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# SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



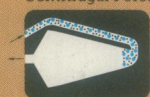
## ELUTRIATION:

*The gentle,  
rapid way to  
separate living  
cells*



### The Separation Chamber

#### Centrifugal Force



1. Sample suspended in a medium enters chamber.



2. Sedimentation tendency of particles balanced by counterflow.



3. Flow increased — slow-sedimenting particles elutriated out of chamber.

For high yield harvesting of whole, living cells, hundreds of researchers use the Beckman elutriation system.

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Separation is by gentle washing action, so cells retain their

viability. Processing can be in isotonic media to avoid the osmotic effects and cellular ingestion of gradient materials. And there's no exposure to the effects of pelleting.

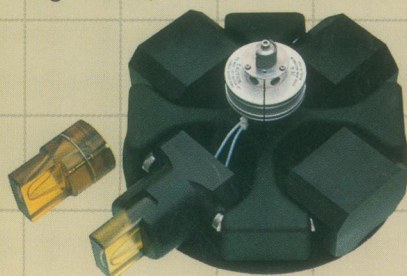
Cell concentration is high with the Beckman system. Typically  $10^{10}$  to  $10^{12}$  cells can be separated according to size, and synchronously dividing cells can be obtained for cancer research and drug inhibition studies.

The popular JE-6B Elutriator Rotor — with the standard chamber or the Sanderson chamber — is used in either J-6 or J-21 centrifuges.

### New Large Volume Rotor

Now there's a larger volume elutriator rotor for J-6 centrifuges. The new JE-10X Rotor with 40-ml separation chamber. It saves you time by processing nearly ten times more cells than the JE-6B Rotor.

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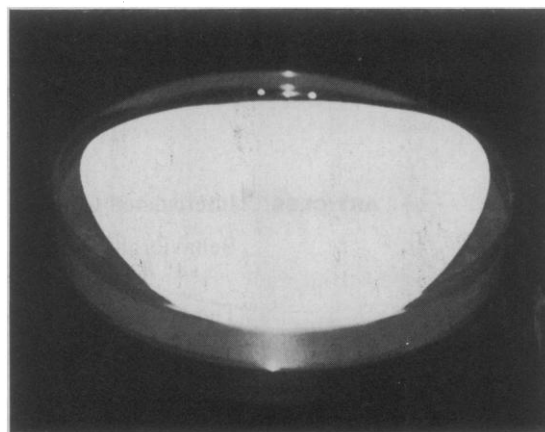
GeneScreenPlus™ is the new transfer membrane that gives you not only highest sensitivity and excellent band resolution, but trouble-free handling as well.

The slight natural curl of the membrane makes it easier to select from the package and easier to place on a moist surface. After drying it returns to its original shape to remind you which side is carrying the bound material. Wet or dry, GeneScreenPlus™ is highly resistant to cracking, distorting, tearing, or shrinking.

