse, repeated receptive anal intercourse, and excessive use of antibiotics to treat repeated bouts of gonorrhea, fre-

I cannot rule out some role for HIV, in concert with other factors, in the development of the complex morbidity we call AIDS, although its effect on the immune system might be indirect. There is, however, a clear need to widen the scope of epidemiological investigation to include the diverse factors mentioned above. Given the statistical problems inherent in AIDS, the citing of anecdotal cases among infants and partners of hemophiliacs—without documenting

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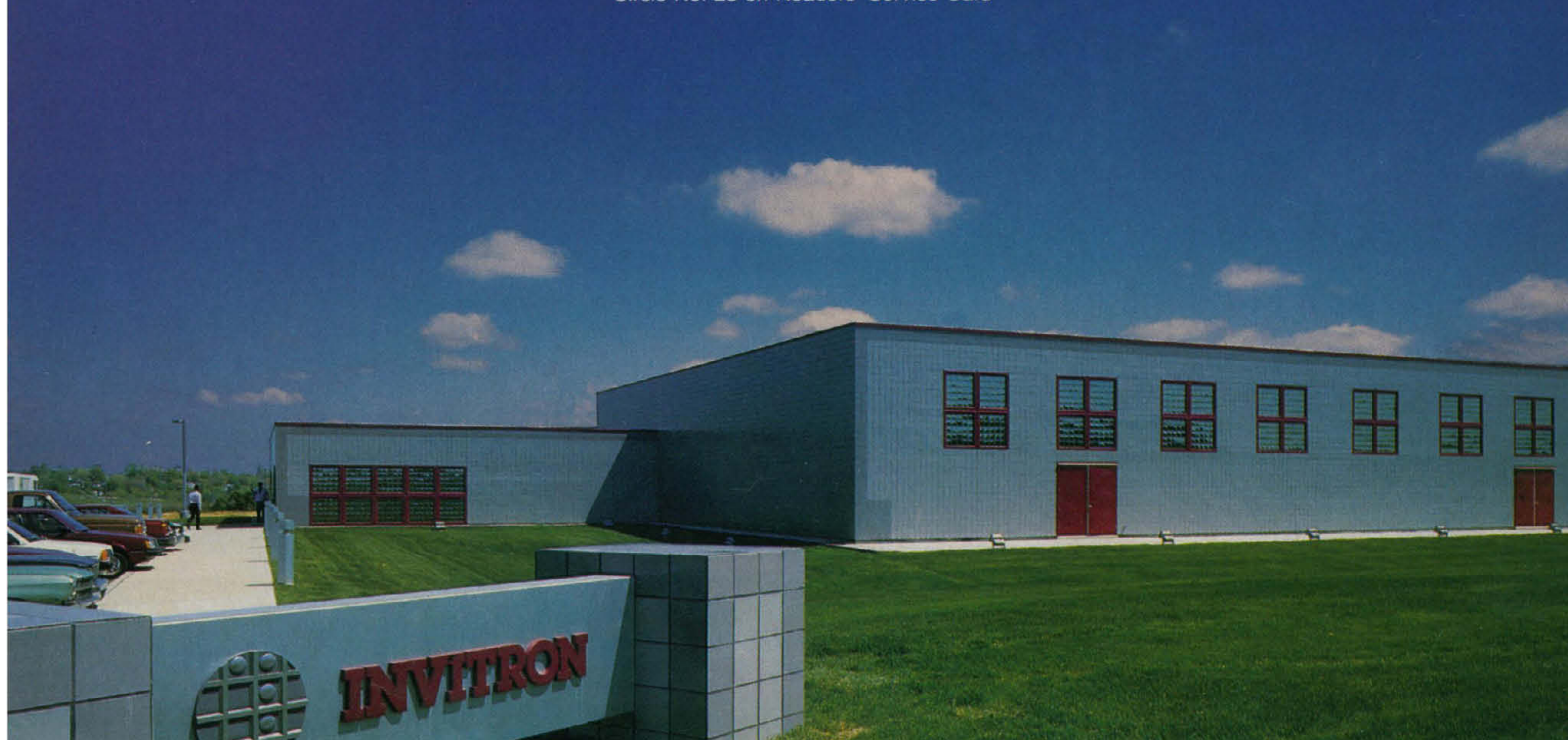
