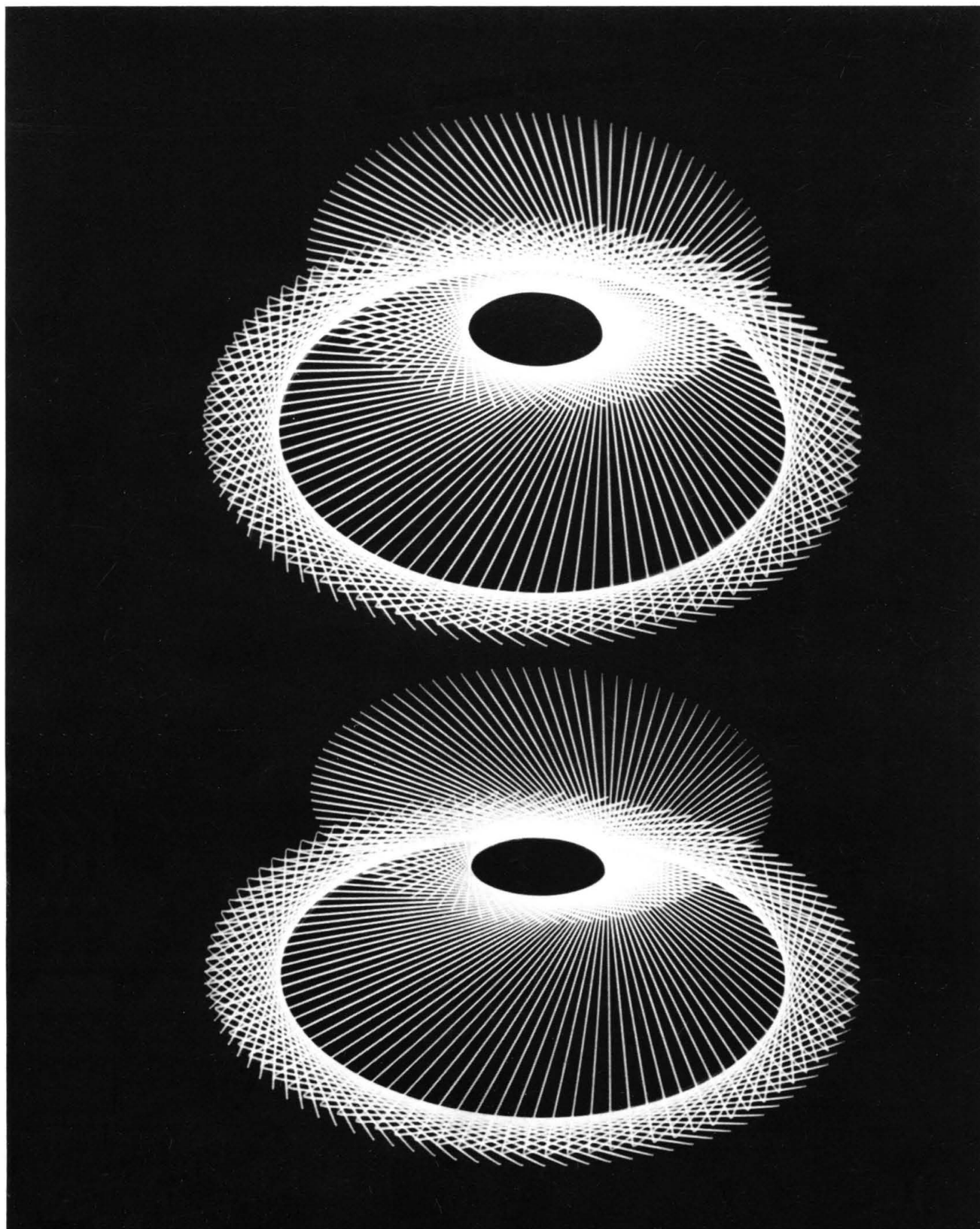


# SCIENCE

12 December 1975

Volume 190, No. 4219

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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Volume 190, No. 4219

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<b>LETTERS</b>	The Ozone Question: <i>F. S. Rowland and M. J. Molina; T. L. Cairns and J. P. Jesson; The "Greenhouse Effect": R. G. Fleagle and J. A. Businger</i> . . . . .	1038
<b>EDITORIAL</b>	Federal R & D—Outmoded Management Policies: <i>R. L. Bisplinghoff</i> . . . . .	1045
<b>ARTICLES</b>	Protein Crystal Structures: Quicker, Cheaper Approaches: <i>D. M. Collins et al.</i> . . . .	1047
	The World Food Prospect: <i>L. R. Brown</i> . . . . .	1053
	The Controversy over Peer Review: <i>T. Gustafson</i> . . . . .	1060
<b>NEWS AND COMMENT</b>	Energy: Plan to Use Peat as Fuel Stirs Concern in Minnesota. . . . .	1066
	Research May Escape Major Damage from \$28 Billion Cutback . . . . .	1069
	<i>Bulletin of the Atomic Scientists</i> : Thirty Years of Clockwatching. . . . .	1070
	Science and Values Discussed at Moon-Sponsored Parley. . . . .	1073
<b>RESEARCH NEWS</b>	Synchrotron Radiation (I): A Light for All Seasons . . . . .	1074
	Neurochemistry: Unraveling the Mechanism of Memory: <i>P. Wallace</i> . . . . .	1076
<b>ANNUAL MEETING</b>	Frontiers of Science and Our Expectations: <i>A. Herschman</i> . . . . .	1079
<b>BOOK REVIEWS</b>	The Evolution of Behavior and Animal Behavior, reviewed by <i>D. P. Barash</i> ; The Florida Experience, <i>P. R. Jutro</i> ; Ecological Diversity, <i>R. M. May</i> ; Salt Glands in Birds and Reptiles, <i>V. H. Shoemaker</i> ; Electric Current Flow in Excitable Cells, <i>R. S. Eisenberg</i> ; Books Received . . . . .	1084
<b>REPORTS</b>	Anaerobic Digestion: The Rate-Limiting Process and the Nature of Inhibition: <i>C. D. Finney and R. S. Evans II.</i> . . . .	1088
	Chromosome Damage in Liver Cells from Low Dose Rate Alpha, Beta, and Gamma Irradiation: Derivation of RBE: <i>A. L. Brooks</i> . . . . .	1090

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<i>Albugo</i> -Like Oogonia from the American Carboniferous: <i>B. M. Stidd</i> and <i>K. Cosentino</i> . . . . .	1092
High Speed Scintillation Autoradiography: <i>B. G. M. Durie</i> and <i>S. E. Salmon</i> . . . . .	1093
Nongenetic Variability in Susceptibility to Oncogenesis: <i>R. T. Prehn</i> . . . . .	1095
Deoxycorticosterone-Adenine Interactions in a Crystalline Complex: <i>C. M. Weeks</i> , <i>D. C. Rohrer</i> , <i>W. L. Duax</i> . . . . .	1096
Phosphoribosylpyrophosphate Overproduction, a New Metabolic Abnormality in the Lesch Nyhan Syndrome: <i>G. H. Reem</i> . . . . .	1098
5-Iododeoxyuridine Potentiation of the Replication in vitro of Several Unrelated RNA and DNA Viruses: <i>J. A. Green</i> and <i>S. Baron</i> . . . . .	1099
Thymus: Central Role in the Immune System of the Frog: <i>E. P. Volpe</i> and <i>J. B. Turpen</i> . . . . .	1101
<i>Neisseria gonorrhoeae</i> and <i>Neisseria meningitidis</i> : Extracellular Enzyme Cleaves Human Immunoglobulin A: <i>A. G. Plaut</i> et al. . . . .	1103
<i>Latimeria</i> , the Living Coelacanth, Is Ovoviviparous: <i>C. L. Smith</i> et al. . . . .	1105
Immunoglobulin E Antibodies to Pollen Allergens Account for High Percentages of Total Immunoglobulin E Protein: <i>G. J. Gleich</i> and <i>G. L. Jacob</i> . . . . .	1106
Infectious Etiology of Neuritic (Senile) Plaques in Mice: <i>H. M. Wisniewski</i> , <i>M. E. Bruce</i> , <i>H. Fraser</i> . . . . .	1108
Adenosine 3', 5'-Monophosphate in Reproducing and Differentiated Trypanosomes: <i>J. E. Strickler</i> and <i>C. L. Patton</i> . . . . .	1110
Axonal Projections of Medial Preoptic and Anterior Hypothalamic Neurons: <i>L. C. A. Conrad</i> and <i>D. W. Pfaff</i> . . . . .	1112
Deficits in Binocular Depth Perception in Cats After Alternating Monocular Deprivation: <i>R. Blake</i> and <i>H. V. B. Hirsch</i> . . . . .	1114
<i>Technical Comments</i> : Stratigraphic Correlation: <i>G. F. Brockman</i> ; Strategic Arms Debate: <i>J. B. Walsh</i> ; <i>S. J. Deitchman</i> ; <i>K. Tsipis</i> . . . . .	1116

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A rotation about a particular axis of the two lines connecting the alpha-carbon positions in a tripeptide. See page 1047. [D. M. Collins *et al.*, Texas A & M University, College Station]