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|                         |                                                                                                                                                                                                                                                           |     |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <b>LETTERS</b>          | SETI Program: <i>J. C. Tarter</i> ; Natural Gas Resources: <i>J. Cason</i> ; Math Archive: <i>J. Kidd</i> ; <i>P. G. Chapin</i> ; Mormon Church Policy: <i>R. G. Chapman</i> ; Evolution Debate: <i>R. M. Schoch</i> ; <i>P. F. A. Maderson</i> . . . . . | 359 |
| <b>EDITORIAL</b>        | Industry's Other Contribution to Education: <i>F. Basolo</i> and <i>E. Wasserman</i> . . . . .                                                                                                                                                            | 363 |
| <b>ARTICLES</b>         | Intercalated Clay Catalysts: <i>T. J. Pinnavaia</i> . . . . .                                                                                                                                                                                             | 365 |
|                         | Behavioral Phylogenies and the Direction of Evolution: <i>L. V. Giddings</i> and <i>A. R. Templeton</i> . . . . .                                                                                                                                         | 372 |
|                         | The Nature of Technological Hazard: <i>C. Hohenemser</i> , <i>R. W. Kates</i> , <i>P. Slovic</i> . . . . .                                                                                                                                                | 378 |
| <b>NEWS AND COMMENT</b> | Satellite Accident May Delay Shuttle Flights . . . . .                                                                                                                                                                                                    | 385 |
|                         | Prescription Drug Ads Put FDA on the Spot . . . . .                                                                                                                                                                                                       | 387 |
|                         | <i>Briefing</i> : Opposition Sends OMB Back to Drawing Board; Animal Welfare and Fetal Research in Bill on NIH; CDC Chief to Step Down . . . . .                                                                                                          | 388 |
|                         | Texas Uses Oil to Fuel Research . . . . .                                                                                                                                                                                                                 | 390 |
|                         | Accelerating Research at Texas A & M . . . . .                                                                                                                                                                                                            | 392 |
|                         | Scientists Settle Cell Line Dispute . . . . .                                                                                                                                                                                                             | 393 |
| <b>RESEARCH NEWS</b>    | Synthesizing the Opioid Peptides . . . . .                                                                                                                                                                                                                | 395 |
|                         | Are the Ocean's Deserts Blooming? . . . . .                                                                                                                                                                                                               | 397 |
| <b>BOOK REVIEWS</b>     | Energy and American Values, reviewed by <i>L. Winner</i> ; Agricultural Research Policy, <i>G. Ranis</i> ; Molecular Approaches to Neurobiology, <i>G. S. Omenn</i> ; The Eukaryotic Ribosome, <i>R. A. Zimmermann</i> ; Books Received . . . . .         | 399 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                          |                                                                                       |                                                                            |                                                                                              |                                                                          |
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|                |                                                                                                                                            |     |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <b>REPORTS</b> | Origin of Whales in Epicontinental Remnant Seas: New Evidence from the Early Eocene of Pakistan: <i>P. D. Gingerich et al.</i> .....       | 403 |
|                | Interstellar Carbon in Meteorites: <i>P. K. Swart et al.</i> .....                                                                         | 406 |
|                | Helium on Venus: Implications for Uranium and Thorium: <i>M. J. Prather and M. B. McElroy</i> .....                                        | 410 |
|                | Desickling of Sickled Erythrocytes by Pulsed Radio-Frequency Field: <i>S. Takashima and T. Asakura</i> .....                               | 411 |
|                | Female Moorhens Compete for Small Fat Males: <i>M. Petrie</i> .....                                                                        | 413 |
|                | Neutrophil Pseudoplatelets: Their Discrimination by Myeloperoxidase Demonstration: <i>J. S. Hanker and B. L. Giammara</i> .....            | 415 |
|                | Methadone Conformation and Opioid Activity: <i>W. L. Duax et al.</i> .....                                                                 | 417 |
|                | Direct Respiration of Lipids During Heat Production in the Inflorescence of <i>Philodendron selloum</i> : <i>D. B. Walker et al.</i> ..... | 419 |
|                | Primary Murine Bone Marrow Cultures Support Continuous Growth of Infectious Human Trypanosomes: <i>A. E. Balber</i> .....                  | 421 |
|                | Serum Ferritin as a Predictor of Host Response to Hepatitis B Virus Infection: <i>E. D. Lustbader, H.-W. L. Hann, B. S. Blumberg</i> ..... | 423 |
|                | The Radicals in Cigarette Tar: Their Nature and Suggested Physiological Implications: <i>W. A. Pryor et al.</i> .....                      | 425 |
|                | Response of Agronomic and Forest Species to Elevated Atmospheric Carbon Dioxide: <i>H. H. Rogers, J. F. Thomas, G. E. Bingham</i> .....    | 428 |
|                | Psychological Stress Induces Sodium and Fluid Retention in Men at High Risk for Hypertension: <i>K. C. Light et al.</i> .....              | 429 |
|                | Conditioned Cues Elicit Feeding in Sated Rats: A Role for Learning in Meal Initiation: <i>H. P. Weingarten</i> .....                       | 431 |
|                | Behavior of Antarctic Krill, <i>Euphausia superba</i> : Chemoreception, Feeding, Schooling, and Molting: <i>W. H. Hamner et al.</i> .....  | 433 |
|                | The Terminal Nerve: A New Chemosensory System in Vertebrates?: <i>L. S. Demski and R. G. Northcutt</i> .....                               | 435 |
|                | Contiguity to Males in Utero Affects Avoidance Responding in Adult Female Mice: <i>H. Hauser and R. Gandelman</i> .....                    | 437 |
|                | Plasticity of Motor Behavior in Monkeys with Crossed Forelimb Nerves: <i>C. Brinkman, R. Porter, J. Norman</i> .....                       | 438 |