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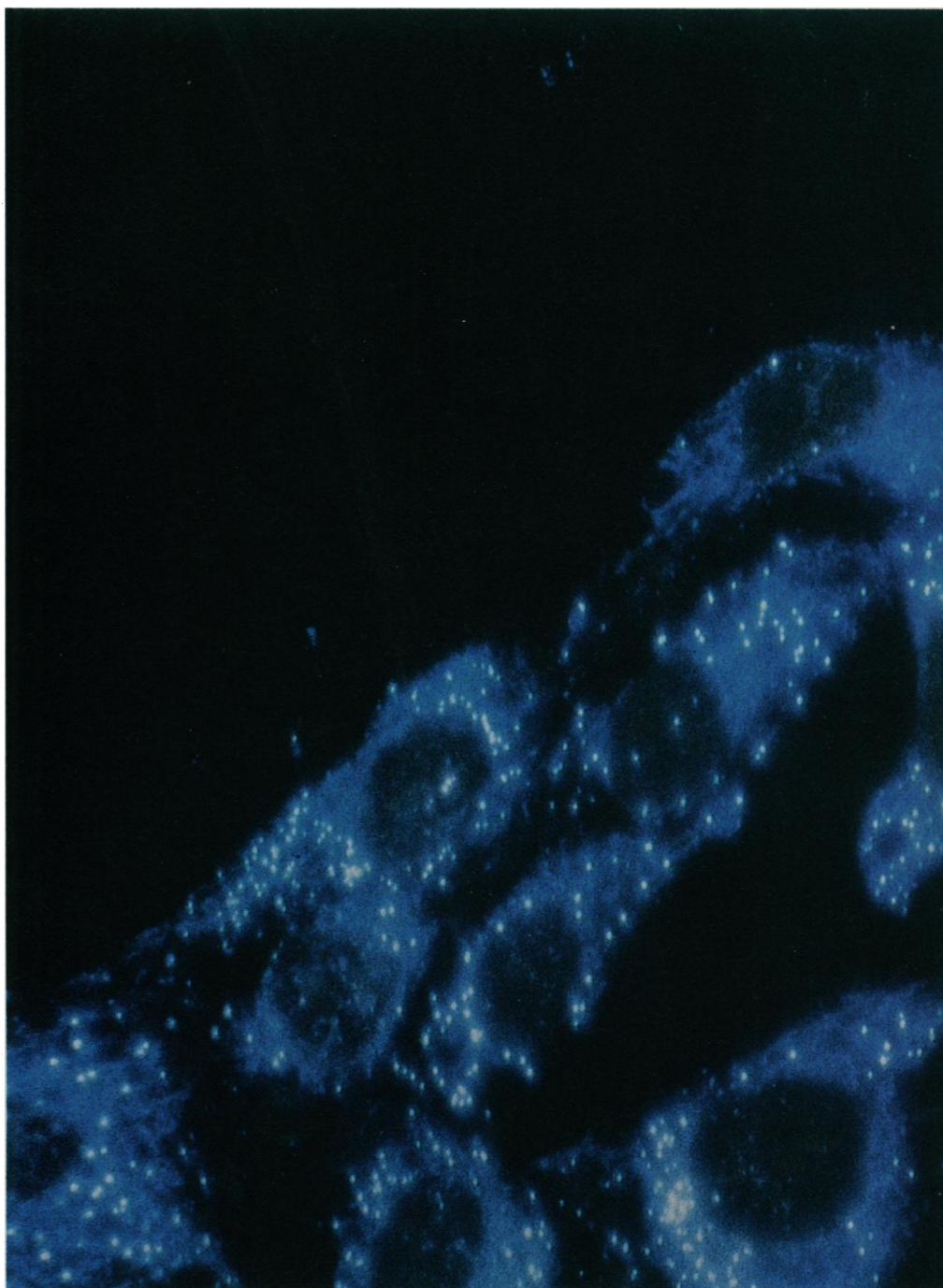
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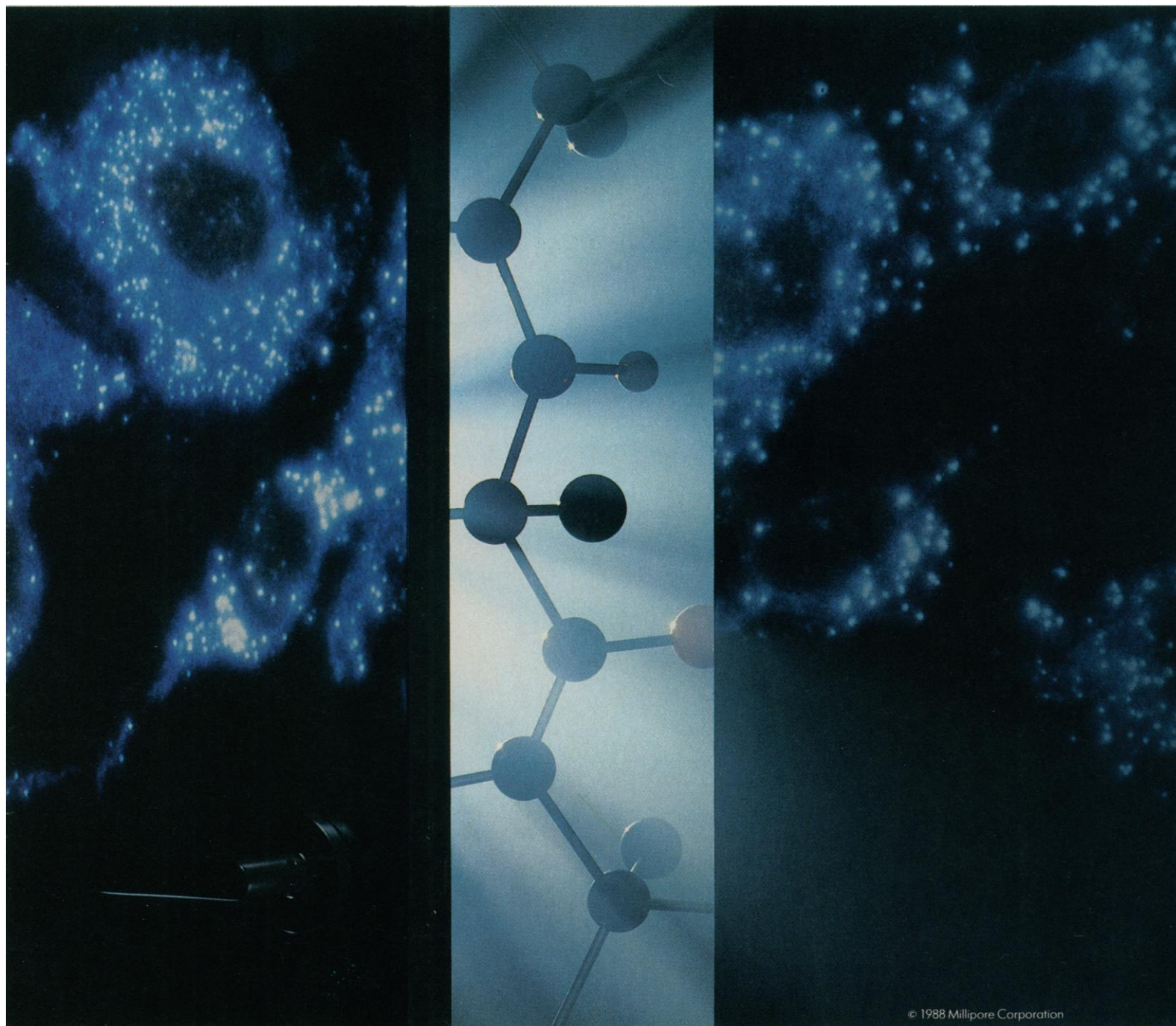
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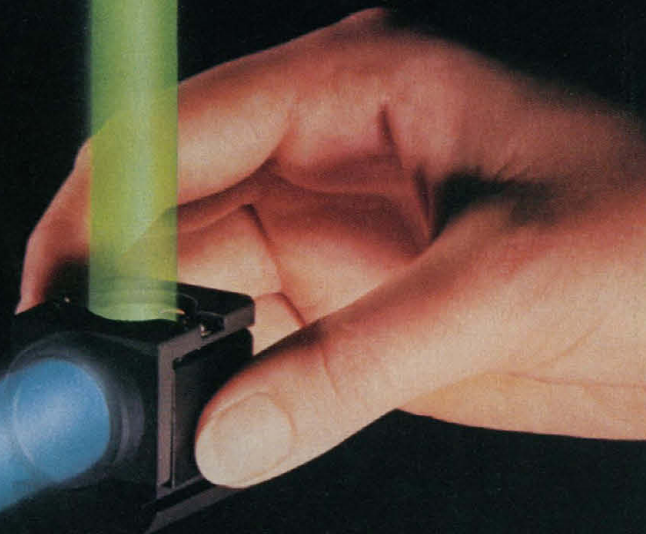
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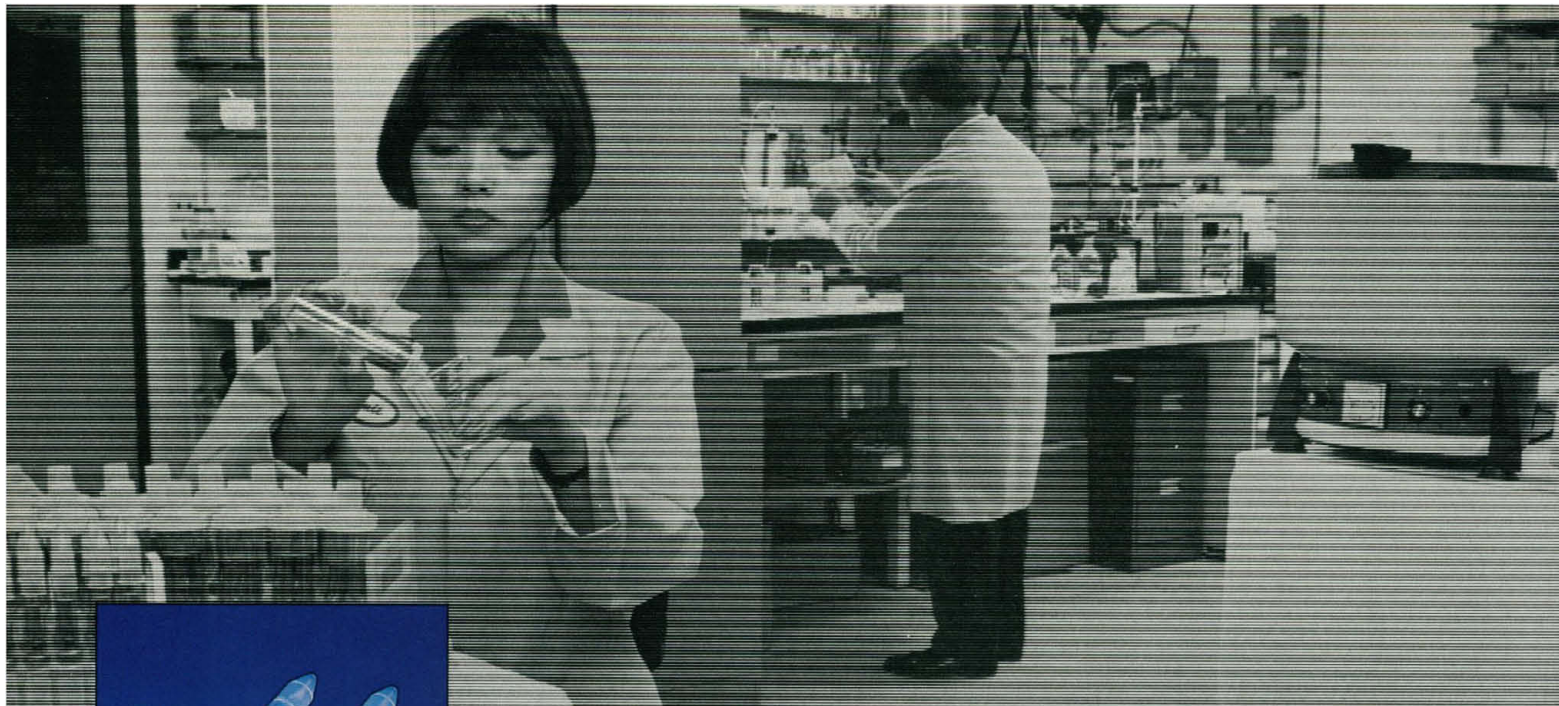
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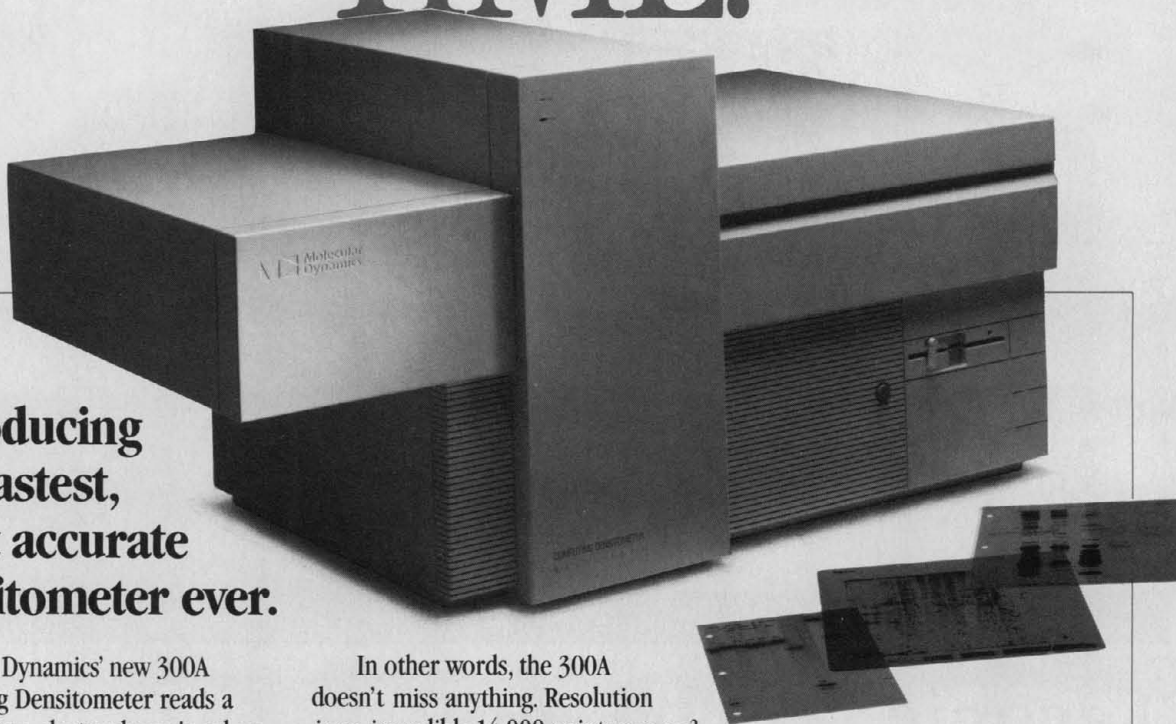
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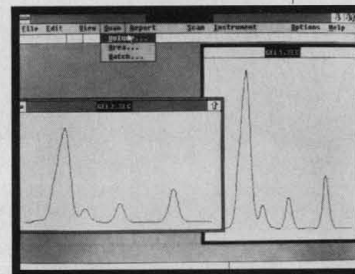
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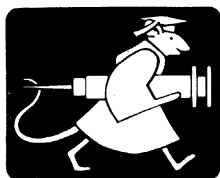