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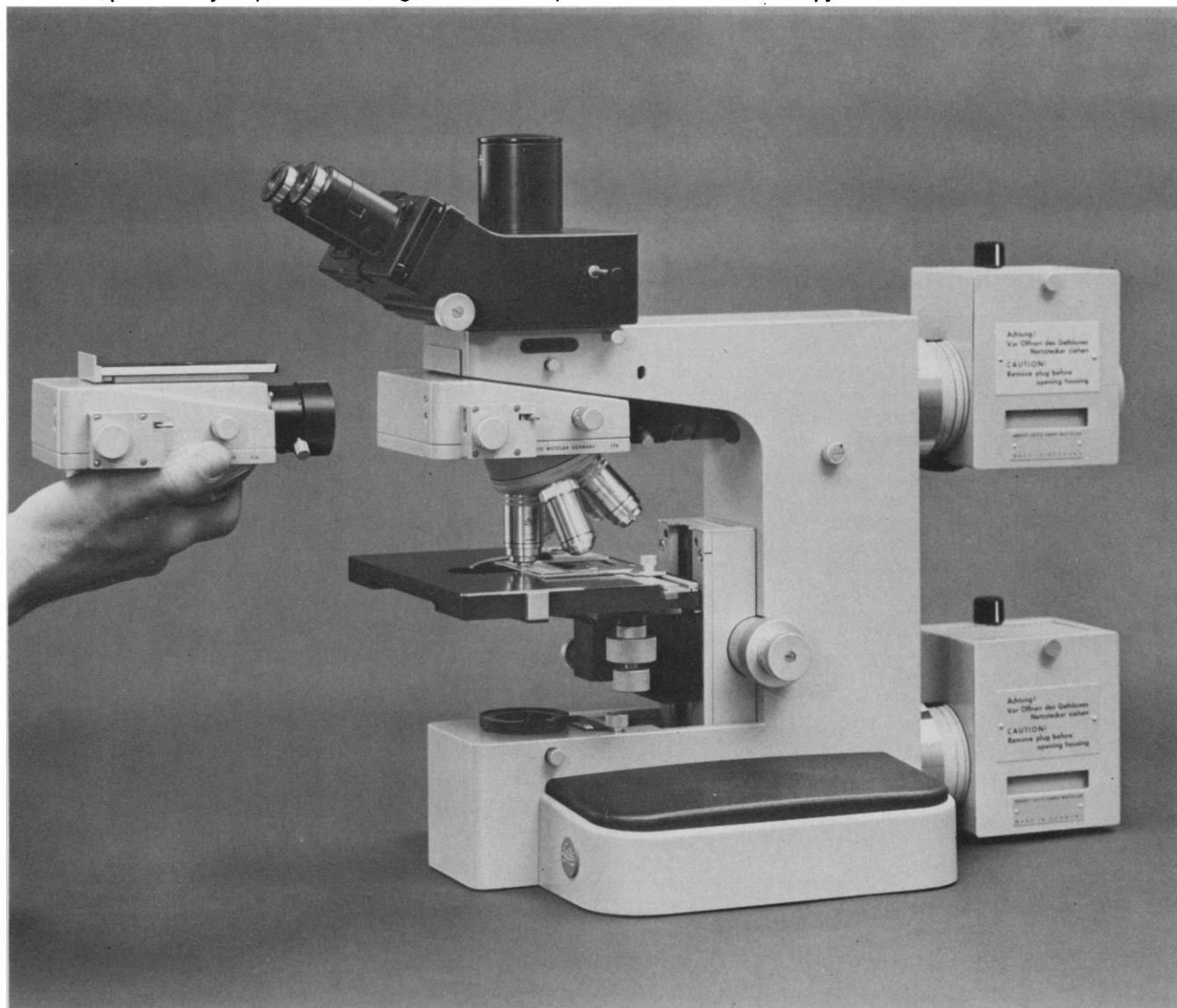
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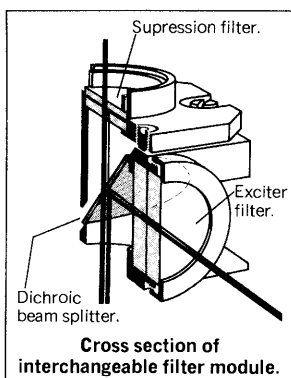
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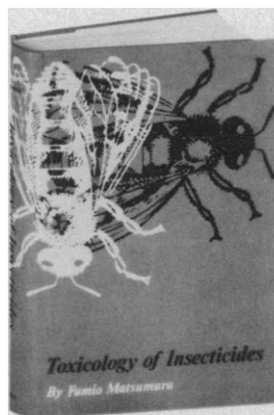
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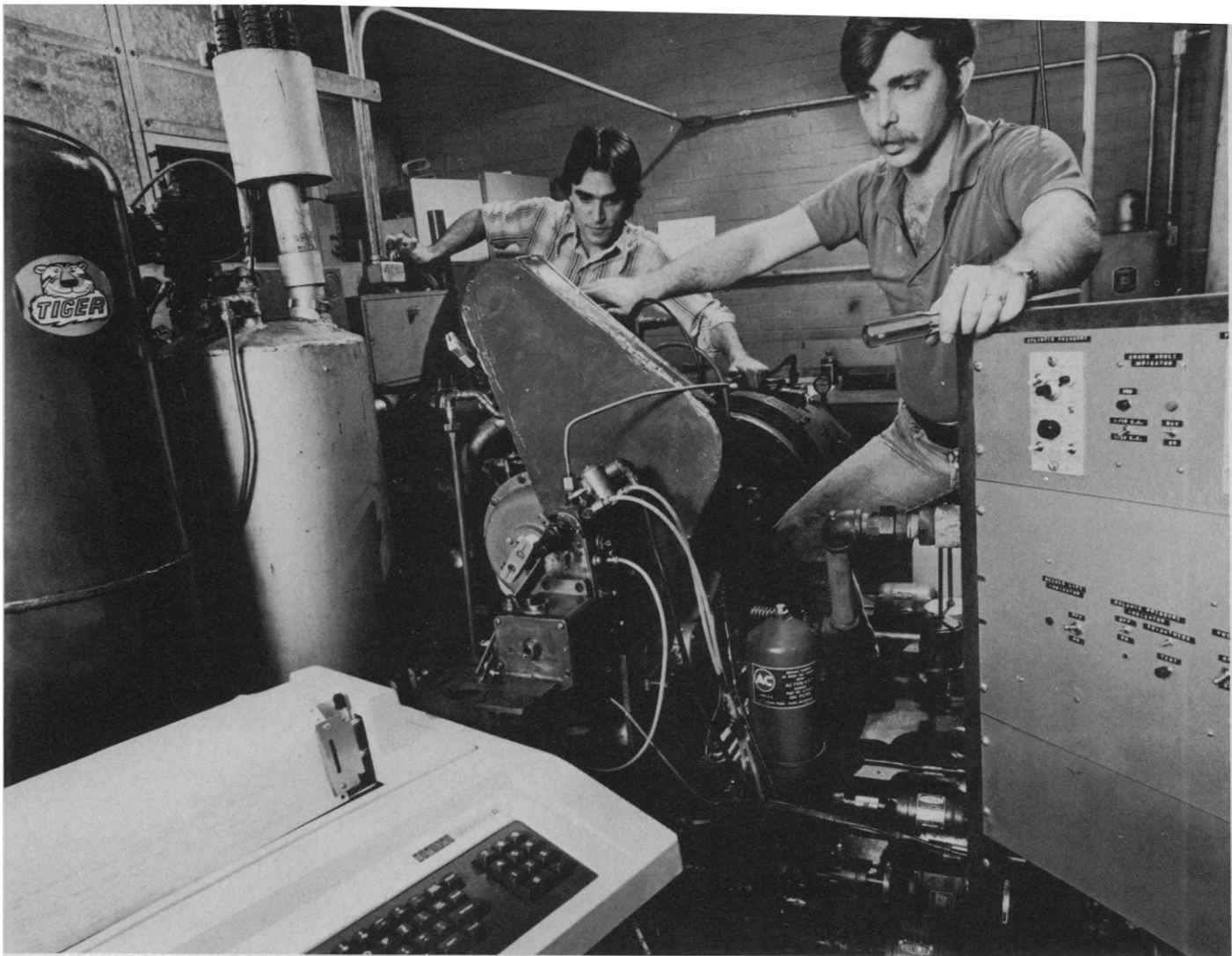
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## Students test alternative fuels and pollution potential of stratified-charge engines. Digital's PDP 11/10 computer helps.

What the future holds for stratified-charge engines is being studied. Students in the automotive research lab at a leading institute are testing the engine's potential. They are applying the power of a Digital computer in experiments to control pollution and conserve energy.

Engine pressure and emissions data are taken at critical points on an operating engine. The volume of test data is then analyzed to determine what gains have been realized. Such testing was difficult at best until special sensors were applied to retrieve analog data for on-line computer conversion and storage in digital form.

The researchers asked Digital Equipment Corporation for some

help. Digital's PDP 11/10 Lab System with LPS analog interface plus RT-11 and LAB APS application software seemed the best approach. The system interfaced with analog test sensors, and was easy to install and use.

Students welcomed the computer as an educational tool for easy access and analysis of test data. Accuracy of data collection was improved dramatically. The entire system was affordable, and will reduce computing costs further with an eventual link to the central system.

Digital's 11/10 is one of the many systems of all sizes offered to the laboratory and research community. Over 60 peripheral devices are also available including basic to sophisticated graphics

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# The SEM doesn't lie!

(It proves superiority of  
Uni-Pore<sup>TM</sup> membranes from Bio-Rad)

The advantages of membrane filtration for preparing specimens for scanning electron microscopy and transmission electron microscopy have long been established.

But what type of membrane system provides the best results—for bacterial cells, viruses or any particulate matter you want to see clearly?

We think the SEM micrographs on this page dramatically illustrate the superiority of Uni-Pore polycarbonate membranes from Bio-Rad, compared to the cellulosic type.

Note the uniform pores of the 0.4  $\mu\text{m}$  Uni-Pore membrane on the left. Almost as if it were drilled. And note the smooth, flat counter-like surface which provides the ideal specimen background for SEM and TEM analysis. It's also a surface that will give you virtually 100% recovery, because there are no fibrous "briar patches" to grip and hold your material.

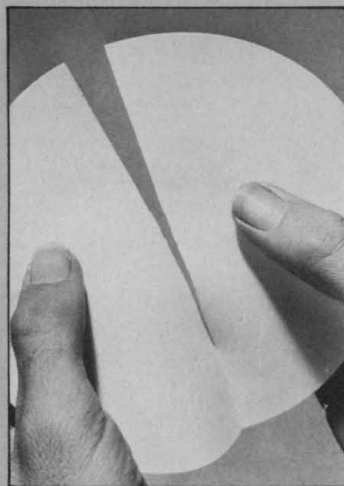
Quite a contrast to the rough, tortuous paths of the 0.45  $\mu\text{m}$  pore size cellulosic filter at the right. The differences in filter thickness—10  $\mu\text{m}$  for the Uni-Pore vs. 150  $\mu\text{m}$  for the cellulosic filter—means lower and more uniform tare weights for Uni-Pore filters.

In addition to their precise pore geometry, thinness and smooth surfaces, Uni-Pore membranes offer superior strength (bend 'em, fold 'em) and chemical/thermal stability compared to other types of filters.

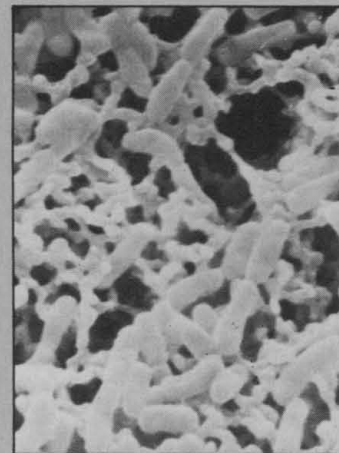
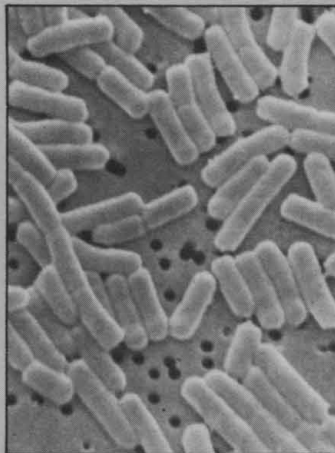
Available in pore sizes from 8.0 down to 0.015  $\mu\text{m}$ , in discs from 13 to 293 mm, in sheets and in filter cartridges. Bulletin 1036 describes Uni-Pore membrane filters in detail, including applications for virus purification and concentration, exfoliative cytology, particulate analysis, chemotaxis and many other uses.