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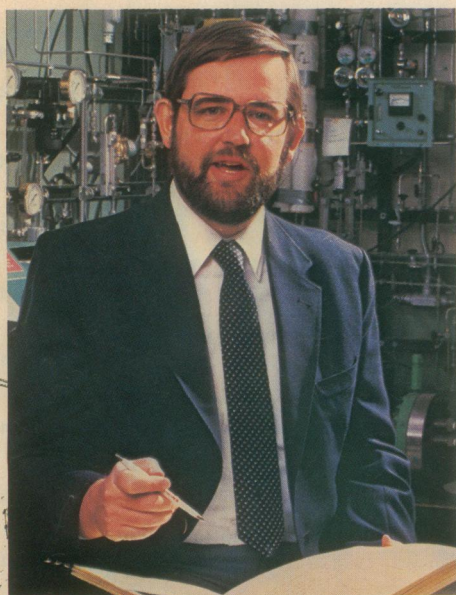
## COVER

Artist's reconstruction of the oldest and most primitive whale (*Pakicetus inachus*) entering an early Eocene epicontinental sea to feed on abundant herrings and other fishes. The skull of *Pakicetus*, recently discovered in Pakistan, is little modified for hearing under water, and all remains found to date are in fluvial red beds associated with land mammals. *Pakicetus* provides the first direct evidence of an amphibious stage in the evolutionary transition of whales from land to sea. See page 403. [Watercolor by Karen Klitz, University of Michigan; reconstruction of postcranial skeleton is entirely hypothetical]

American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

# How neutron scattering entirely new polymer

**Exxon Chemical's David Lohse can observe the structure and behavior of polymer molecules.**



From easy-care fabrics to the nose cones of space vehicles, the long chain molecular structures called polymers have become, both literally and figuratively, woven into the fabric of 20th century life. Now, Exxon's David Lohse is exploring the characteristics of polymers to extend the potential of these remarkable materials.

## Polymer Blends

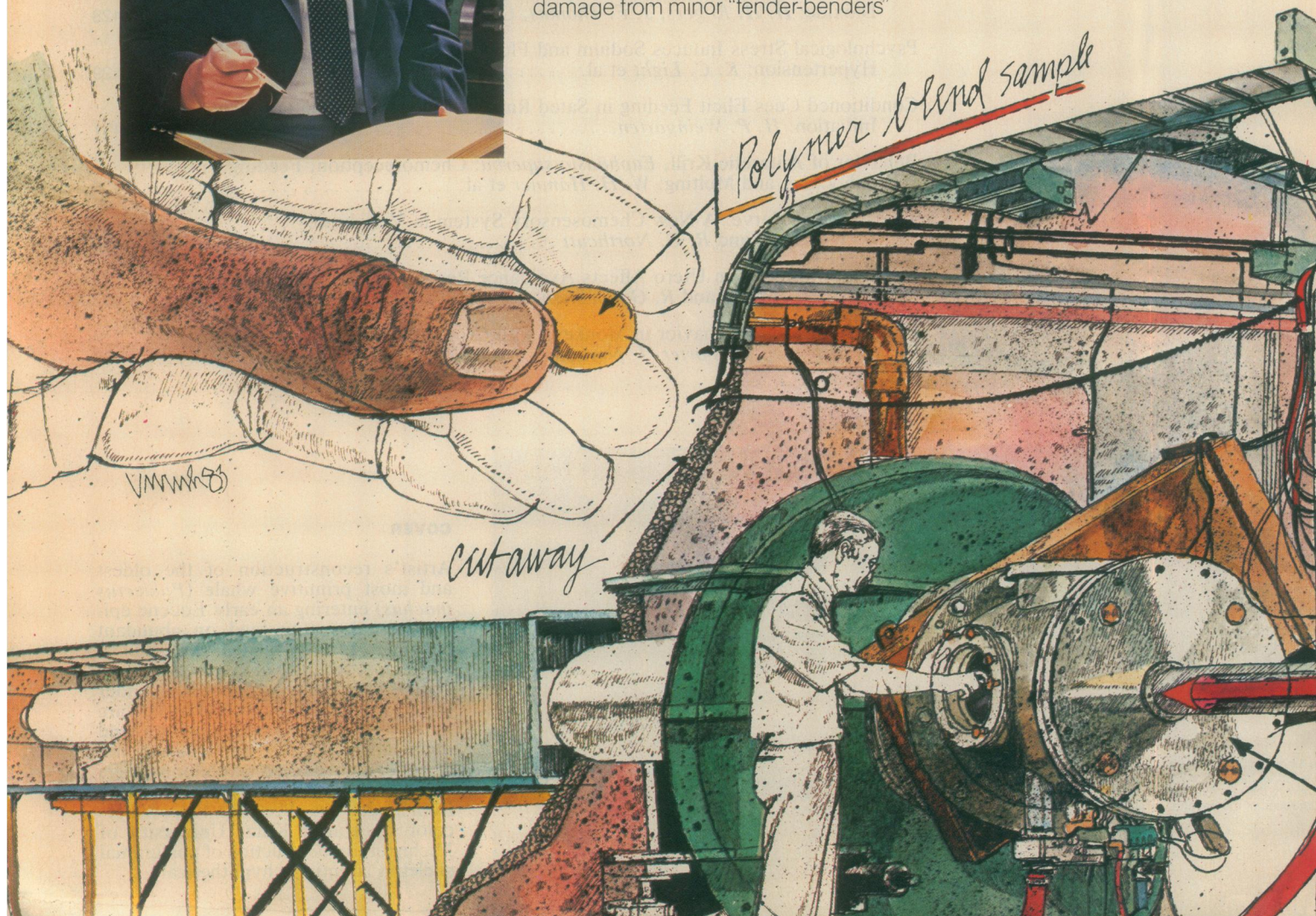
Combinations of polymer molecules can produce materials with better properties than those of the individual components. Exxon Chemical developed and is currently marketing, for example, a blend of plastic and synthetic rubber polymer material which has the formability of plastic and the elasticity of rubber. Used in automobile bumpers, this material helps reduce damage from minor "fender-benders"