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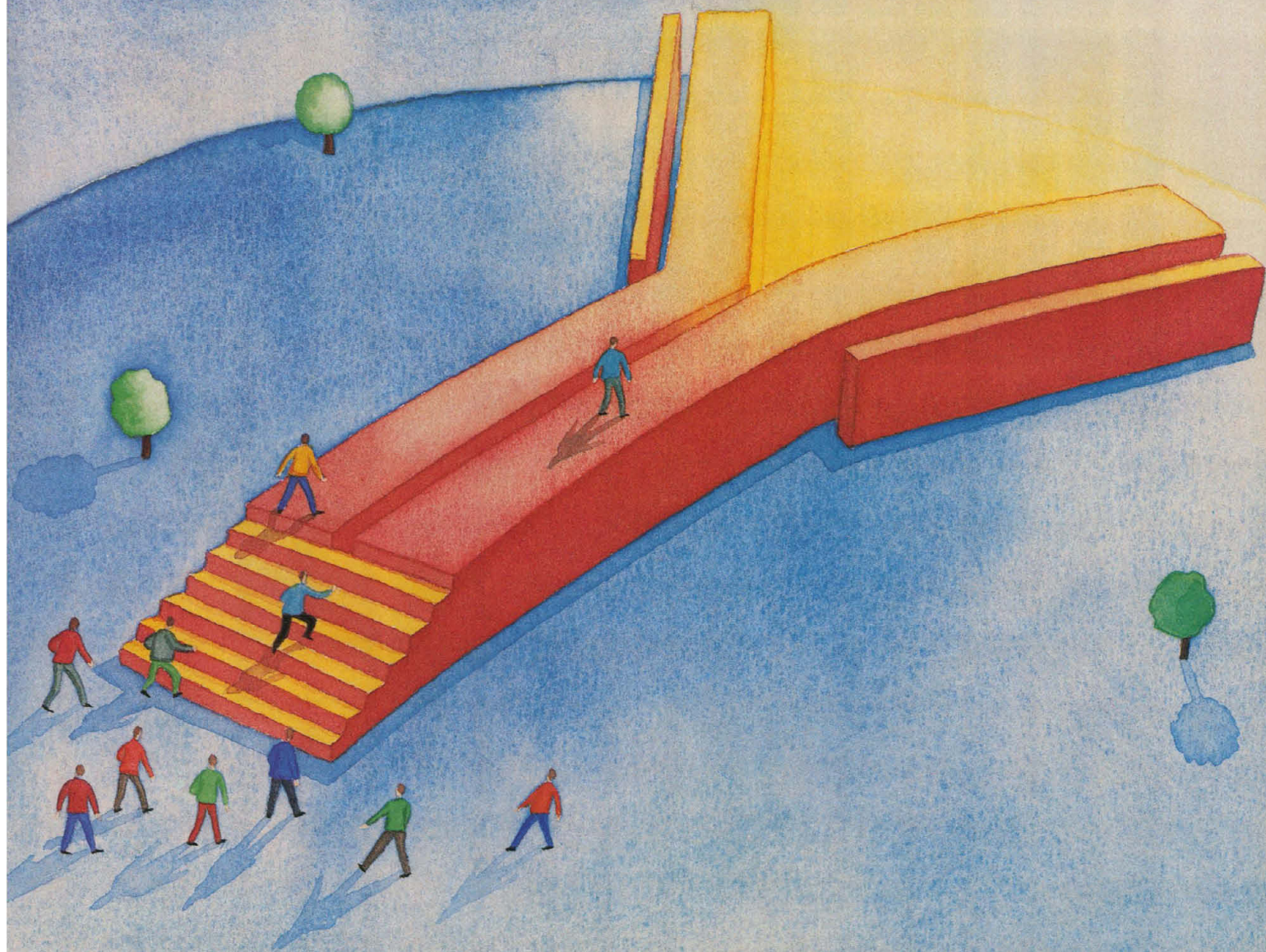
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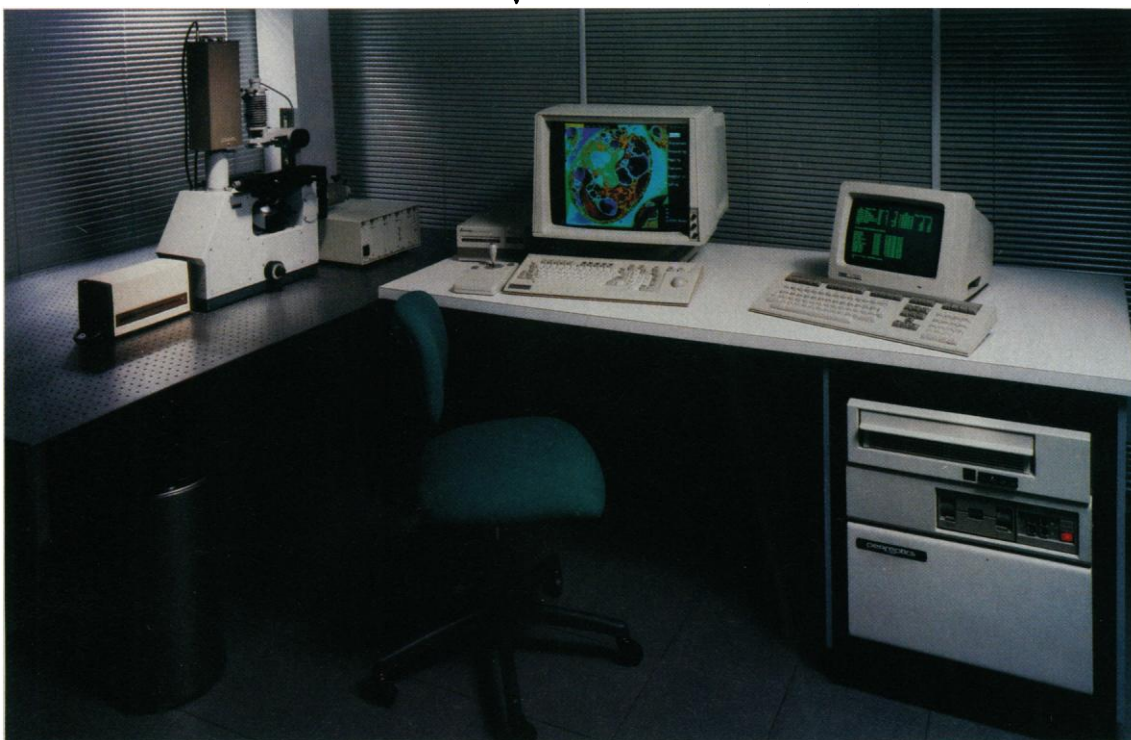
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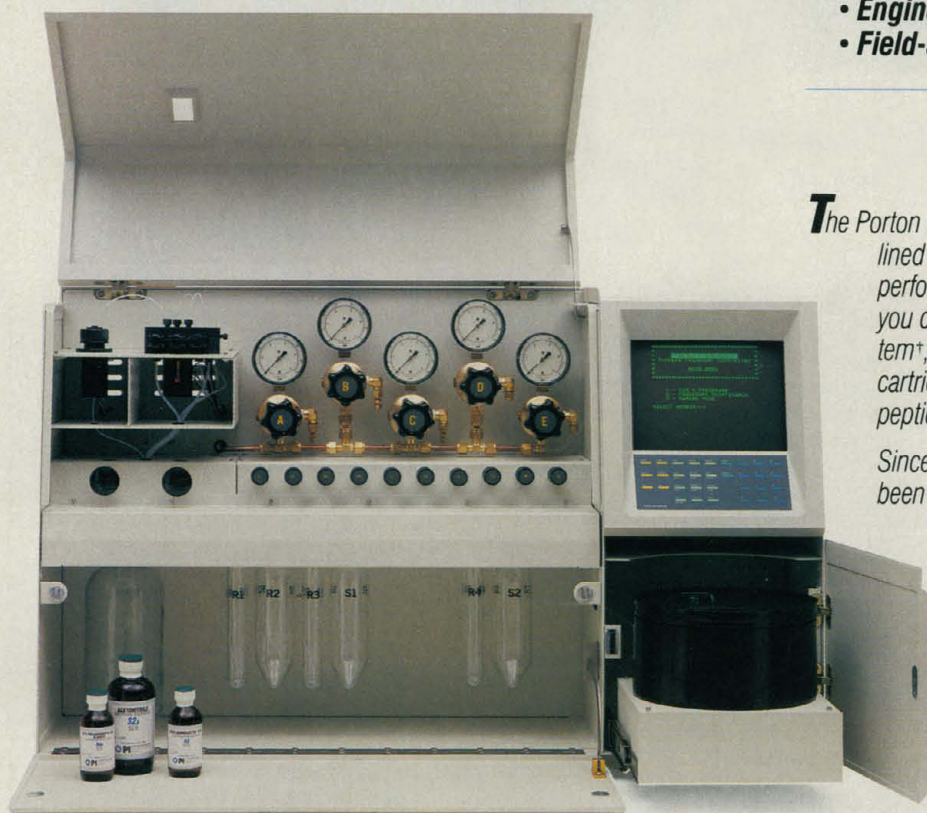
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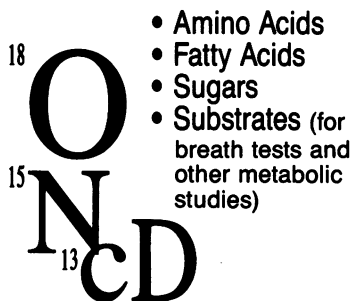
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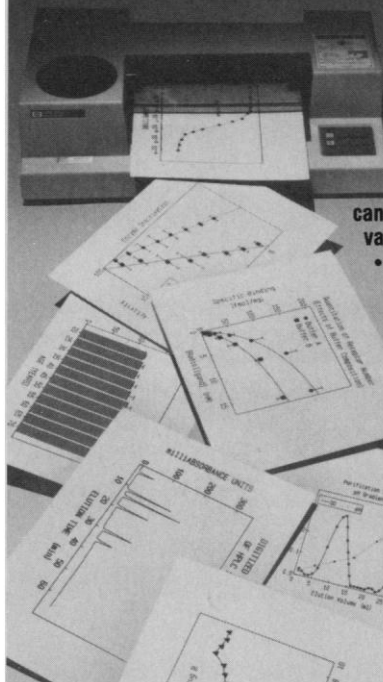
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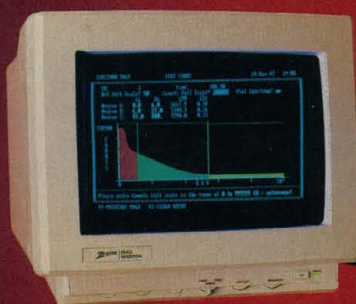
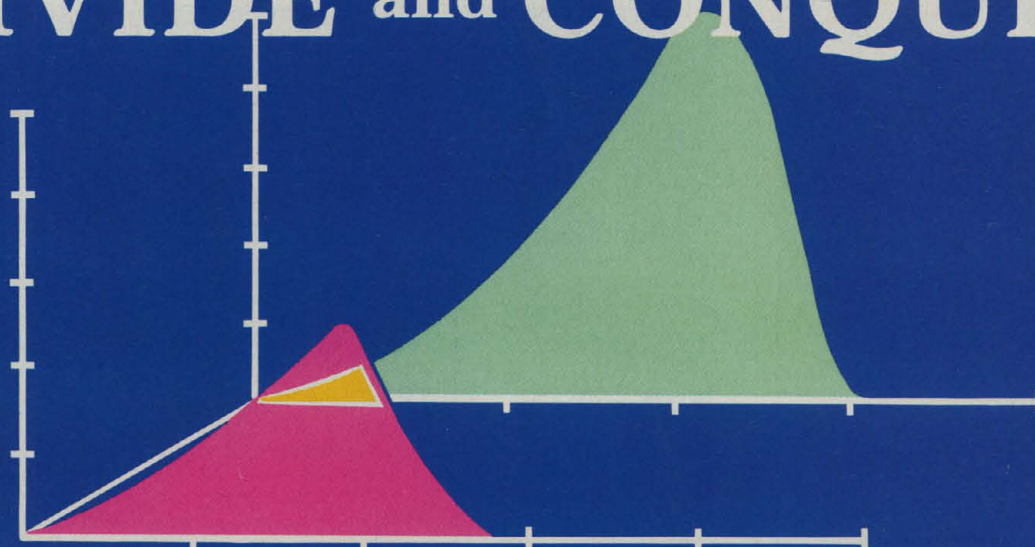
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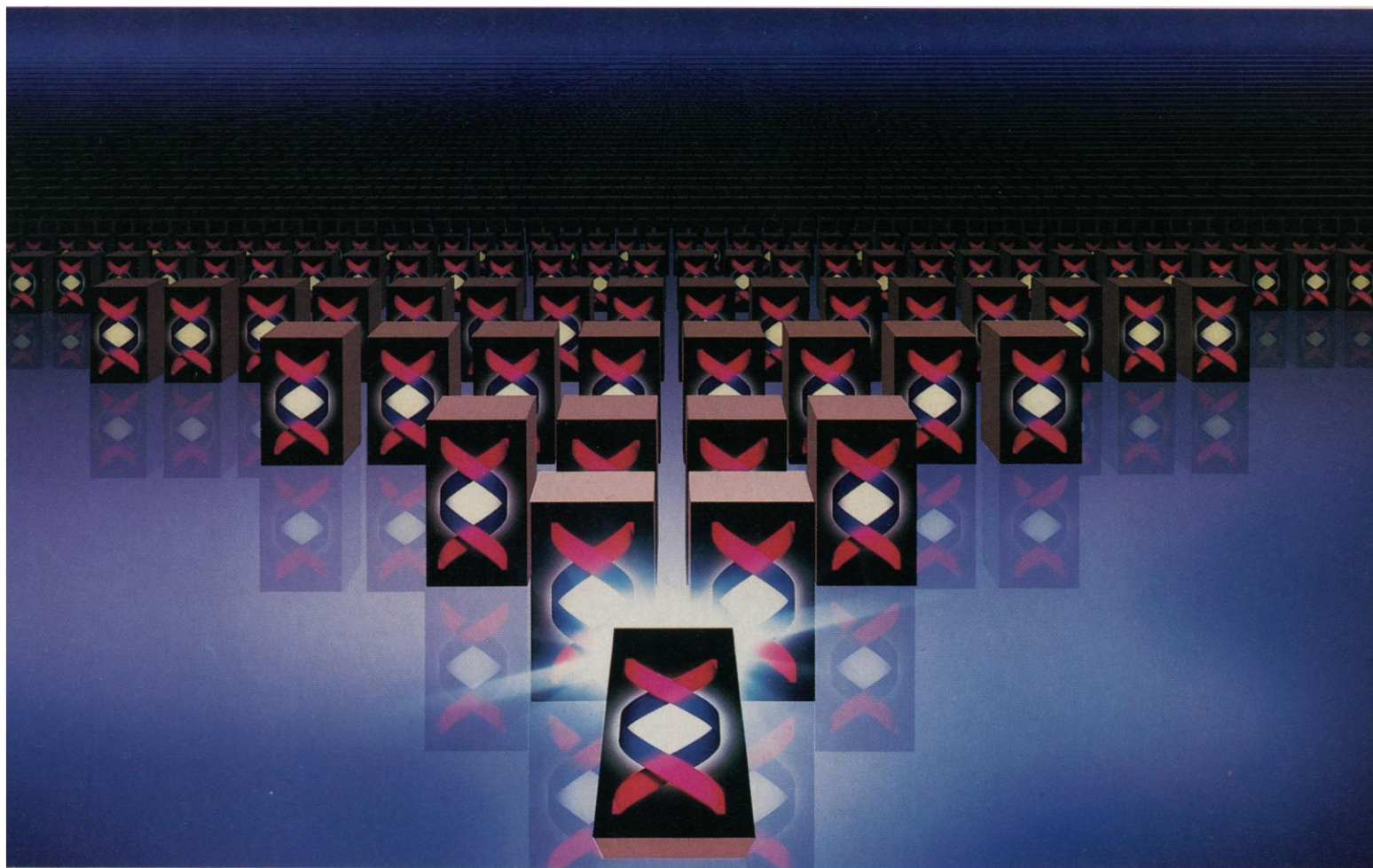