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Uni-Pore membranes can be bent and folded without damage as shown in photo on the left. Cellulosic membranes crack and break under the same treatment as shown in photo on the right.



Scanning electron micrographs of *Bacillus subtilis*, 5000X, on 0.4  $\mu\text{m}$  pore size polycarbonate membrane on the left and a standard 0.45  $\mu\text{m}$  pore size cellulosic membrane on the right.

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Extreme UV grazing incidence monochromator	McPherson	247
Rapid scan, monochromator	Perkin-Elmer	108
Raman double monochromator	Spex	1401
AA spectrophotometer	Perkin-Elmer	103, 107, 290B, 303, 403
AA spectrophotometer	IL	253, 453
AA spectrophotometer	Varian	1200, AA4
Spectrofluorometer	Turner	430
Infrared spectrophotometer	Beckman	IR-10, IR-11, IR-12, IR-20, 4250
Infrared spectrophotometer	Perkin-Elmer	E-1, 180, 221, 257, 301, 521
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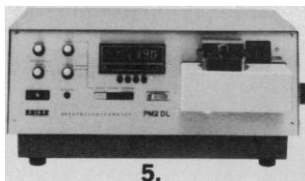


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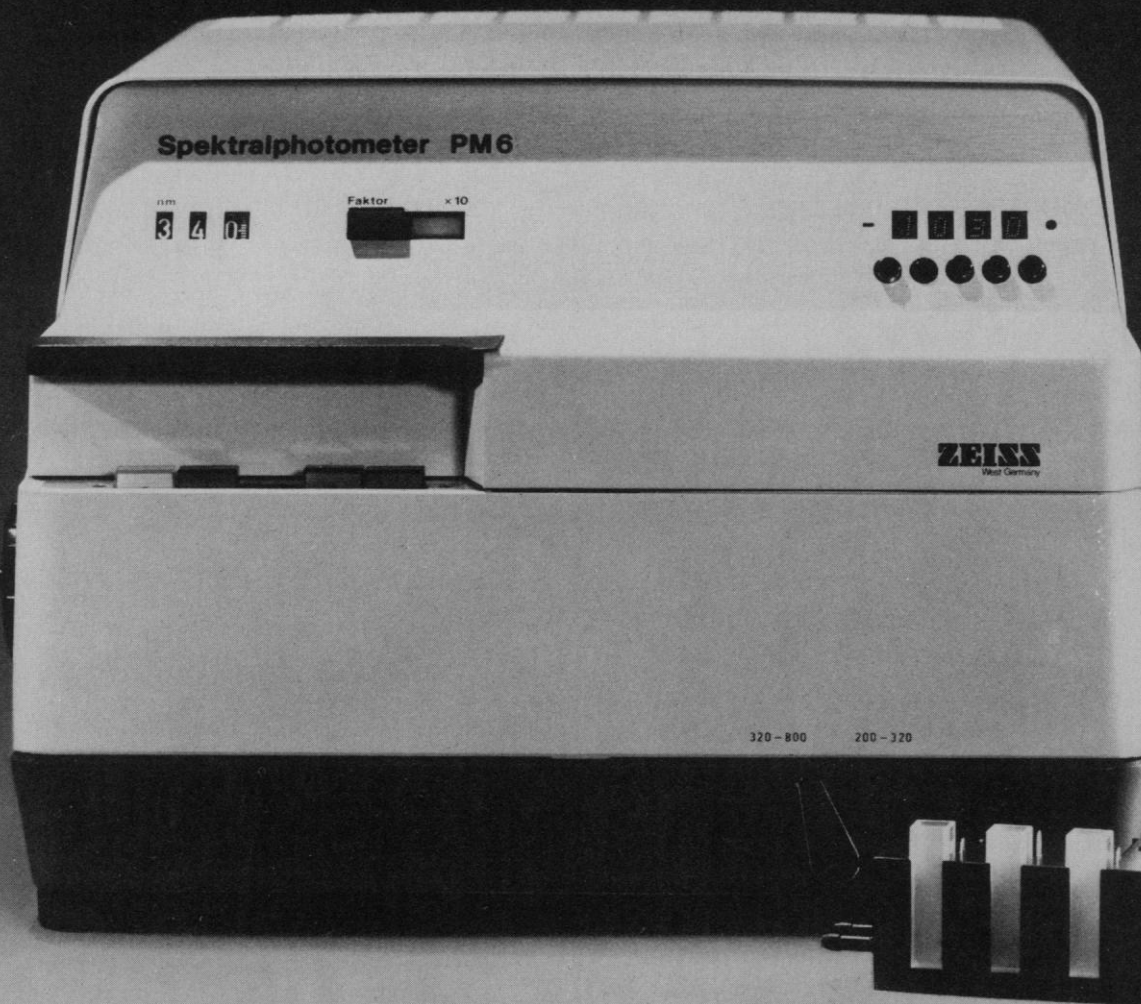
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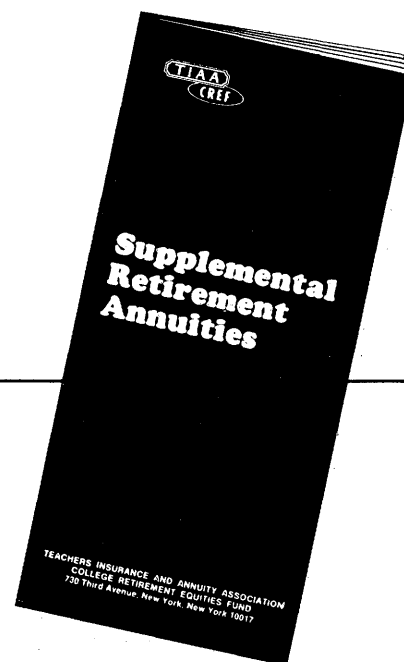
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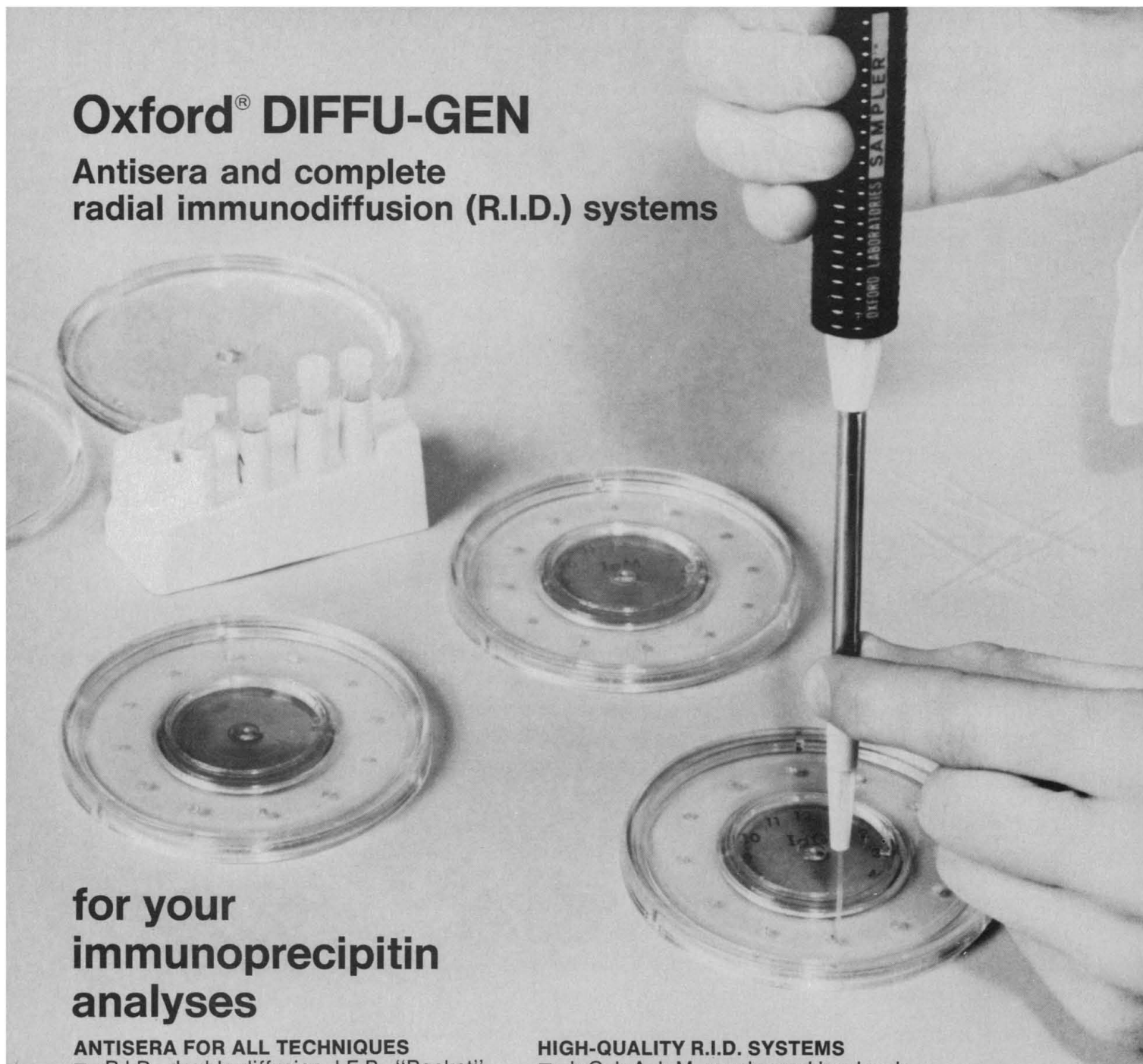
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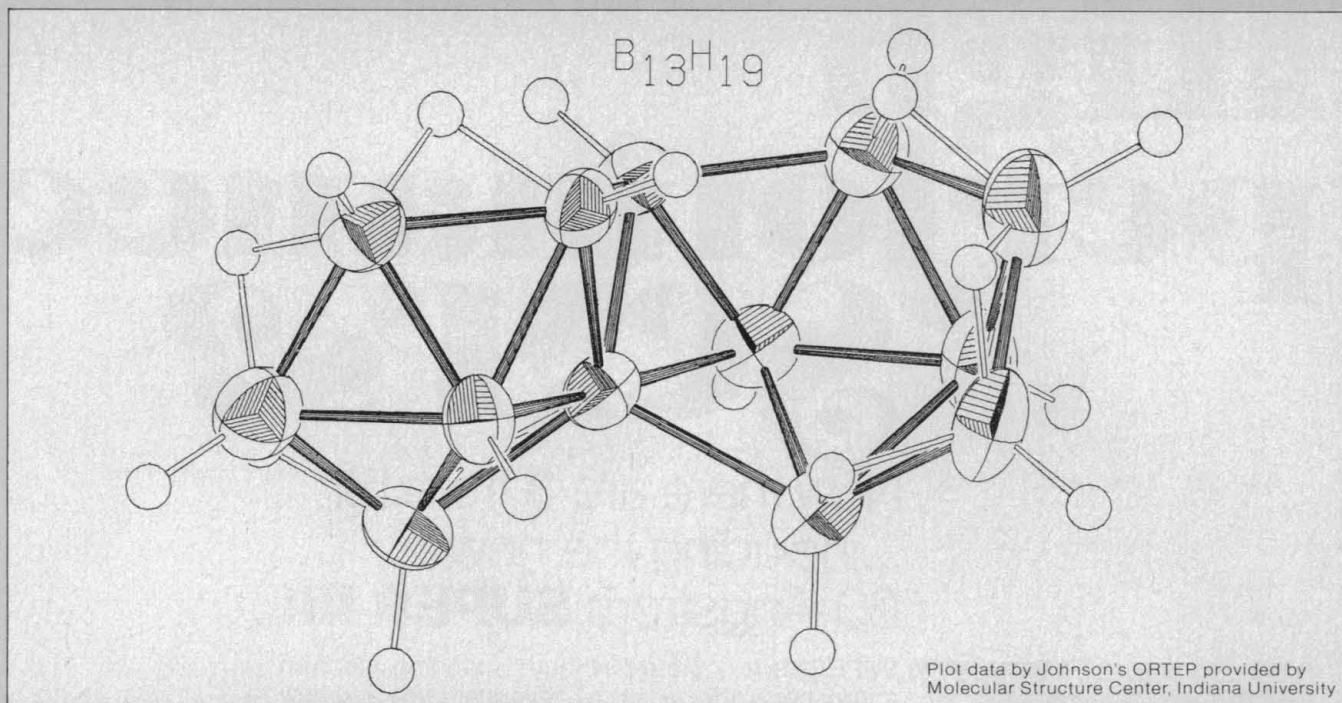
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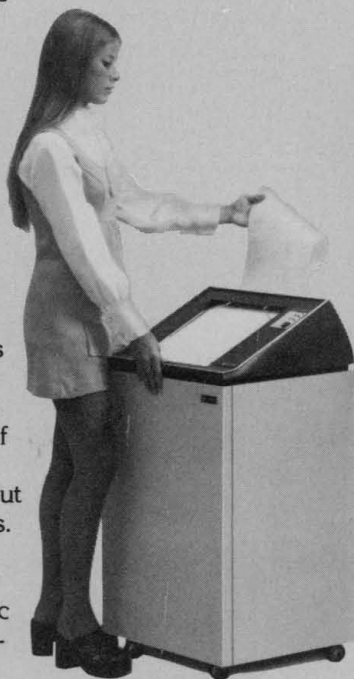
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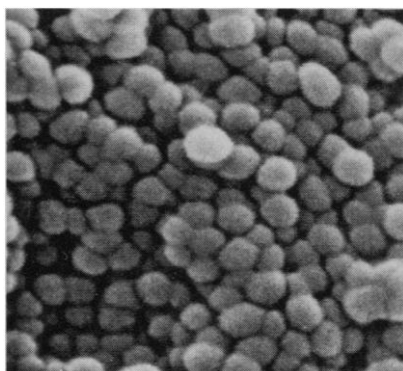
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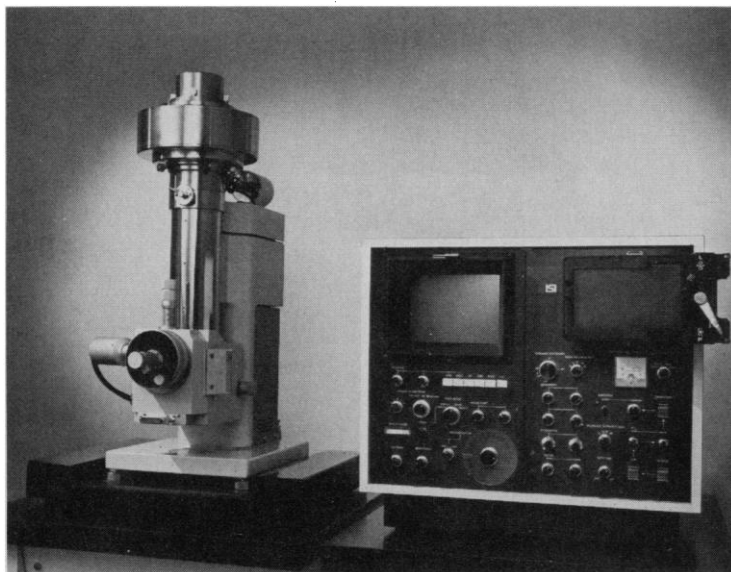