by absorbing impact and then returning to its original shape

In order to develop more sophisticated blends, David Lohse and others in Exxon Chemical's Long Range Polymer Research Group are developing the use of Small Angle Neutron Scattering (SANS), a technique that subjects these molecules to detailed scrutiny.

## Small Angle Neutron Scattering

Conventional electron microscopy techniques allow scientists to study the structure of a polymer blend at room temperature. But the technique, used by Exxon at the National Center for Small Angle Scattering Research (Oak Ridge National Laboratory) and at the National Bureau of Standards in Mary-



# is helping Exxon create materials.

land, permits scientists to study polymer molecules at temperatures of 180°C or higher. This is crucial, since it requires high temperatures for the polymer to melt and be processed. In this melt state, the molecules are most mobile and the structure of the blends is formed.

## Seeing Polymer Structure by SANS

Small Angle Neutron Scattering involves the same basic physics as other types of scattering such as light or X ray. A well-collimated beam of neutrons is directed onto the sample. Some of the neutrons are scattered due to interactions with the atoms in the sample. The angle of the scatter is determined by the size of the molecular structures. Different structures can be labeled by substituting deuterium for hydrogen atoms, which allows a single polymer chain to be "seen" in its environment.

Using SANS, David Lohse can determine the dimensions not only of individual polymer molecules