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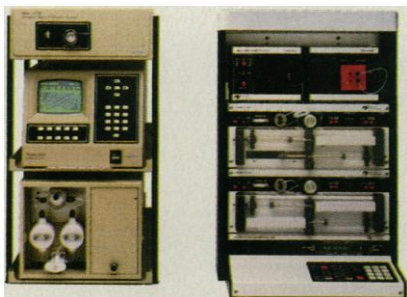
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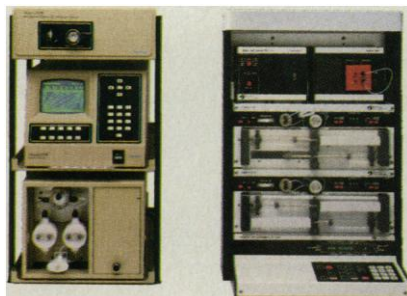
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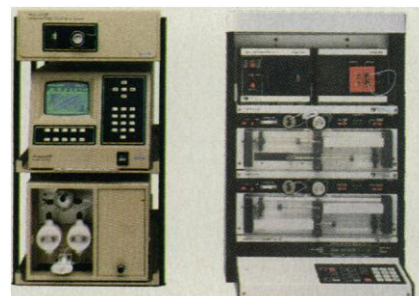
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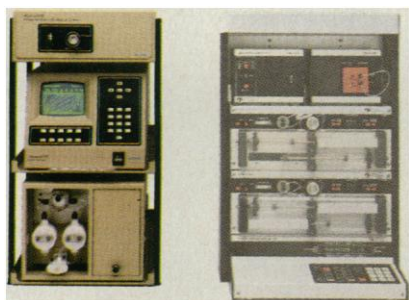
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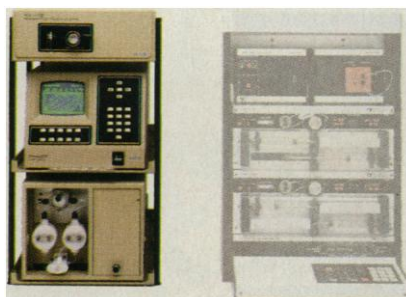
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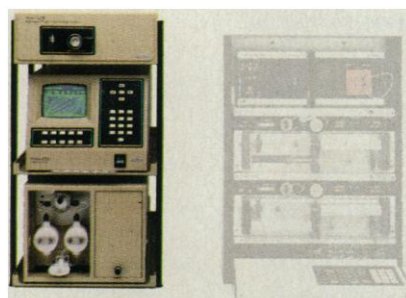
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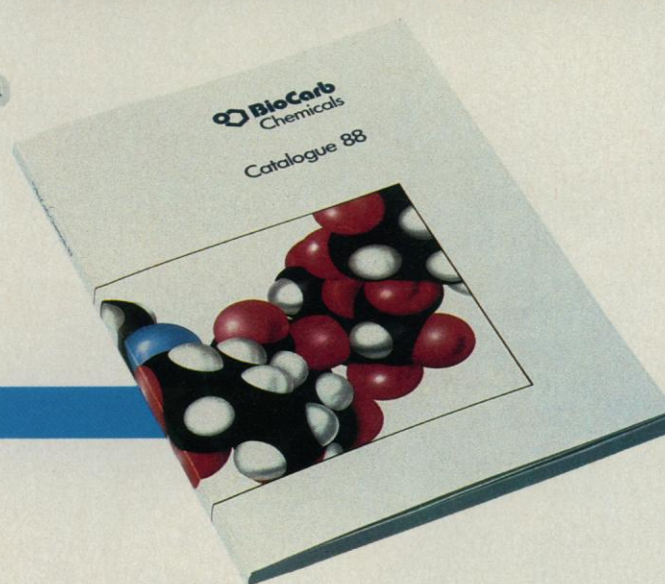
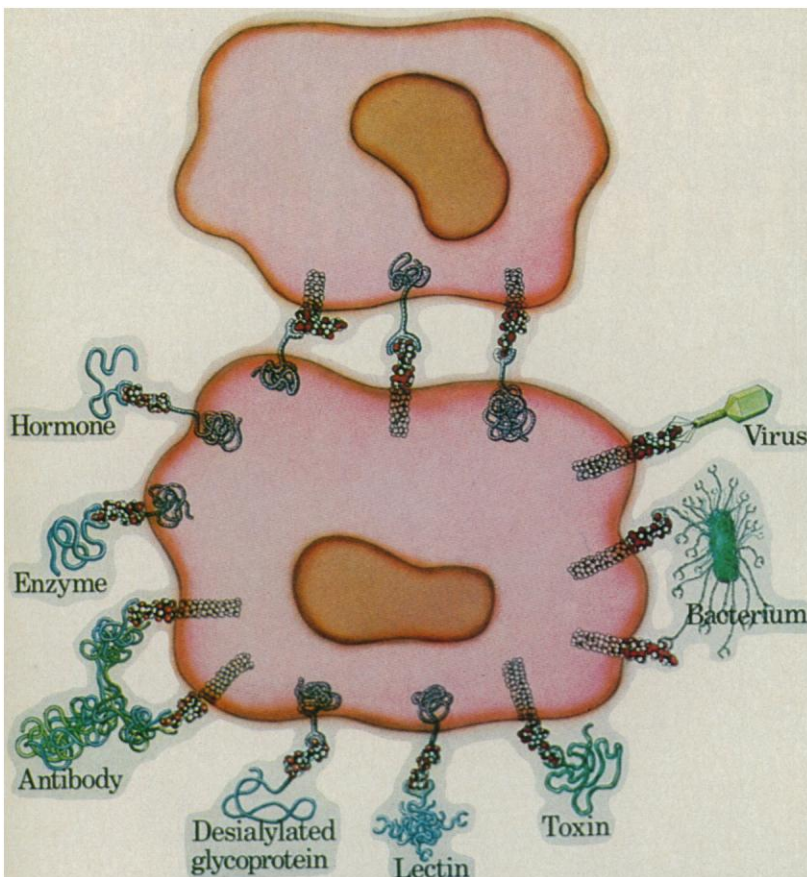
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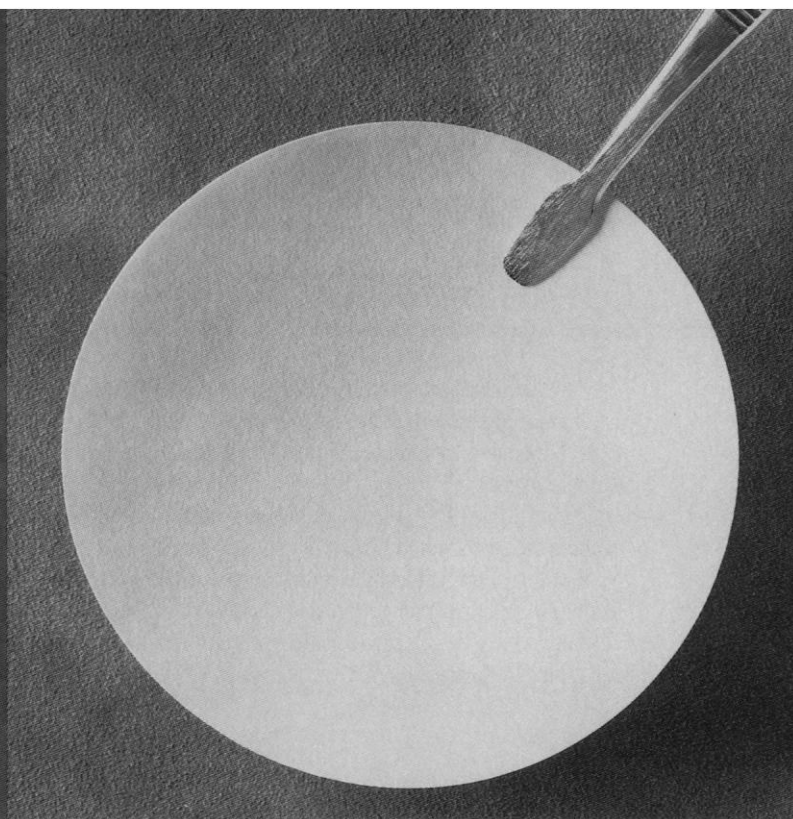
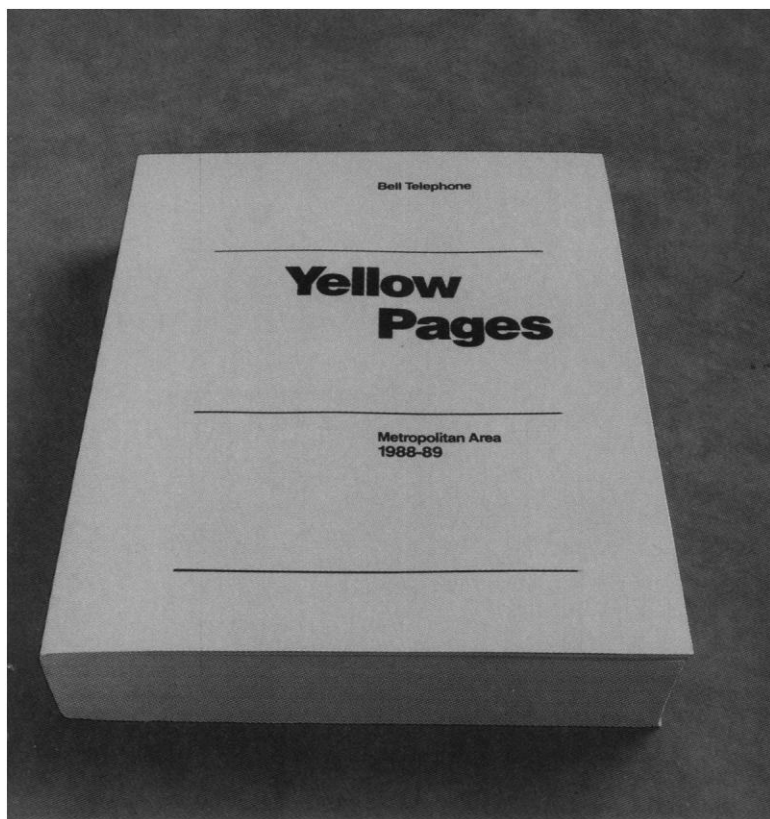
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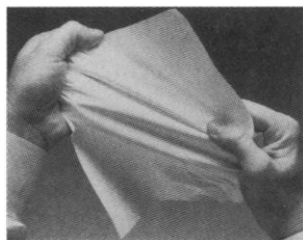
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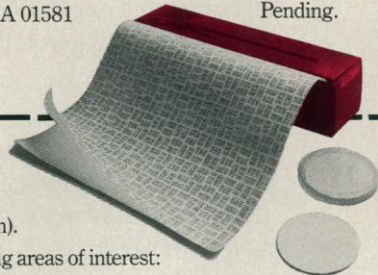
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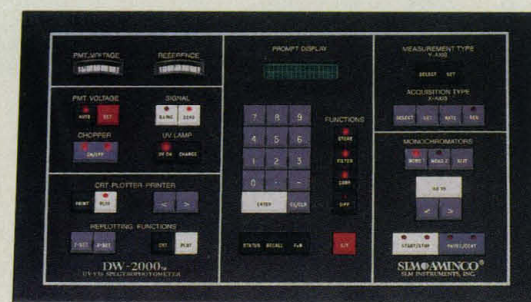
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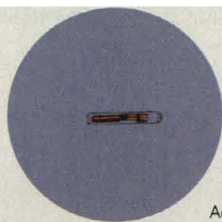