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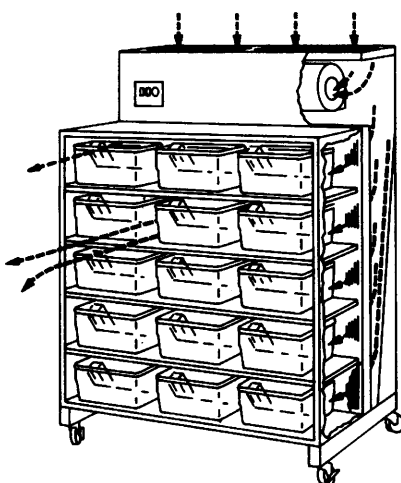


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## LETTERS

### The Ozone Question

The 3 October issue of *Science* (pp. 8 and 9) carried a paid advertisement from the Du Pont Company on the fluorocarbon-ozone question. The same advertisement appeared also in many other newspapers and magazines. This advertisement stated that, "The ozone depletion theory, based on a computer model of the stratosphere, was reported in 1974 by two chemists at the University of California. . . . In order to estimate hypothetical reactions, and because little is actually known about the real ones, the modelers made a number of assumptions about the way the upper atmosphere behaves."

All of the major reactions included in our calculations had been observed and measured in the laboratory (1-5). The hypotheses involved estimates of present and future stratospheric consequences, reached by combining the measured reactions with known intensities of solar radiation, and with the known stratospheric concentrations of a number of species (for example,  $\text{CH}_4$ ,  $\text{O}_3$ , and  $\text{NO}$ ) (6) plus those of some (for example,  $\text{O}$  and  $\text{OH}$ ) whose concentrations were then indirectly inferred from other stratospheric measurements and have since been measured directly (7, 8).

The statements about our assumptions were not made by us, but are apparently inferences drawn by the writers of the advertisement. The three supposed assumptions listed in the advertisement are as follows.

ASSUMPTION: The ozone-depleting reaction with chlorine from fluorocarbons takes place at a rate that demands an *immediate decision* on fluorocarbon use.

We made no such assumption.

ASSUMPTION: Fluorocarbons are the only significant source of chlorine available for interaction with ozone in the stratosphere.

We made no such assumption.

ASSUMPTION: There is *no other way to get fluorocarbons out* of the atmosphere except by the ozone-depleting reaction.

We made no such assumption in our actual research. Such a statement about models can easily be misinterpreted, since readers might assume that reactions not included in the model had not been considered. We searched for removal processes and found none of any importance except stratospheric decomposition processes (1-5). No important removal process has since been discovered which does not lead to the release of stratospheric chlorine species



capable of depleting ozone (9). The models simply reflect this situation.

The advertisement further states, "... the net effect of both reactions [ozone/chlorine and chlorine/methane] is to lessen the originally-calculated impact of fluorocarbons. In fact, the impact was overstated by 300%."

The quantitative statement is in error. The two reactions mentioned are among several which have been more accurately measured in the past 15 months (10). The concentrations of important species (for example, OH) have also been measured more accurately (8). When all corrections have been made, the current assessment of ozone depletion by models falls within the range of our original estimates made in August 1974 (2, 3, 11, 12).

The advertisement also stated, "One well-known class of chemical reactions not considered in this model is that of chlorine compounds in the atmosphere in heterogeneous reactions."

Heterogeneous reactions were considered, but they were not included because the evidence indicates that they are negligible in importance. The possible involvement of heterogeneous reactions with the chlorofluoromethanes was discussed in extensive detail on pages 22 and 23 of (4). We found no evidence that such reactions were occurring and some strong evidence that they were at most minor. We know of no evidence in the refereed scientific literature leading to a conclusion different from ours.

A further statement in the advertisement was, "Atmospheric chemistry involving ion molecule reactions has been described in recent months by several investigators... ion molecules could react with fluorocarbons, allowing them to be removed from the atmosphere."

The only extensive description so far published in the scientific literature about the possible ion-molecule reactions for removal of chlorofluoromethanes is our own discussion on pages 20 and 21 of (4). We concluded there that ion-molecule reactions were not important for the removal of these compounds, and no conclusions to the contrary have been published in the scientific literature (13).

This further statement was also made in the advertisement, "Many chlorine-containing materials are present in the atmosphere in varying concentrations. Of particular significance, large amounts of methyl chloride and carbon tetrachloride have been discovered in the troposphere and stratosphere."

The pertinence of carbon tetrachloride for this problem is the chief topic discussed by us more than a year ago in (14). The im-

portance of chlorine compounds of natural origin, such as  $\text{CH}_3\text{Cl}$  (15), relative to the fluorocarbon-ozone problem is easily (and frequently) overstated. The concern is with changes from the natural situation caused by man. All calculations indicate a progressive effect of added stratospheric chlorine (16) such that the change from the natural situation is basically the same whatever the precise level of natural chlorine before the introduction of further stratospheric chlorine by man. Carbon tetrachloride released by man in quantities comparable to the current release rates for fluorocarbons 11 and 12 would also have important effects on ozone depletion, but its current atmospheric release is much less than that of the two molecules listed above.

Our original conclusion was that, at current rates of technological use, fluorocarbons 11 and 12 were the two most important man-made compounds, in terms of potential effects on the ozone layer. This conclusion still stands and has been amplified and supported by numerous studies, including direct stratospheric experiments (17) as well as more detailed calculations of ozone depletion (11, 12, 18).