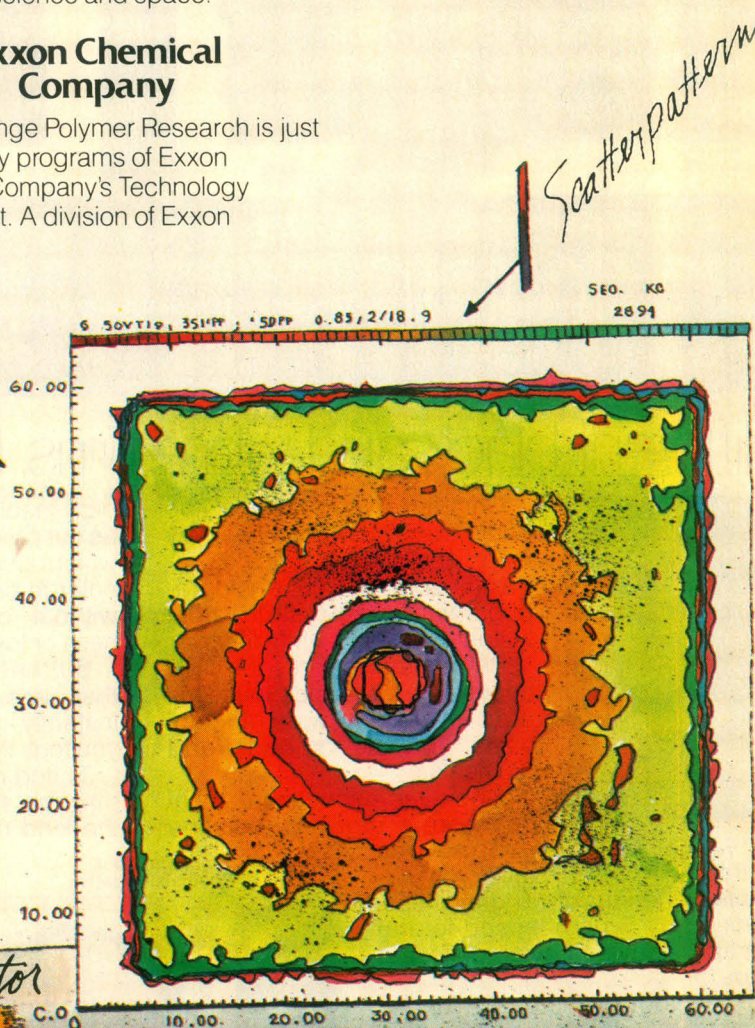
(10-100 angstroms) but also the dimensions of the phase domains of the blends (greater than 1000 angstroms). More importantly, while the blends are being heated, he can measure changes in the sizes of the individual molecules and the domains. It is these changes which determine the physical properties of the materials.

The information obtained using SANS will be used to develop new polymer blends that may find important commercial applications in the home, in industry, medicine, science and space.

## Exxon Chemical Company

Long Range Polymer Research is just one of many programs of Exxon Chemical Company's Technology Department. A division of Exxon

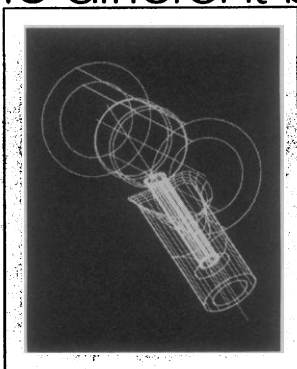
Corporation, Exxon Chemical is the world's ninth largest chemical company. Its research activities are diverse, with 2,000 scientists, researchers and technicians located in 10 countries working in advanced fields of catalysis and polymer science, and on ways to produce chemicals from new feedstocks or from more efficient processes.