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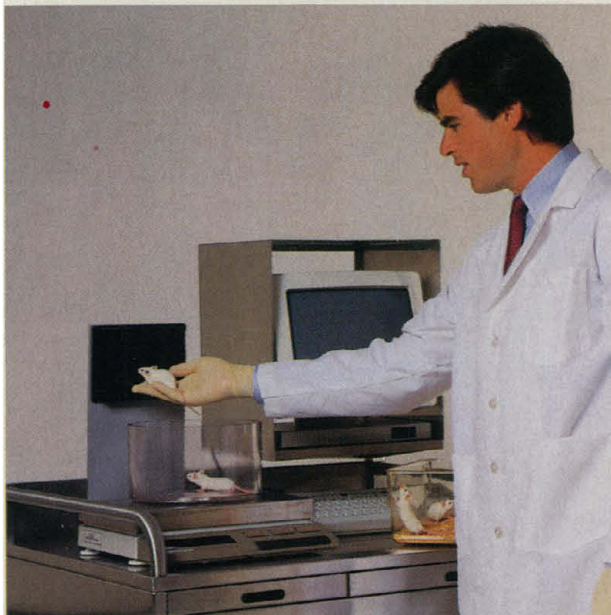
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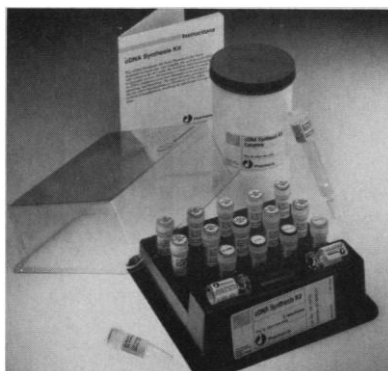
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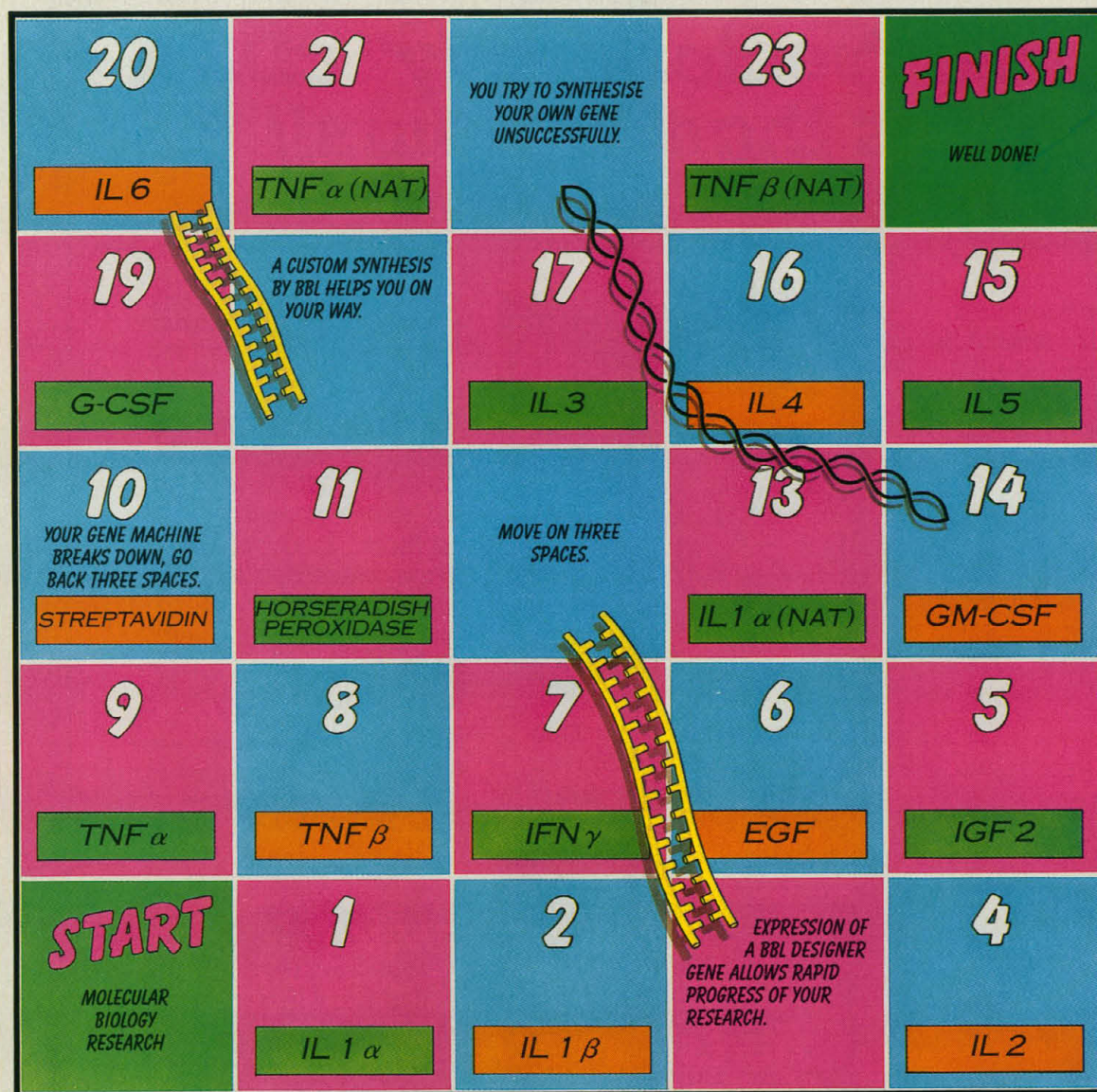
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| 2  | 6.95296 | 4.48335 | 4.09407  | 3.55091    | F3 AIn Data   |         |
| 3  | 6.98012 | 4.48542 | 4.07288  | 3.55895    | F4 Goto       |         |
| 4  | 7.00101 | 4.41459 | 4.05211  | 3.55884    | F5 Col Title  |         |
| 5  | 7.00101 | 4.25553 | 4.03134  | 3.55884    | F6 Status     |         |
| 6  | 7.06191 | 4.25563 | 4.00999  | 3.52895    | F7 AIn        |         |
| 7  | 7.02287 | 4.35570 | 3.98989  | 3.55894    | F8 Clear All  |         |
| 8  | 7.02287 | 4.35577 | 3.97121  | 3.55894    | F9 Print      |         |
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| 10 | 7.04394 | 4.29698 | 3.95587  | 3.53863    | F11 Copy Bk   |         |
| 11 | 7.04394 | 4.27207 | 3.94048  | 3.53863    | F12 Paste Bk  |         |
| 12 | 7.04394 | 4.25648 | 3.90294  | 3.53863    | F13 Find Data |         |
| 13 | 7.04394 | 4.23611 | 3.86325  | 3.53863    | F14 Transform |         |
| 14 | 7.06291 | 4.21510 | 3.84015  | 3.52894    |               |         |
| 15 | 7.06291 | 4.19625 | 3.81911  | 3.52894    |               |         |
|    | X       | Y       | Distance | Area       | Angle         |         |
|    | unit    | unit    | unit     | unit       | degrees       |         |