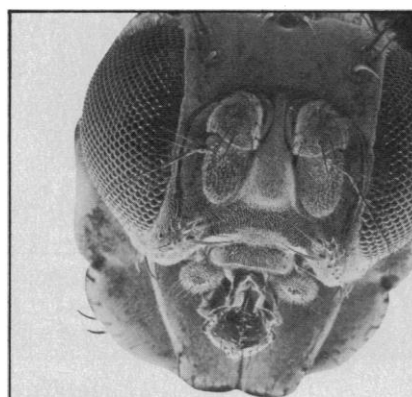
We believe that sufficient facts are already available in the refereed scientific literature to establish that chlorine released by stratospheric photolysis of fluorocarbons 11 and 12 will indeed have a substantial effect on the average ozone level of the earth in the future if present usages are maintained. The possible consequences of such ozone depletion have been outlined in detail in (12) and (19), together with the uncertainties involved. The 3 October issue of *Science* also carried a report of the possibility of a "greenhouse" effect of accumulated chlorocompounds in the atmosphere (20).

F. S. ROWLAND  
MARIO J. MOLINA

Department of Chemistry,  
University of California, Irvine 92664

#### References and Notes

1. M. J. Molina and F. S. Rowland, *Nature (London)* **249**, 810 (1974); in *2nd International Conference on the Environmental Impact of Aerospace Operations in the High Atmosphere, 1974, San Diego, Calif., Preprint Volume* (American Meteorological Society, Boston, Mass., 1974), p. 99.
2. F. S. Rowland and M. J. Molina, "Chlorofluoromethanes in the environment" (Atomic Energy Commission report No. 1974-1, Univ. of California, Irvine, 1974).
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5. F. S. Rowland, *New Sci.* **64**, 717 (1974).
6. A. J. Grobbeck, Ed., "The natural stratosphere of 1974" [Climatic Impact Assessment Program (CIAP), Monograph 1, Department of Transportation, Washington, D.C., 1975]. See also earlier reports of the 2nd and 3rd CIAP conferences.
7. J. G. Anderson, *Geophys. Res. Lett.* **2**, 231 (1975).
8. ———, "The in situ measurement of atoms and



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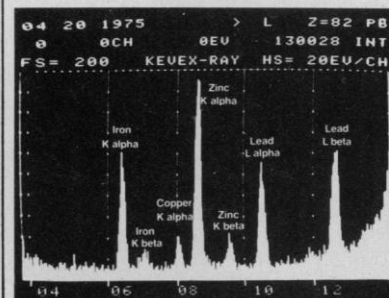
However, when you have an analysis—quantitative or qualitative—that calls for low concentration detection in a small sample mass such as this fruit fly, it's beyond the scope of ordinary X-ray energy spectrometers. Only a high-intensity system with a secondary target that emits pure mono-chromatic X-rays with low background can produce results such as shown here. And only KEVEX has a high-intensity (2,000 or 3,000 watt) XES system for trace analysis in the less than 100 parts-per-billion range for many elements in organic matrices. That's why the man with the fruit fly came to us. It might pay you to do the same. Here's how to go about it:

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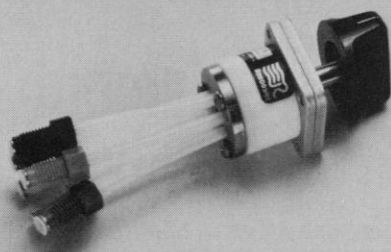
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Du Pont's advertisement was not intended to attack the published scientific work of Rowland and Molina on ozone depletion, which, as we have said before, we believe to have raised a significant point.

The principal source of misunderstanding appears to be that the authors interpret the advertisement to say they made certain assumptions in their "actual research." To the contrary, the assumptions lie in the products of their research—particularly in the public position taken by Rowland with regard to the implications of his research.

The stimulus for the advertisement was the many media articles discussing the issue, which have been presented with scare headlines and predictions of dire consequences that are at variance with scientific facts as they exist today. Insofar as differing viewpoints have not been adequately reported, our intent was to present a less technical description of the question to ensure that nonspecialists were informed on both sides of the issue.

That early model predictions were overstated by some 300 percent as mentioned in the advertisement is easily documented. An overstatement range of 280 percent has been calculated (1) for the two revised rate constants described in the advertisement. These two rate constants are the only significant revisions to the calculated depletions since the first time-dependent calculations of Wofsy *et al.* (2). Rowland and Molina make reference in their letter to OH, but any attempt to revise HO<sub>2</sub> reaction rates on the basis of a single measurement at a particular latitude, altitude, time of day, and season is premature. The HO<sub>2</sub> rate constants in question will be measured in the laboratory, and appropriate revisions to estimated depletions can then be made.

We are firmly of the impression that Rowland has been asking for immediate regulation of fluorocarbons, although not, of course, in his "refereed scientific articles." As early as December 1974, Rowland testified before the House subcommittee on public health and the environment that he believed the use of fluorocarbons as aerosol propellants should be banned now.

Additionally, Rowland and Molina state in their original article (3), "We have not included any estimates for other chlorinated aliphatic hydrocarbons also found in the atmosphere such as CCl<sub>4</sub> . . . for which there is no evidence for long residence times in the atmosphere." Six months later, an article (4) by the same authors was published treating CCl<sub>4</sub> in exactly the same manner that the fluorocarbons were treated in the first article. A month after that, CH<sub>3</sub>Cl, a molecule not even mentioned in the first article, was shown (5) to be the largest single source of chlorine presently established in the atmosphere. Whether or not the authors assumed that fluorocarbons are the only significant source of chlorine available for interaction with ozone in the atmosphere, the fact remains that there are other significant sources than those mentioned in their original article and that they were only pointed out at a later date. There is thus an established record of things having been left out; one may reasonably ask what else has been left out.



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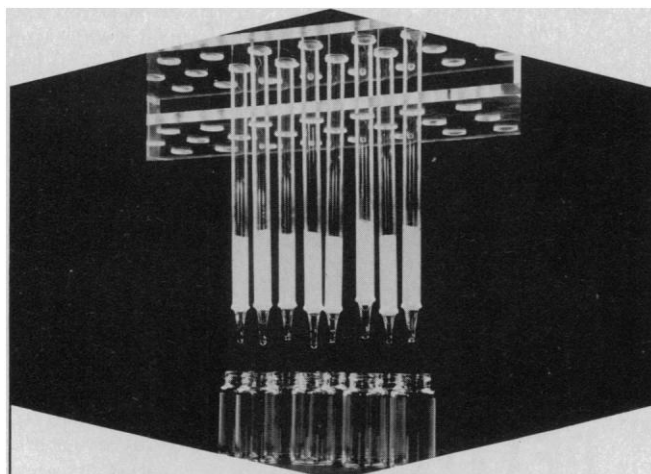
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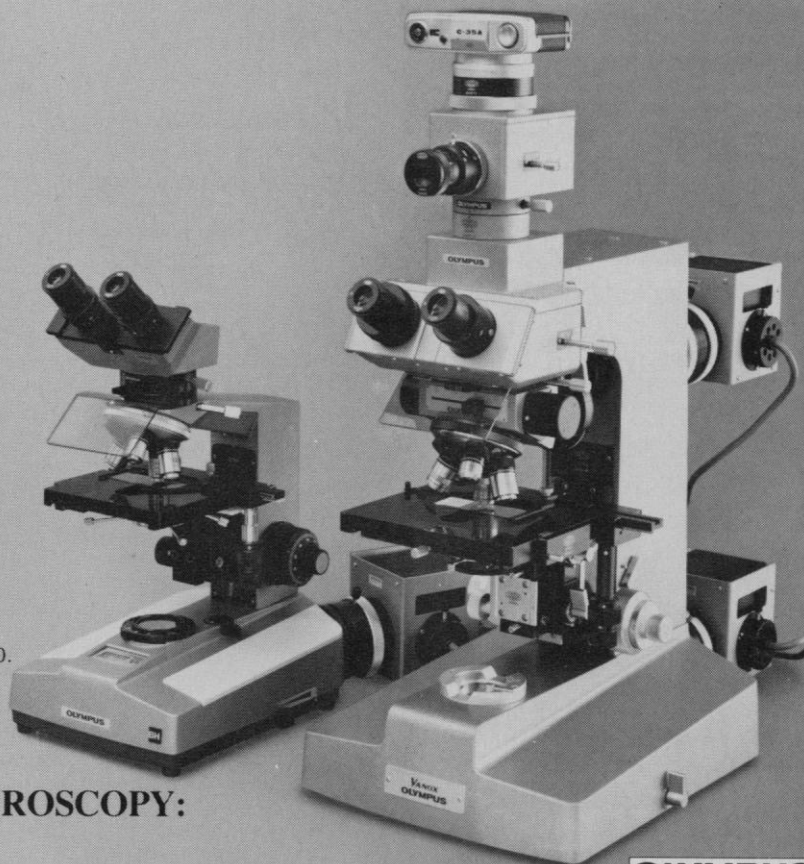
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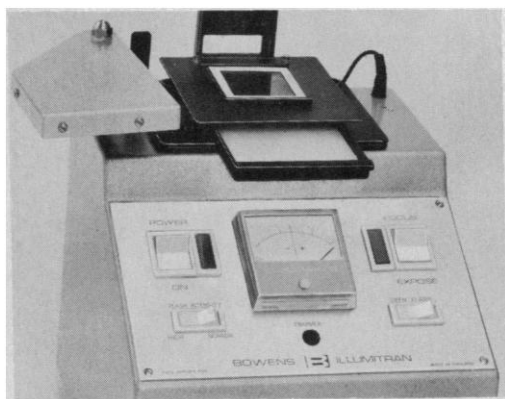
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This leads to a clear philosophical distinction which appears to be at the basis of the differences between Rowland and Molina and the fluorocarbon industry. There is, on the one hand, the review involved in the refereeing of published papers and, on the other hand, the much more stringent test of nature. Thus one hears statements to the effect that the theory has been around for a year and no one has seriously challenged it. This is somehow regarded as establishing its validity, which, of course, it does not. Similar reasoning is implicit in the statements in the Rowland-Molina letter concerning removal mechanisms and heterogeneous processes.

All of the above would indeed be academic if it were not for the fact that Rowland has asked for a fluorocarbon ban. This is the stage at which the implicit assumption of correctness of the conclusions enters the picture. If that is not the case, how is it that other eminent scientists, not related to industry, have said the evidence is not conclusive and a ban is premature?

It is clear that experiments can be performed to validate or invalidate the theoretical conclusions and that no undue risk is involved in taking the time to perform them. Large-scale government and industry programs are under way. Under these circumstances, reason would appear to dictate that we should permit science to pursue its normal course to enable public policy-makers to make informed judgments based on fact.

T. L. CAIRNS  
J. P. JESSON

*Central Research & Development  
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1. A value of 280 percent has been calculated using the original (2) set of HO<sub>2</sub> rate constants (N. D. Sze, personal communication).
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### The "Greenhouse Effect"

The term "greenhouse effect" continues to be incorrectly applied to the effect of the atmosphere in warming the earth's surface by absorbing and reradiating infrared radiation. In fact, because of the importance of understanding climatic change (including man-induced change), use of the term is becoming part of "accepted knowledge" (1).