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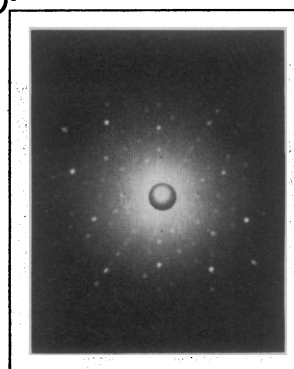
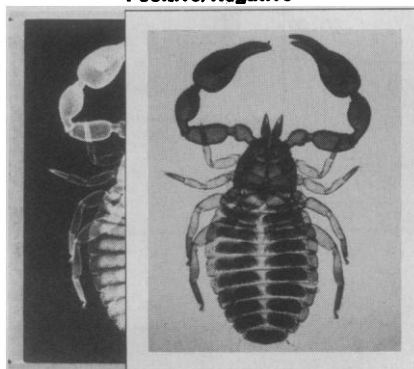
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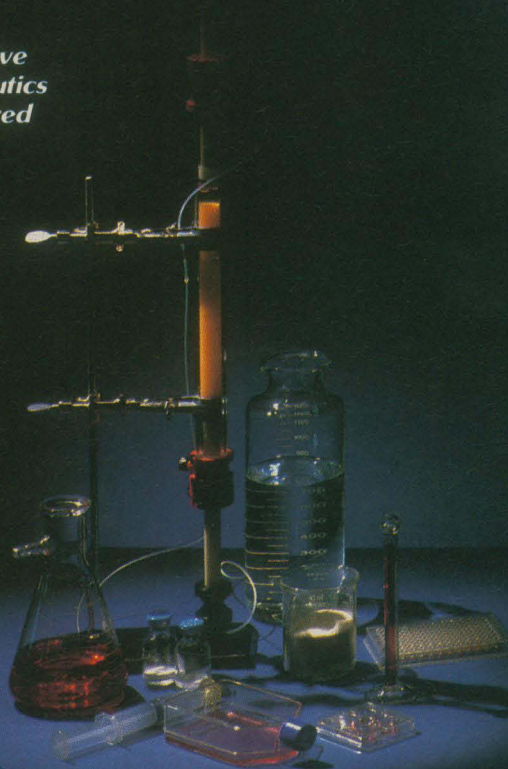
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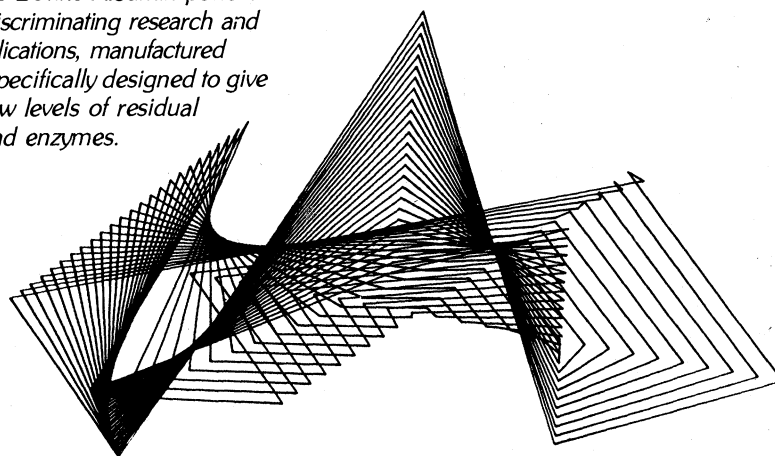
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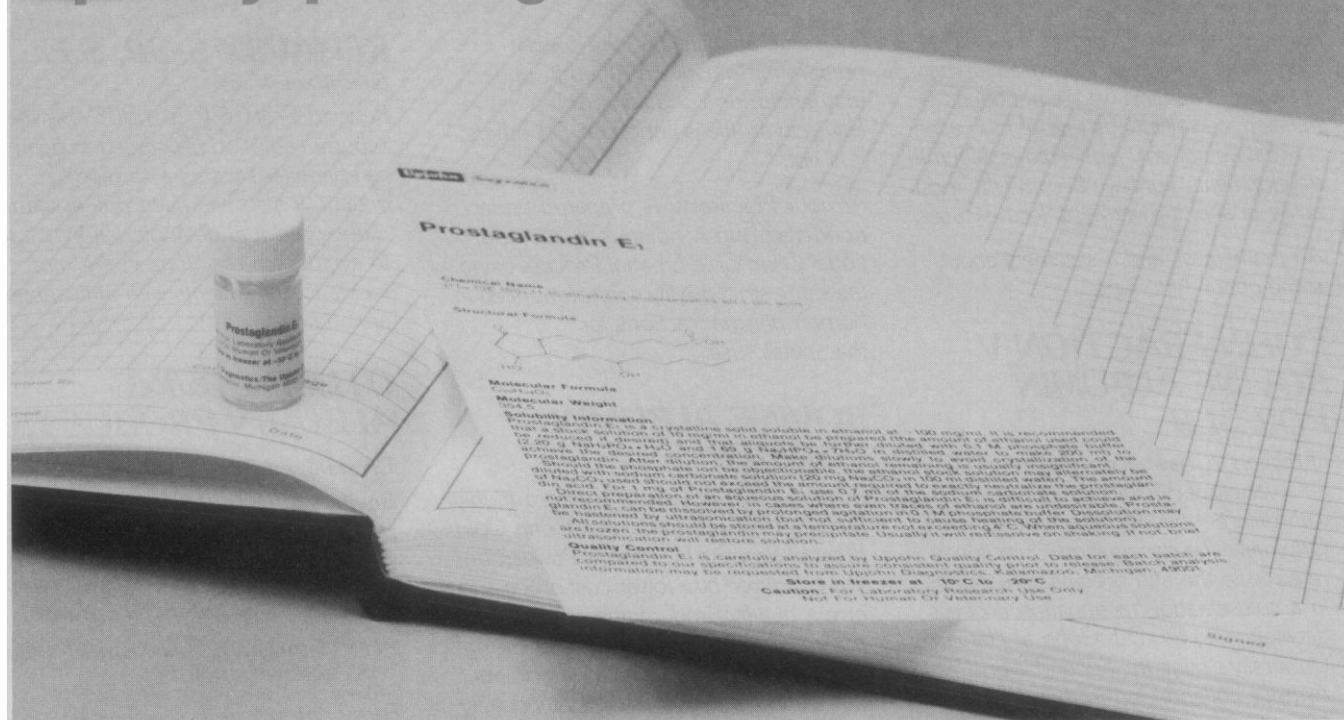