[illegible]

The screenshot shows the 'Transform' window in the 'Data' application. The window is divided into two panes. The left pane shows a list of transform functions: 'L1', 'L2', 'L3', 'L4', 'L5', 'L6', 'L7', 'L8', 'L9', 'L10', 'L11', 'L12', 'L13', 'L14', 'L15', 'L16', 'L17', 'L18', 'L19', 'L20', 'L21', 'L22', 'L23', 'L24', 'L25', 'L26', 'L27', 'L28', 'L29', 'L30', 'L31', 'L32', 'L33', 'L34', 'L35', 'L36', 'L37', 'L38', 'L39', 'L40', 'L41', 'L42', 'L43', 'L44', 'L45', 'L46', 'L47', 'L48', 'L49', 'L50', 'L51', 'L52', 'L53', 'L54', 'L55', 'L56', 'L57', 'L58', 'L59', 'L60', 'L61', 'L62', 'L63', 'L64', 'L65', 'L66', 'L67', 'L68', 'L69', 'L70', 'L71', 'L72', 'L73', 'L74', 'L75', 'L76', 'L77', 'L78', 'L79', 'L80', 'L81', 'L82', 'L83', 'L84', 'L85', 'L86', 'L87', 'L88', 'L89', 'L90', 'L91', 'L92', 'L93', 'L94', 'L95', 'L96', 'L97', 'L98', 'L99', 'L100'. The right pane shows a list of transform functions: 'L1', 'L2', 'L3', 'L4', 'L5', 'L6', 'L7', 'L8', 'L9', 'L10', 'L11', 'L12', 'L13', 'L14', 'L15', 'L16', 'L17', 'L18', 'L19', 'L20', 'L21', 'L22', 'L23', 'L24', 'L25', 'L26', 'L27', 'L28', 'L29', 'L30', 'L31', 'L32', 'L33', 'L34', 'L35', 'L36', 'L37', 'L38', 'L39', 'L40', 'L41', 'L42', 'L43', 'L44', 'L45', 'L46', 'L47', 'L48', 'L49', 'L50', 'L51', 'L52', 'L53', 'L54', 'L55', 'L56', 'L57', 'L58', 'L59', 'L60', 'L61', 'L62', 'L63', 'L64', 'L65', 'L66', 'L67', 'L68', 'L69', 'L70', 'L71', 'L72', 'L73', 'L74', 'L75', 'L76', 'L77', 'L78', 'L79', 'L80', 'L81', 'L82', 'L83', 'L84', 'L85', 'L86', 'L87', 'L88', 'L89', 'L90', 'L91', 'L92', 'L93', 'L94', 'L95', 'L96', 'L97', 'L98', 'L99', 'L100'. The 'L1' function is selected in the right pane. The 'L1' function is defined as: 'L1 = (L1 + L2) \* L3'. The 'L1' function is defined as: 'L1 = (L1 + L2) \* L3'. The 'L1' function is defined as: 'L1 = (L1 + L2) \* L3'.

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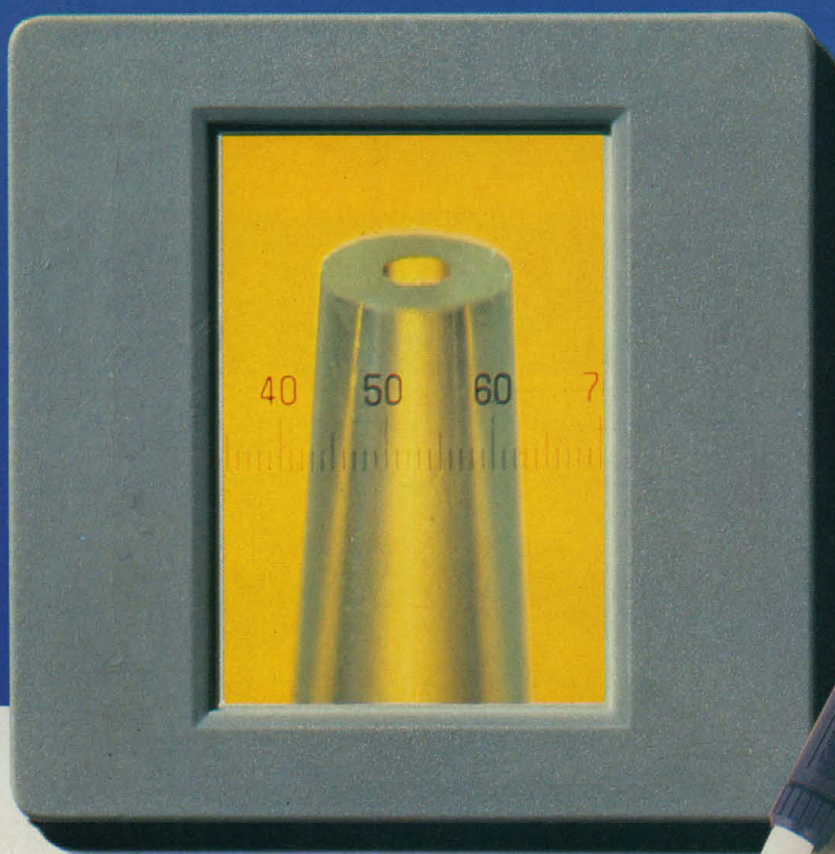
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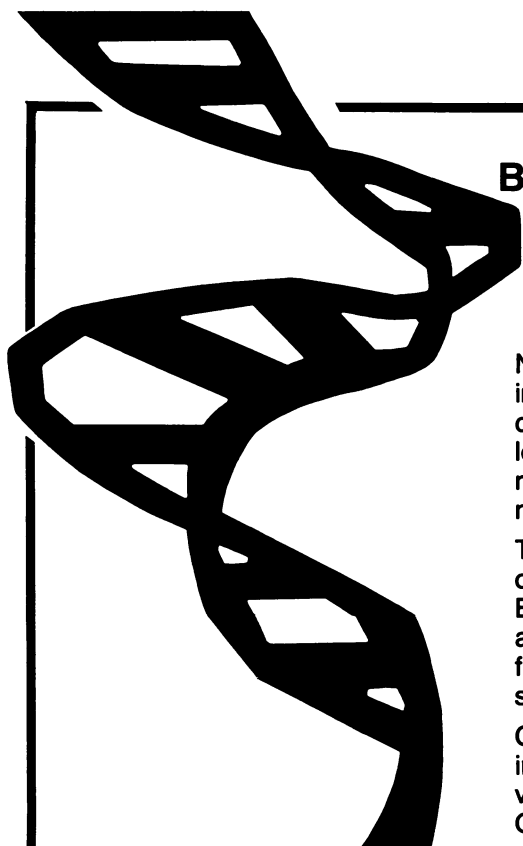
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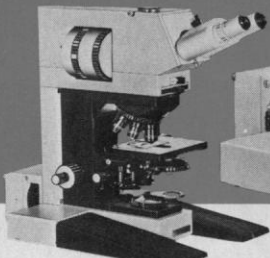
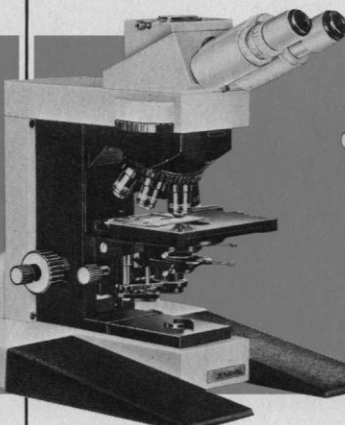
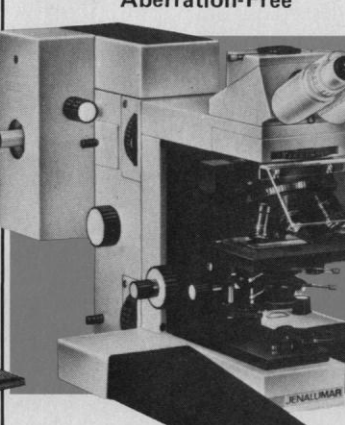
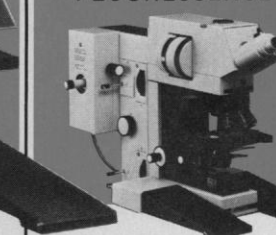
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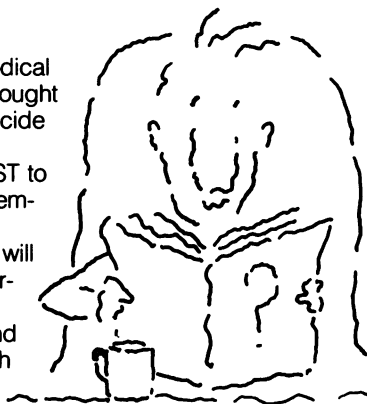
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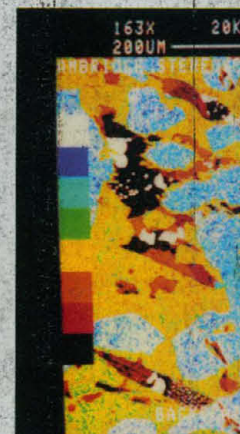
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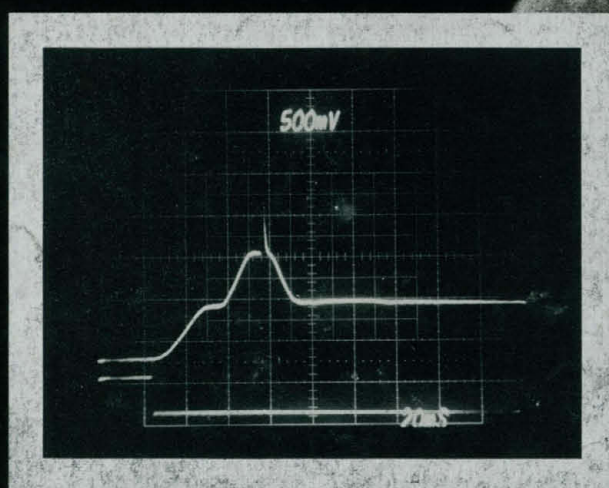