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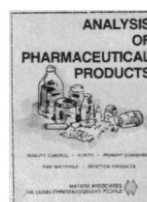
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sphere is largely transparent to the sun's radiation, but is largely opaque to the infrared radiation emitted by the earth's surface. Much of the energy absorbed in the atmosphere is radiated back to the earth with the result that the mean temperature of the earth's surface is about 35°C (63°F) higher than it would be if the atmosphere were absent. Glass also absorbs infrared radiation while transmitting visible radiation—hence the term “greenhouse effect.”

However, greenhouses are warmer than the surrounding air because the glass prevents the warm air inside from rising and removing heat from the greenhouse. Absorption of infrared radiation by the glass contributes only a little to the warming effect. Polyethylene sheets, even though they are largely transparent to infrared radiation, are just about as effective as glass in greenhouses. The essential facts were established by a simple experiment carried out by Johns Hopkins University physicist Robert W. Wood in 1909. He found that two model greenhouses, one covered with glass and the other with rock salt (which is transparent to both short- and long-wave radiation) reached very nearly the same high temperatures. Thus the “greenhouse effect” results from suppression of vertical convection by a rigid lid.

Persistence of the term “greenhouse effect” in the face of verified fact is an interesting phenomenon in its own right. Perhaps we feel more comfortable with the illusion that we live within a rigid protecting envelope. However, it should be noted that agriculturalists, who are well aware of how greenhouses work, do not apply the term “greenhouse effect” to the atmosphere.

In 1963 we proposed in a textbook (2) that the term “atmosphere effect” should replace “greenhouse effect” as applied to the atmosphere. The suggestion has had no detectable effect on popular or scientific literature. So long as references to the “greenhouse effect” appeared only rarely in the literature, misconceptions engendered by the term probably were of little consequence. But in view of the greatly increased interest of the radiative properties of the atmosphere, it is time that scientists correct their misconceptions and clean up their language.

ROBERT G. FLEAGLE  
JOOST A. BUSINGER

*Department of Atmospheric Sciences,  
University of Washington, Seattle 98195*

#### References and Notes

1. See, for example, “Micropedia,” in the new *Encyclopaedia Britannica* (Encyclopaedia Britannica, Chicago, ed. 15, 1975), vol. 4, p. 718; H. A. Wilcox, *Hothouse Earth* (Praeger, New York, 1975).
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## Federal R & D—Outmoded Management Policies

One of the most significant trends in federal research and development in the 1970's has been the shift in emphasis to a domestic market. Until recently, the preponderance of federally supported R & D was targeted to military, space, and other objectives, where the government itself was the primary customer. Most of the present national research institutions, laboratories, and management policies have evolved since World War II with this direction. But we have now entered a new era in which the federal government will not be the primary customer. The new customers are industry, local government, and private citizens. The proportion of federal R & D directed to the civilian sector has increased from 23 to 35 percent over the last 6 years, and it will undoubtedly grow in the future with the growth of government involvement in energy, transportation, food production, recovery of nonrenewable natural resources, environmental protection, and a host of other areas involving the private sector. But an important policy question is not being faced. It is not at all clear that funneling federal R & D funds through existing federal institutions will come within a country mile of accomplishing the intended purpose.

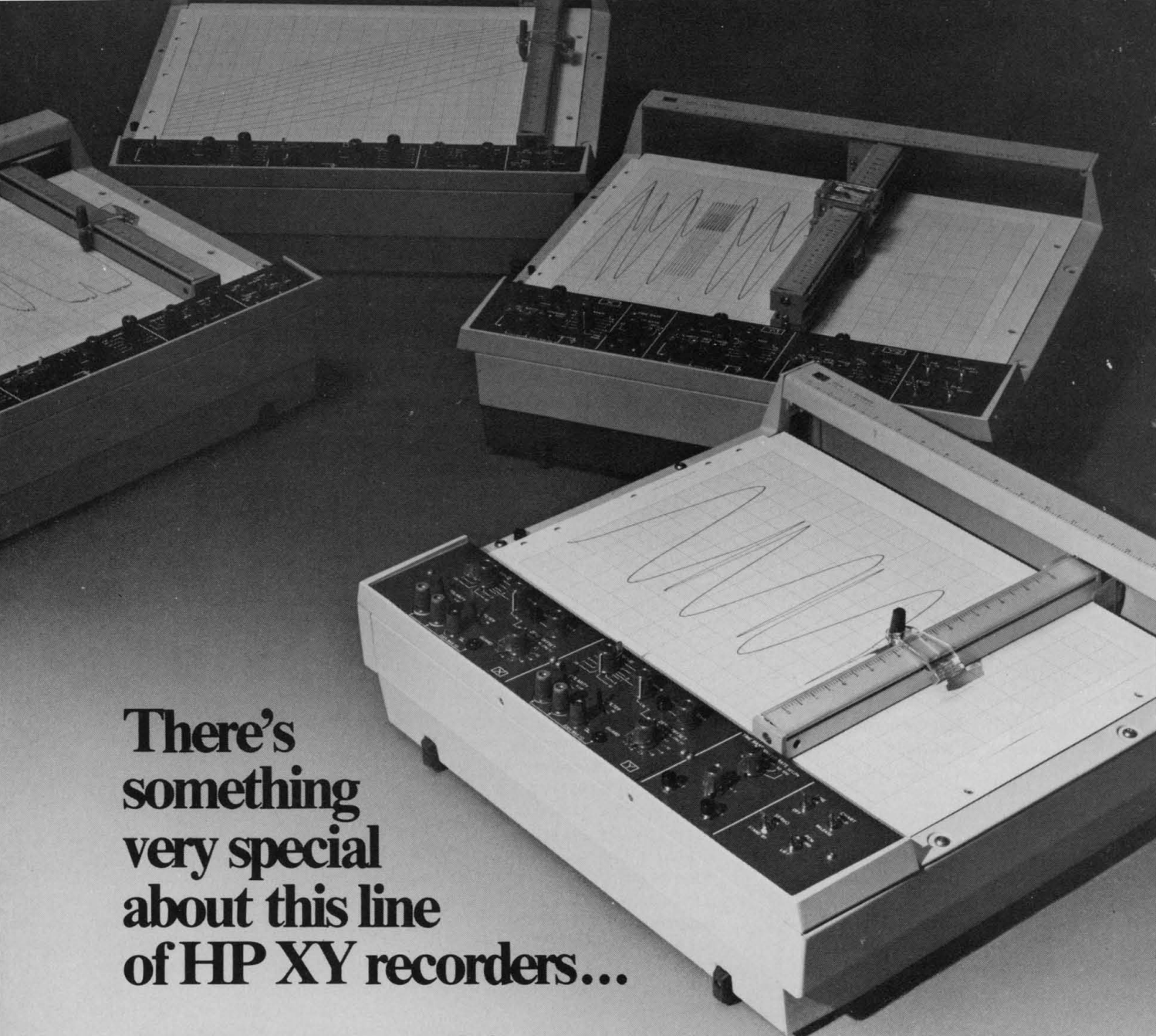
The objective is to move the products through the marketplace to the consumer. But the decision-making process of the marketplace is circumvented by a different, politically oriented form of decision-making in the Executive and Legislative branches. The barriers to moving new products and processes from federal agencies and laboratories to private consumers are formidable, and we are making slow progress, if any, in understanding and reducing them. Private companies tend to divide into two groups. One looks on government contracts as an end in themselves. Its record in commercial business is poor. The other, which includes America's best commercial companies, with a thorough understanding of the marketing problems of the domestic sector, is usually reluctant to involve itself in federal programs. When such companies do get involved, it is not with their best people or with their total resources. One reason is the government's patent policies, such as its reluctance to grant exclusive licenses, licensing policies on prior patents, deferred determination of rights, march-in rights, and various other entanglements.

Management policies for federal R & D directed to the domestic sector need more explicit attention by the Executive Branch and Congress. How should existing federal institutions and policies be modified so that it will have some meaningful influence on the economy? Approaches such as injecting federal monies directly into the private sector through R & D tax refunds or other fiscal devices should be seriously explored. Experience has shown that federal appropriations for civilian R & D may be necessary but not sufficient to push a new technology into the marketplace. A confluence of other important factors is required. Marketplace decision-making should be reflected in the federal budget process and new technologies pulled into the marketplace through incentives rather than pushed through federal dollars. Finally, more thought needs to be given to clearing away legislative and regulatory snares so that the innovation process can operate more freely and hence more effectively in the private sector.

Existing federal agencies are not likely to examine such questions with enthusiasm since changes may not be in their interest. In-house R & D activities in national laboratories and centers should be given careful scrutiny in terms of their ability to translate results into the public and private sectors. The country can ill afford many monuments that find no useful application.

Federal R & D management poses one of the foremost policy questions of this decade. The citizens of the United States deserve a greater economic return on their investment. Feeble attempts have been made to examine these questions in the past. But the stakes are now much larger, they are growing daily, and the hour is late.—RAYMOND L. BISPLINGHOFF, *Chancellor, University of Missouri, Rolla 65401*





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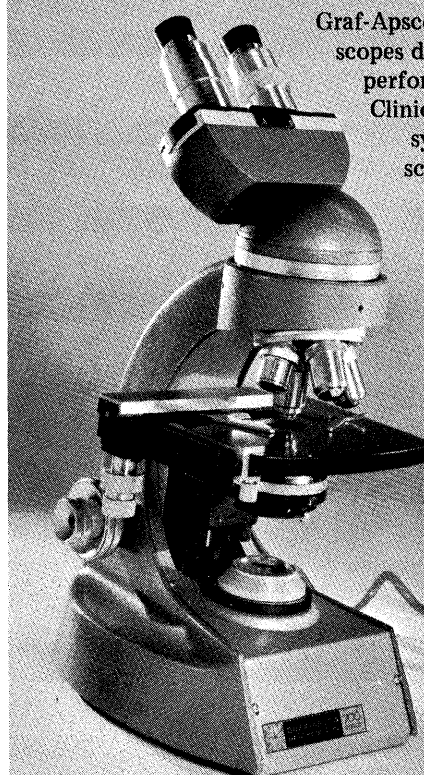
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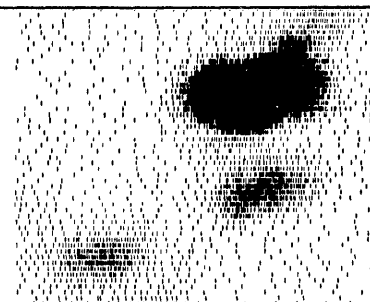
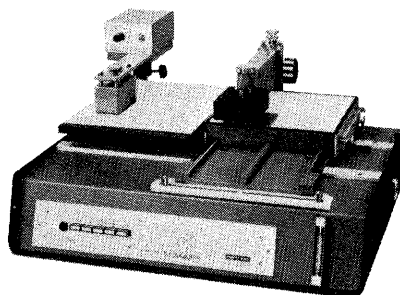
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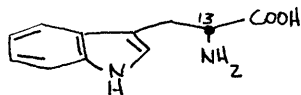