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| PGB <sub>2</sub> . . . . .                        | 135        | 16,16-dimethyl-PGE <sub>2</sub> . . . . .                         | 200        |
| PGD <sub>2</sub> . . . . .                        | 200        | 6,15-diketo-13,14-dihydro-<br>PGF <sub>1</sub> α . . . . .        | 200        |
| PGE <sub>1</sub> . . . . .                        | 135        | Thromboxane B <sub>2</sub> . . . . .                              | 400        |
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| 6-keto PGF <sub>1</sub> α . . . . .               | 200        |                                                                   |            |
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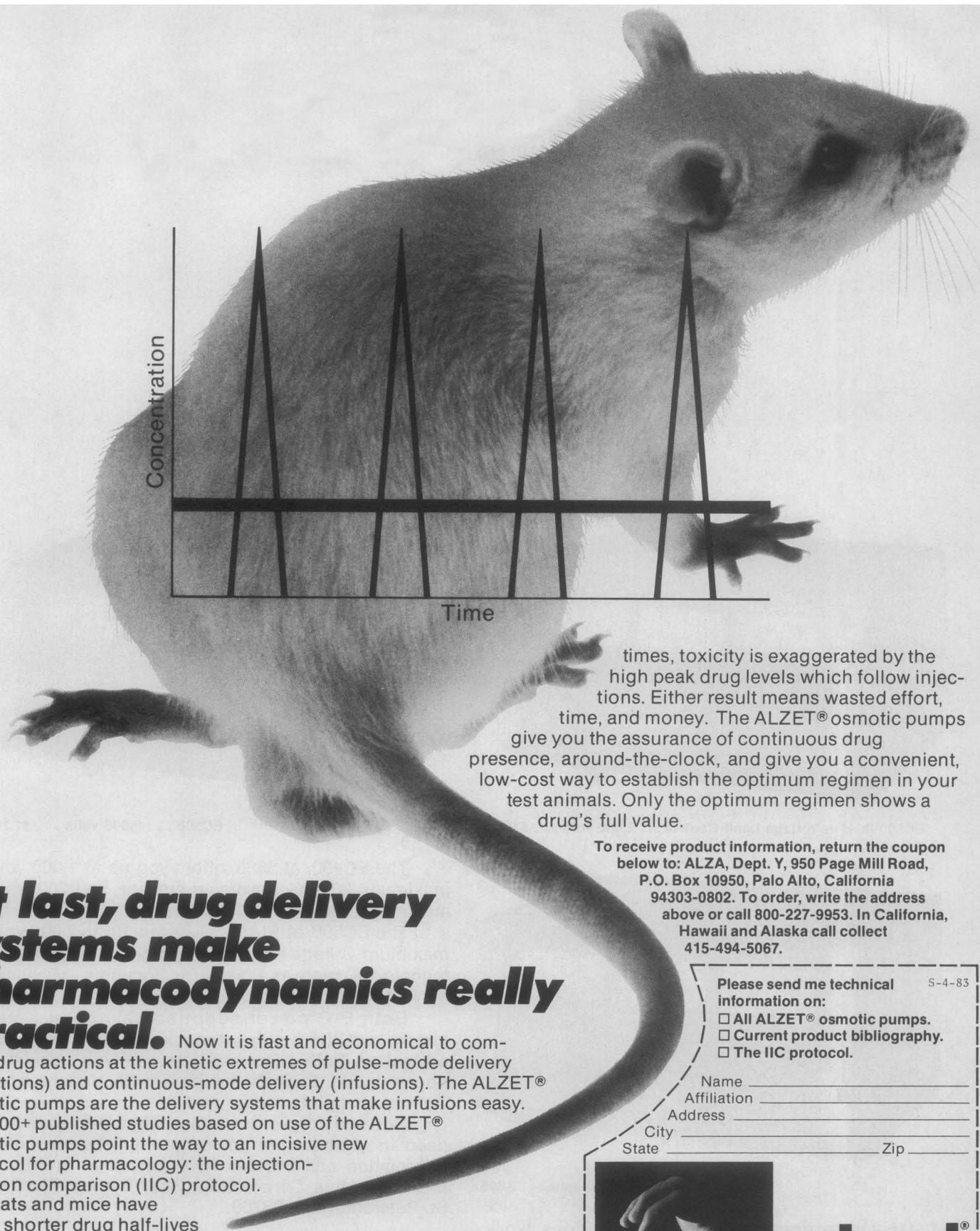
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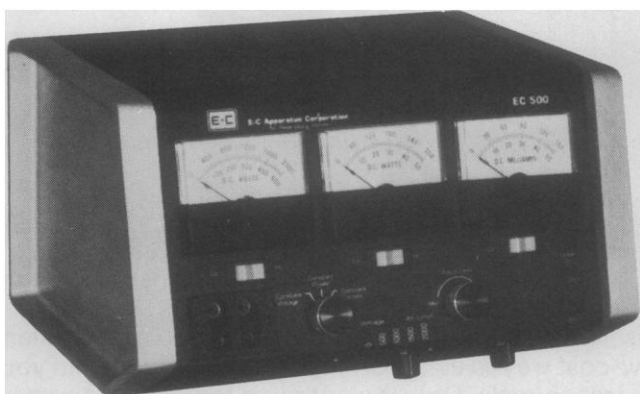
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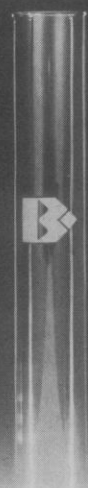
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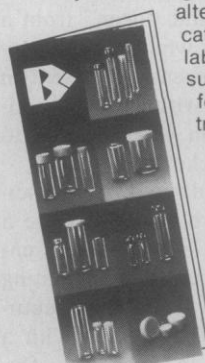
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Kudos to Gina Kolata for leaving the "honey" and the "dear" in her quotes from Decherd Turner of the University of Texas. Seeing just how those terms look in print is a more effective consciousness-raising device than a full article on sexism would have been.