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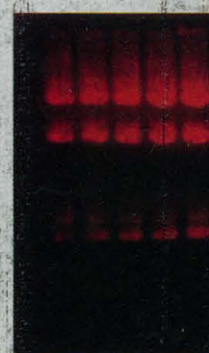
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|   | Type 909                    | Integral Pack<br>4x4 in.         | ISO 640/29°  | Self-timing                          | Balanced for daylight<br>and electronic flash.   |
|   | Type 339                    | Integral Pack<br>4.5x4.2 in.     | ISO 640/29°  | Self-timing                          | General purpose, high speed,<br>medium contrast.   |
|   | Polacolor ER<br>Type 669    | Pack 3 1/4x4 1/4 in.             | ISO 80/20°   | 60 seconds                           | Medium contrast; extended<br>dynamic range. Balanced for<br>daylight and electronic flash.           |
|   | Polacolor ER<br>Type 559    | Pack 4x5 in.                     | ISO 80/20°   | 60 seconds                           | Medium contrast; extended<br>dynamic range. Balanced for<br>daylight and electronic flash.           |
|   | Polacolor ER<br>Type 59     | Sheet 4x5 in.                    | ISO 80/20°   | 60 seconds                           | Medium contrast; extended<br>dynamic range. Balanced for<br>daylight and electronic flash.           |
|   | Polacolor ER<br>Type 809    | Sheet 8x10 in.                   | ISO 80/20°   | 60 seconds                           | Medium contrast; extended<br>dynamic range. Balanced for<br>daylight and electronic flash.           |
| Instant B&W<br>Prints                       | Type 331                    | Integral Pack<br>4.5x4.2 in.     | ISO 400/27°  | Self-timing                          | Medium contrast, automatic<br>development.   |
|   | Type 612                    | Pack 3 1/4x4 1/4 in.             | ISO 20000/44°  | 30 seconds                           | Ultra high speed for<br>oscilloscope recording.  |
|   | Type 667                    | Pack 3 1/4x4 1/4 in.             | ISO 3000/36°   | 30 seconds                           | General purpose, high speed<br>film. No coating required.  |
|   | Type 52                     | Sheet 4x5 in.                    | ISO 400/27°  | 15 seconds                           | Wide tonal range, superb<br>detail.  |
|   | Type 53                     | Sheet 4x5 in.                    | ISO 800/30°  | 30 seconds                           | Medium contrast film. No<br>coating required.  |
|   | Type 57                     | Sheet 4x5 in.                    | ISO 3000/36°   | 15 seconds                           | General purpose, high speed<br>film.   |
|   | Type 553                    | Pack 4x5 in.                     | ISO 800/30°  | 30 seconds                           | General purpose, high speed<br>film. No coating required.  |
|   | Type 803                    | Sheet 8x10 in.                   | ISO 800/30°  | 30 seconds                           | Fine grain medium contrast<br>film. No coating required.   |
| Print & Negative                            | Type 55                     | Sheet 4x5 in.                    | ISO 50/18°   | 20 seconds                           | Negative requires brief<br>clearing in sodium sulfite<br>solution, washing and drying<br>before use. |
|   | Type 665                    | Pack 3 1/4x4 1/4 in.             | ISO 80/20°   | 30 seconds                           | Negative requires brief<br>clearing in sodium sulfite solution,<br>washing and drying before use.    |
| Instant Color<br>Overhead<br>Transparency   | Colorgraph<br>Type 691      | Pack 3 1/4x4 1/4 in.             | ISO 80/20°   | 4 minutes                            | Small format overhead<br>projection use.   |
|   | Colorgraph<br>Type 891      | Sheet 8x10 in.                   | ISO 80/20°   | 4 minutes                            | For overhead projection use.   |
| Instant B&W<br>Radiographic<br>Transparency | Type TPX                    | Sheet 8x10 in.                   | N/A  | 60 seconds                           | Medium to high contrast.<br>High speed Orthochromatic<br>sensitivity. No darkroom<br>needed.         |
| Instant 35mm<br>Color Slides                | PolaChrome CS               | 35mm Roll<br>(12 & 36 Exposures) | ISO 40/17°   | 60 seconds                           | General purpose, continuous<br>tone color.   |
|   | High Contrast<br>PolaChrome | 35mm Roll<br>(12 Exposures)      | ISO 40/17°   | 2 minutes                            | High contrast color for text<br>and graphic imaging.   |
|   | PolaBlue BN                 | 35mm Roll<br>(12 Exposures)      | ISO 4/7°<br>(Tungsten)<br>ISO 8/10°<br>(Electronic<br>Flash) | 4 minutes                            | White-on-blue negative<br>film for word slides, charts<br>and graphs.                                |
| Instant 35mm<br>B&W Slides                  | PolaPan CT                  | 35mm Roll<br>(12 & 36 Exposures) | ISO 125/22°  | 60 seconds                           | General purpose, continuous<br>tone black and white.   |
|   | PolaGraph HC                | 35mm Roll<br>(12 Exposures)      | ISO 400/27°  | 2 minutes                            | High contrast black and white.<br>Ideal for line copy.   |

We also have many other films to meet additional applications.



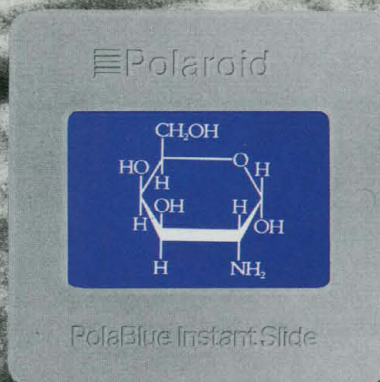
Analysis of a Metal Alloy –  
toFilm Type 339



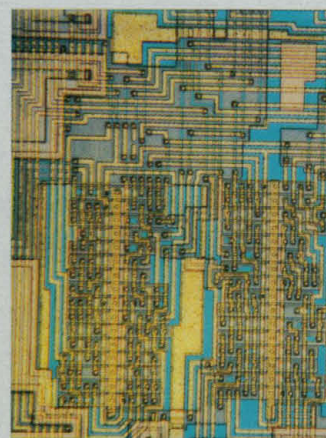
CAD/CAM Image of a Ball Bearing –  
PolaChrome Instant 35mm Film



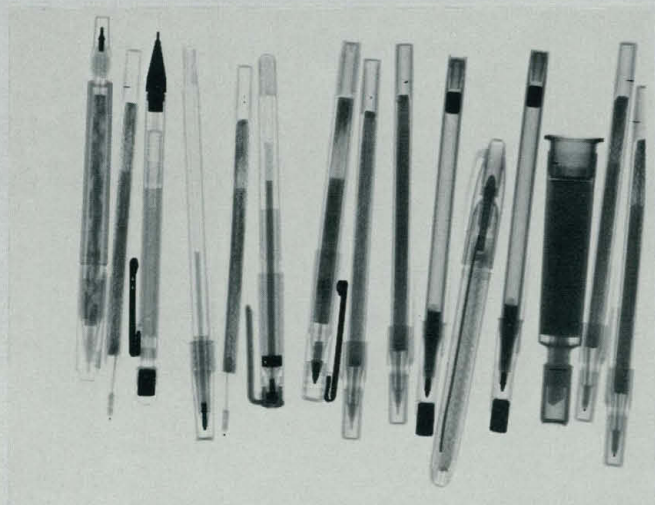
Molecular Structure of Galactosamine –  
PolaBlue Instant 35mm Film



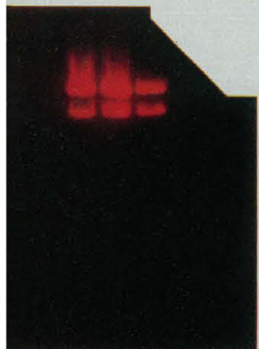
Photomicrograph of Integrated  
AutoFilm Type 339



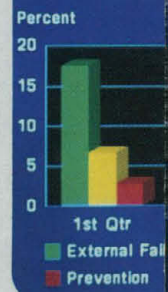
X-ray of Pens –  
Type 53

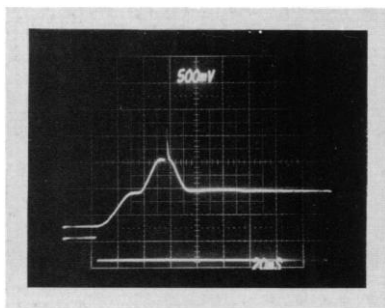


Pattern from an  
Plasmid DNA –  
669 Film



COST OF QUALITY  
% OF MANUFACTURING





Screen Camera were used to document this oscillograph.

## Test and Measurement.

Polaroid Type 667 black and white high speed print film and Polaroid DS-34 Direct

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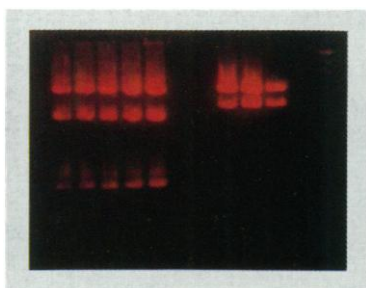
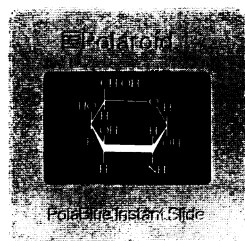


image of an electrophoresis pattern from an enzyme digestion of Plasmid DNA. Type 667 and Type 53 black and white films are also used for electrophoresis documentation.

## Biotechnology.

Polaroid Polacolor ER Type 669 film and the Polaroid MP-4 Multipurpose Camera were used to produce this



**Physical Science.** This white on blue slide of the molecular structure of galactosamine was made with new Polaroid PolaBlue Instant 35MM Slide Film. New PolaBlue

provides bright, high quality, white on blue slides in minutes for presentation or documentation. It's more cost effective than traditional methods of making blue slides.