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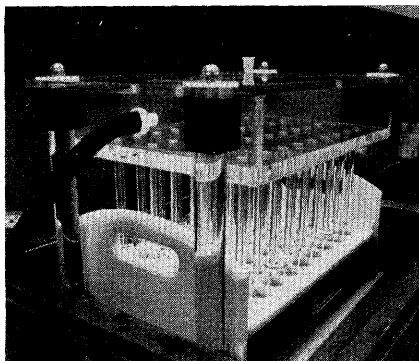
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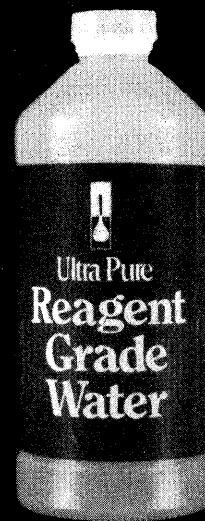
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# Electron Microscopy In Pathology

NORELCO REPORTER/VOL. 20 NO. 3, 1973

by George Bridges and J. H. Martin, Baylor University Medical Center, Dallas, Texas

## Introduction

Electron microscopy has become a useful diagnostic tool of the pathologist. Although its use on every specimen is impractical and, in fact, wasteful at our present level of knowledge and technical capability, the electron microscopic examination of selected surgical specimens and autopsy specimens is every bit as practical and useful as many of the "special" stains routinely employed in many pathology laboratories.

The principal developments allowing for the increased current application of electron microscopy in diagnostic pathology as we see them are: (1) the collection of specimens in a dual purpose aldehyde fixative allowing for both light and later electron microscopy on the same biopsy specimen, (2) rapid, simplified and reliable dehydration, embedding, staining and photographic techniques making

the results of electron microscopy available within twenty four hours of receiving the specimen, (3) wide-spread usage of the "adjacent" or "thick" 0.5 micron epoxy embedded and cover slipped sections for light microscopy as a selective device and bridge between conventional paraffin embedding techniques and electron microscopy and (4) the relatively recent development of excellent, reliable ultramicrotomes and high-quality, simplified electron microscopes opening the door to technologists as operators rather than highly skilled artisans.

The purpose of this paper is to outline briefly some of these viewpoints on methodology, instrumentation, and current applications of electron microscopy in diagnostic pathology.

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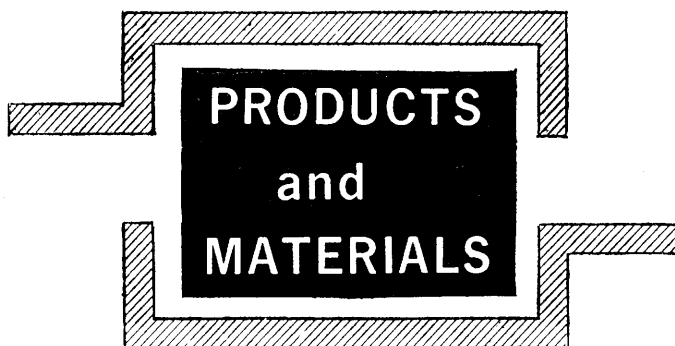


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#### Chloride-Carbon Dioxide Analyzer

Each determination requires 10 microliters of serum, plasma, or sweat and is made in 30 seconds. Results are displayed in millimoles per liter. Chloride concentration is determined by coulometric titration and carbon dioxide is measured with a rate pH-sensing methodology. Advantages of the device include the speed and reliability of the determinations, the small sample requirement and the small size of the device itself. Beckman Instruments. Circle 813.

#### Antibiotic Susceptibility Testing

The MIC-2000 system includes a 96-channel liquid dispenser, an automatic inoculator, a plate viewer, and a tape dispenser. The plates are designed with round-bottom cups and a key slot that permits them to be mounted in only one direction. Any series of dilutions may be accommodated by the dispenser; filling is precise and rapid. Volume selection, filling, and emptying are automatic. The inoculator delivers inoculum from a disposable tray to specified cups in the plate. Sterilization completes the cycle. The inoculator will also work with test tubes and petri dishes. The viewer operates in bright-

or dark-field modes. The tape dispenser seals the plates to prevent loss by evaporation during incubation. Cooke Laboratory Products. Circle 814.

#### Buffer Solutions

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#### Animal Bedding Disposable Cabinet

This portable device is designed for dumping animal bedding containing wastes from biologically infected animals. The negative air flow meets class I biological requirements and offers protection to the technician and to the room environment. The cavity in the work area is designed to be used with plastic bags and standard trash receptacles. Contamination Control. Circle 823.

#### Electron Microscope

The EM400 offers a seven-lens optical system that is computer controlled. Acceleration may be selected from 20 to 120 kilovolts. Resolutions of 1.4-angstrom units may be achieved. This transmission microscope offers a clean vacuum system pumped to  $10^{-7}$  torr. The seven lenses include five imaging lenses. Magnification ranges from 50 to 800,000 power. A eucentric goniometer stage complements the resolution of the lens system. Two options are available: one offers resolutions to 2 angstroms with tilt of 30 degrees and 440,000 power; the other offers resolution of 3.4 angstroms with 60 degrees of tilt and 300,000 power. Philips Electronic Instruments. Circle 824.

#### Syringe Shield

A device is available for the protection of researchers and others against delayed effects of cumulative exposure to radiation from technetium-99m and other radiopharmaceuticals. The shield is made of tantalum which offers advantages over lead for such applications. Atomic Products. Circle 821.

#### Renin Activity Control Plasma

This control plasma [NEA-022C PRA Control (lyophilized)] is produced for use with the company's angiotensin I kit. This is a radioimmunoassay based on iodine-125. This material provides a means of controlling the quality and reliability of the procedure from generation of angiotensin I in vitro through quantification through radioassay. New England Nuclear. Circle 817.

#### Spectrophotometer

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1. Lefkowitz, R.J., C. Mukherjee, M.G. Caron and M. Coverstone. J. Biol. Chem. 250, 13, 7/10/75.

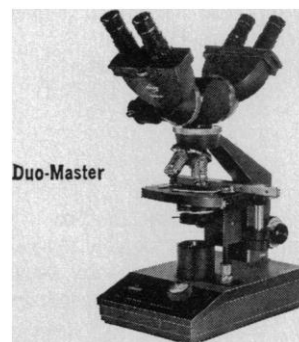
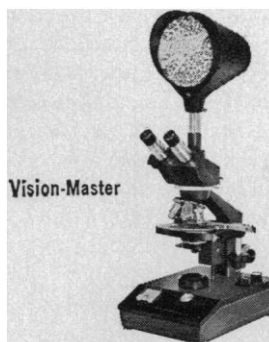
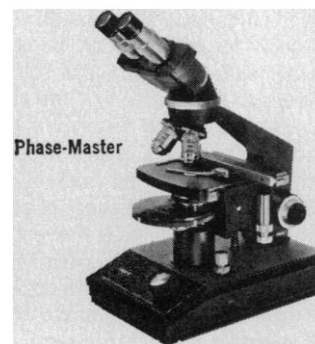
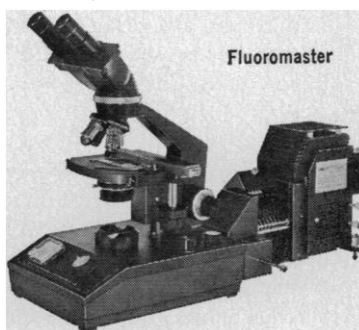
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### Liquid Thyroid Function Test

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### Free Thyroxine Index

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### Literature

*Life Science Separations* is a bimonthly publication devoted to liquid chromatography and its application to biological materials. Waters Associates. Circle 827.

*Linear and Angular Displacement Transducers* is a 24-page catalog. Schae-vitz Engineering. Circle 842.

*Auto-FI Coagulation Instrument* describes a device for analysis of prothrombin, activated partial thromboplastin, fibrinogen, or factor assays. Dade Division, American Hospital Supply. Circle 826.

*Biology, Earth Science and Chemistry Catalog 1976-77* comprises over 600 pages of items for teaching all levels of many disciplines. Ward's Natural Science Establishment. Circle 828.

*SCISEARCH* makes available the complete Science Citation Index which initially includes over 800,000 items from January 1974 to the present from about 2500 scientific journals. Institute for Scientific Information. Circle 830.

*The Story of Asbestos* describes mining and milling techniques, characteristics, and applications for this natural resource. Johns-Manville. Circle 831.

*Test & Measurement Instruments* is a product directory to a line of electronic test devices. John Fluke Manufacturing. Circle 832.

*Rare Earths and Nitrogen Oxides* is a survey of catalysts for the cleansing of air and exhaust emissions from industrial plants, engines, and other sources. Moly-corp. Circle 833.

*Omniscribe Strip-Chart Recorders* are described in a brochure. More than 200 models are offered. Houston Instrument. Circle 834.

*Cone-Plate Viscometer System* is devoted to a device suitable for many flow analyses in research or industrial applications. Ferranti Electric. Circle 835.

*Fiber Optic Illuminators* lists accessories for spectral research including optical filters, lens assemblies, and so forth. PBL Electro-Optics. Circle 836.

*Metal Digest* includes items for metallographic and metallurgic studies. The current issue is devoted to new equipment suitable for small facilities. A. Buehler. Circle 837.

*Lab Monitor II* describes an instrument for automatic control of temperature, liquid level, vacuum, or pressure. Pope Scientific. Circle 838.

*Instrument News* for November includes a test bridge for laser trimming systems. James G. Biddle. Circle 839.

*Van-Lab Disposable Culture Tubes* lists specifications for 20 different-sized borosilicate glass tubes. VWR Scientific. Circle 840.

*Metrohm Polarographic Analyzer* describes the E506 for all polarographic applications. Brinkmann Instruments. Circle 841.

*Spectroscopic Supplies and Equipment* includes all forms of light measurement and analytical techniques based on spectral analysis. Wilmad Glass. Circle 829.

## RESEARCH NEWS

(Continued from page 1076)

mally researchers obtain a photoemission spectrum by scanning across a range of photoelectron kinetic energies with an electronic detector; that is, the detector is set at a particular energy and the number of photoelectrons with that energy is counted. Then the detector is reset to a higher energy, and the process is repeated. But, because of the long time between pulses at SPEAR, a method called "time of flight spectroscopy" can be used in which the time it takes a photoelectron to reach the detector can be converted into its kinetic energy. This method avoids the need for scanning the photoelectron energy, and is faster because all the photoelectrons are counted.