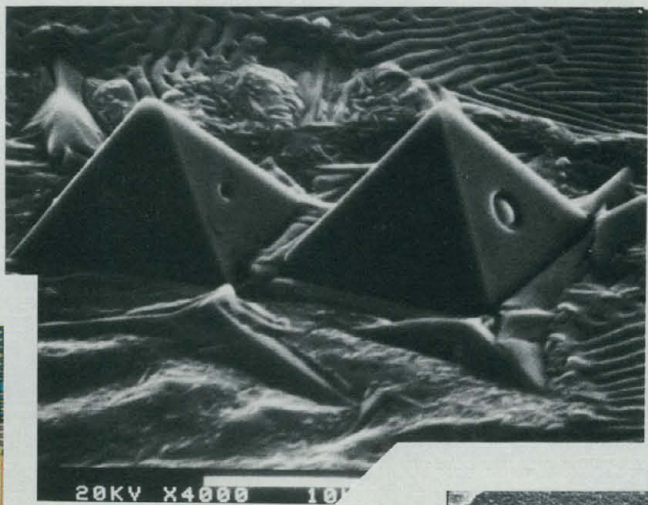
Polaroid offers you more than forty different instant film types – an entire world of solutions – for general purpose or highly specific applications.

With Polaroid instant color or black and white print films, you can actually speed up

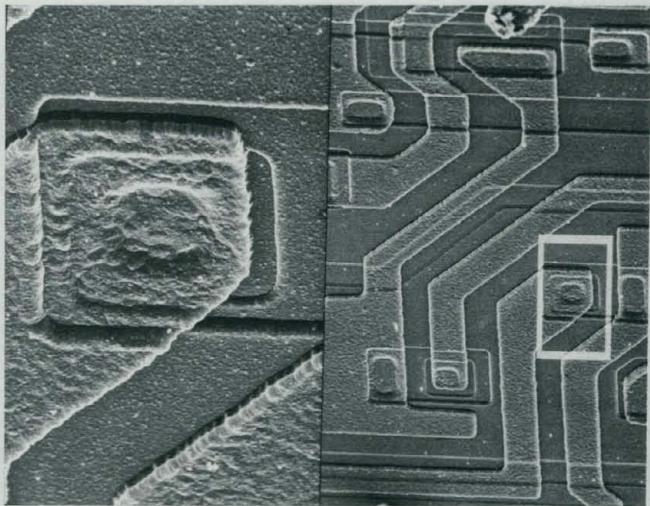
# Polaroid



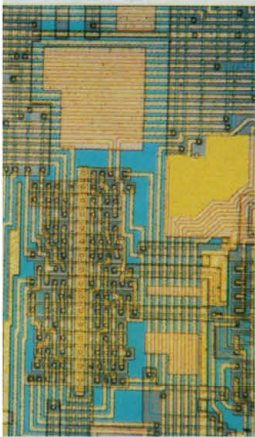
S.E.M. Image of Inner Surface Cavity  
of a Nickel-Tin Eutectic Alloy Sphere –  
Type 55



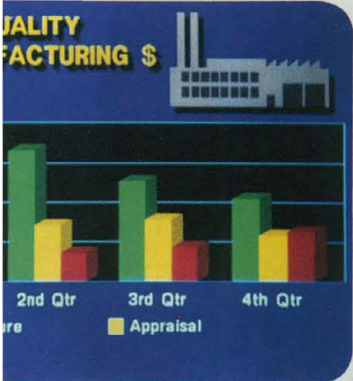
S.E.M. Image of an Integrated Circuit –  
PolaPan Type 52



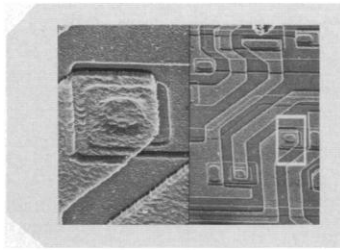
ed Circuit –



Cost Analysis Graph –  
Colorgraph Type 691



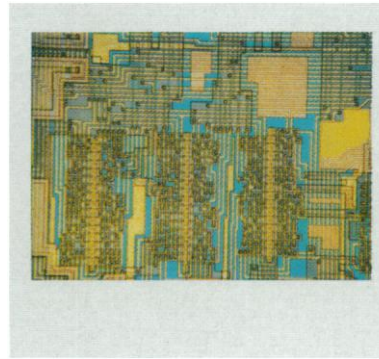




grain print film offers a wide tonal range and provides superb detail.

### Electronics.

PolaPan Type 52 sheet film was used to capture this split-field S.E.M. of an integrated circuit. This black and white, fine



### Clean Room Microscopy.

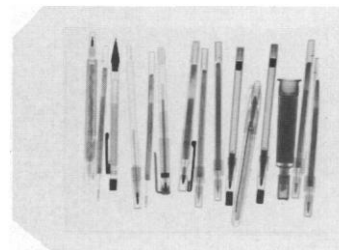
Polaroid AutoFilm Type 339 was used to produce this photomicrograph of an integrated circuit viewed through an optical microscope.



### Quality Assurance.

This particle analysis of a metal alloy, shown on Polaroid High Speed AutoFilm Type 339, displays consistent saturated color and

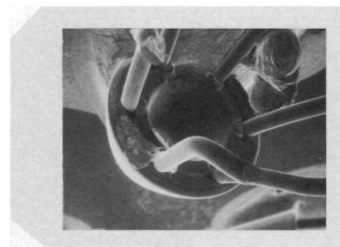
requires no pulling, timing, or peeling. It was made with the Polaroid FreezeFrame Video Image Recorder



### Non-Destructive Testing.

This X-ray of a representative group of pens was made on Type 53 to view the alignment of the parts. This general purpose

high speed film requires no print coating.



### Failure Analysis.

This S.E.M. image of a heart valve, magnified 18x, is on Type 55 instant film. This black and white sheet film provides you with

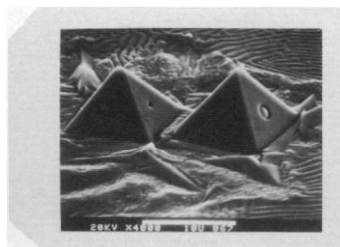
a positive and negative to make high quality, professional images.



### Presentations.

An instant color overhead transparency, such as this cost analysis graph, can be made using Polaroid Color-graph Type 691

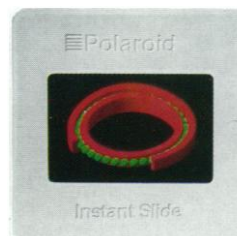
film. This full color film creates small format overhead transparencies so the latest findings can be presented instantly. The actual graph was generated on a personal computer using the PalettePlus Computer Image Recorder.



### Metallurgy.

This S.E.M. image magnified 4000x is of the inner surface shrinkage cavity formed on solidification of a nickel-tin eutectic

alloy sphere levitated in microgravity aboard the space shuttle. To capture the fine detail, Polaroid Type 55 black and white instant film was used.



### Graphic Design.

To capture the subtle color differentiations in this CAD/CAM image of a ball bearing, new Polaroid High Contrast PolaChrome Instant 35MM Slide Film was

used. New High Contrast PolaChrome provides bright, high quality, color slides in minutes for presentation or documentation.



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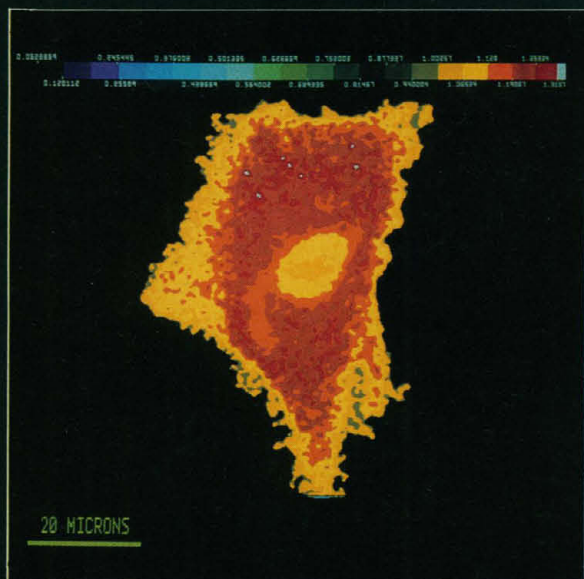
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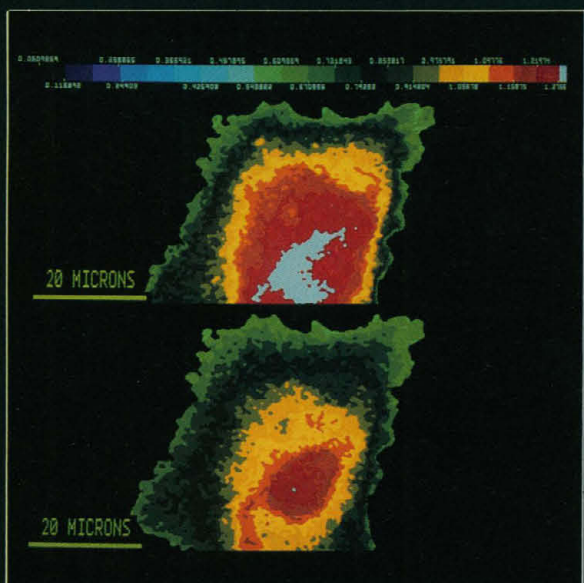
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A 340/380 ratioed image of cultured neonatal rat myocyte



Split screen for comparison of spatial distribution

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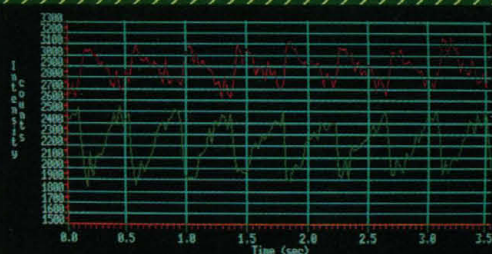
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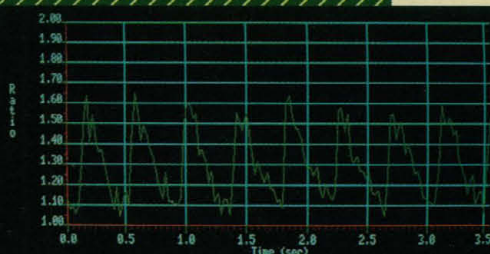
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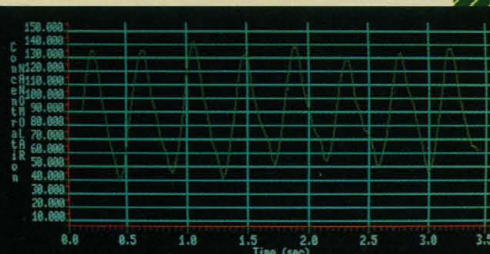
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Intensity



Ratio



Calcium Concentration

Analysis of dynamic calcium changes in spontaneously beating myocytes

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