Other properties of synchrotron radiation include natural collimation of the light beam, polarization of the light, and a high vacuum environment. The light comes tangentially off the electron's orbit in a narrow cone. For a 2.5-GeV electron, for example, the apex angle of the cone is  $2 \times 10^{-4}$  radian, but because the electrons emit light continuously while orbiting, an observer sees a horizontal fan of radiation with strong vertical collimation. This property permits scientists to obtain bright light beams a considerable distance from the electron beam, a condition necessitated by considerations such as shielding from x-rays.

The extent of the polarization of the radiation depends on its wavelength and its position relative to the plane of the orbit. At the wavelength of maximum intensity and on the orbital plane, the polarization is nearly 100 percent with the electric vector of the light in the plane of the orbit. This polarization can be used to deduce the symmetry of quantum states in solids and to study the structure of anisotropic materials.

Storage rings must hold electron and positron beams for several hours. In order to avoid collisions between the electrons or positrons and residual gas molecules, the storage rings are evacuated to better than  $10^{-9}$  torr. This high vacuum is ideal for certain types of experiments, such as those designed for studying solid surfaces that are free of contamination. The vacuum in synchrotrons can be much less ( $10^{-6}$  torr) because of the short lifetime of the beam.

For now, at least, researchers' enthusiasm about the future of synchrotron radiation is at a high level. Despite the fact that the average x-ray experiment at SSRP takes only a few hours, the facility has well over a year's backlog of experiments awaiting their chance at the synchrotron radiation beam. —ARTHUR L. ROBINSON

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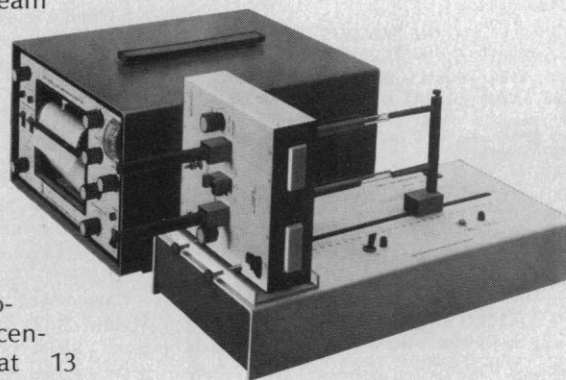
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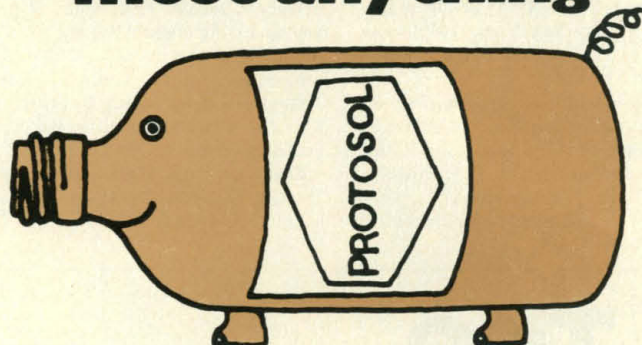
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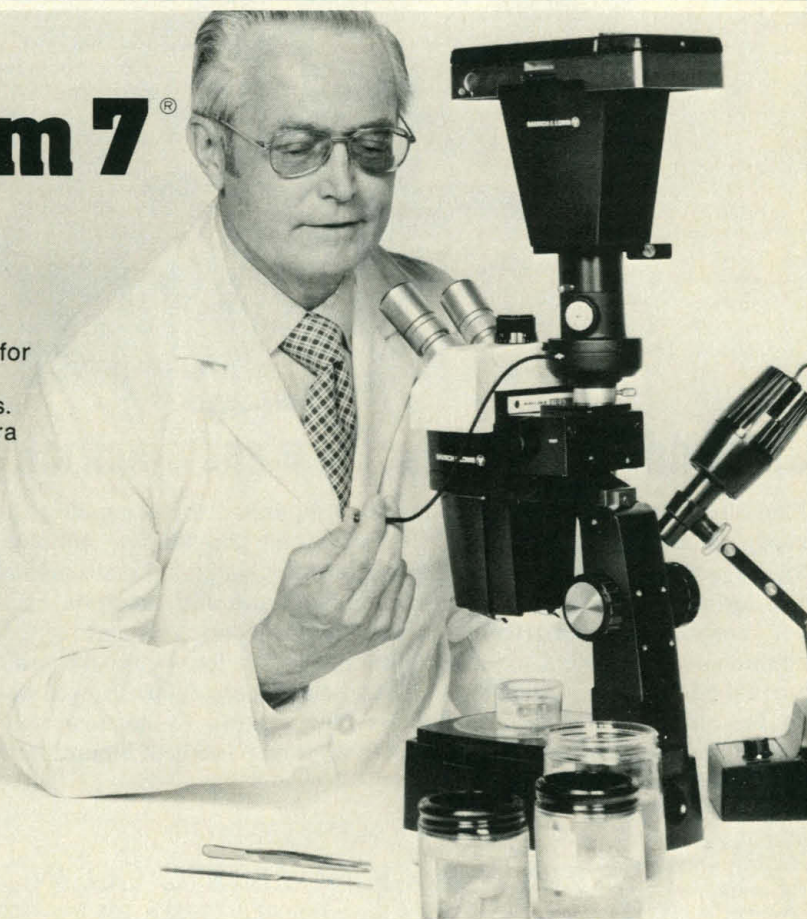
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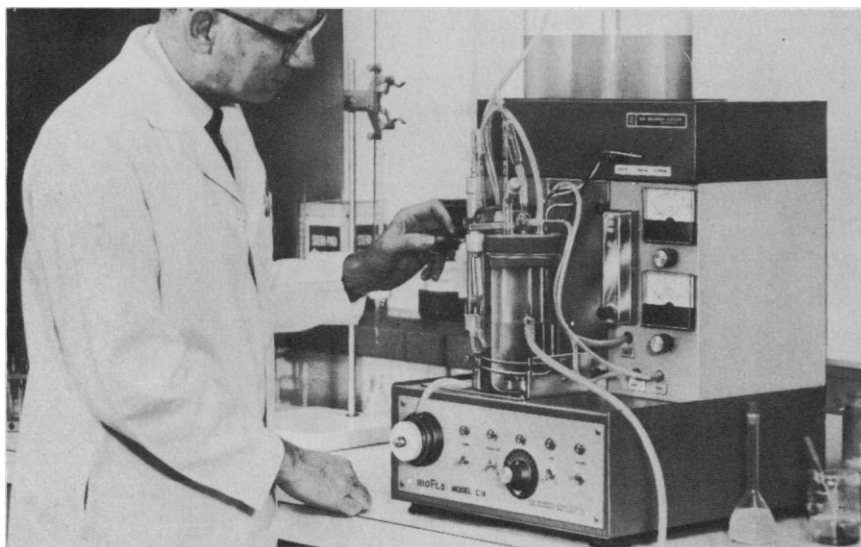
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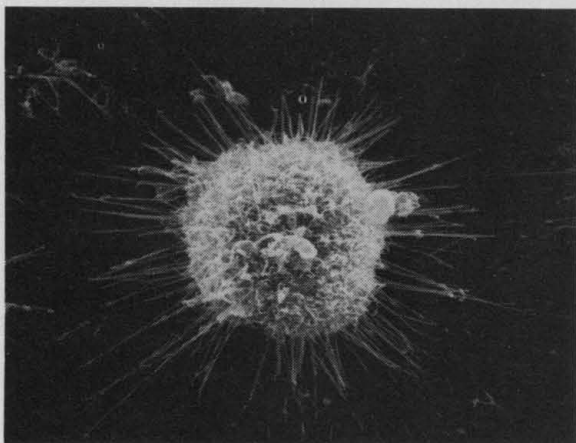
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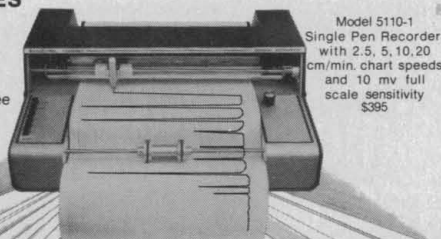
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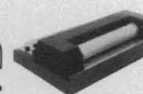
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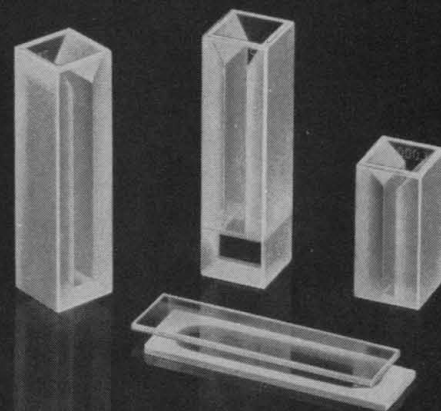
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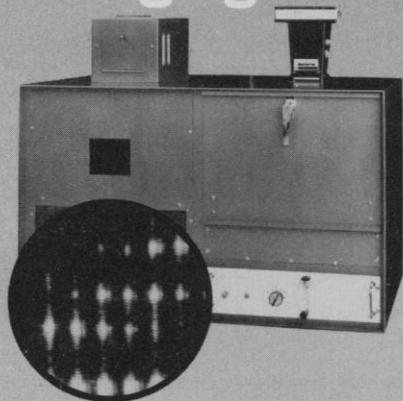
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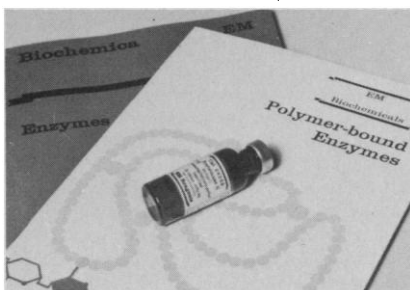
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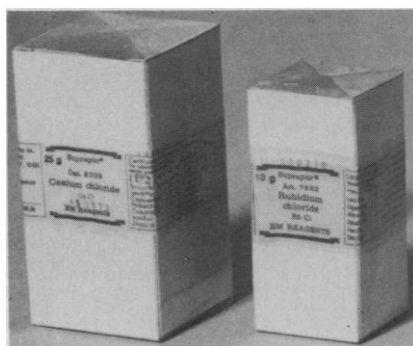
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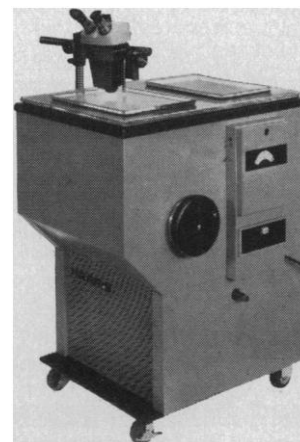
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