PAUL G. CHAPIN

*Linguistics Program,  
National Science Foundation,  
Washington, D.C. 20550*

## Mormon Church Policy

In discussing the appointment of David Gardner to the position of president of the University of California (News and Comment, 18 Mar., p. 1301), R. Jeffrey Smith mentions that the Church of Jesus Christ of Latter-day Saints (Mormons) bars blacks from the priesthood; this is no longer the case.

ROGER G. CHAPMAN

*4535 Twilight Drive,  
Kearns, Utah 84118*

## Evolution Debate

I agree with Richard E. Grant (Letters, 11 Mar., p. 1170) that ancestor-descendant relationships cannot be objectively recognized in the fossil record (1). I suggest, however, that the debate over phyletic gradualism versus punctuated equilibrium be viewed as a debate over the distribution of rates of evolution; that is, over the tempo of evolution, not the mode of evolution as Grant suggests. Viewed in this light, there are at least three separate and distinct questions to be investigated: (i) whether the punctuational tempo is prevalent in the fossil record, as Gould and Eldredge suggest (2); (ii) whether punctuations are roughly equivalent to speciation events; and (iii) given that punctuations mark speciation events, whether speciation is the dominant mode of macroevolutionary change. Thus, the punctuational model of the tempo of evolution is distinct from, although perhaps related to, the previous models of differing modes of speciation cited by Grant ("saltation," "allopatric speciation"). Furthermore, the choice between gradualism and punctuated equilibrium need not "always . . . devolve to a matter of personal preference." Even if ancestor-descendant relationships cannot be objectively recognized, data obtained from the fossil record, such as origination and extinction rates of species, species dura-

tions, and aggregated changes in entire faunas (3) can be analyzed and may shed light on the question of the predominance of punctuationalism or gradualism. Likewise, study of the possible, and even most probable or common, mechanisms of evolution and speciation (for example, the genetics, molecular biology, and behavioral biology of extant organisms) may shed light on the question of the most common tempo of evolution.

ROBERT M. SCHOCH

*Department of Geology and Geophysics  
and Peabody Museum of Natural  
History, Yale University,  
New Haven, Connecticut 06511*

### References

1. R. M. Schoch, *Nature (London)* **299**, 490 (1982).
2. S. J. Gould and N. Eldredge, *Paleobiology* **3**, 115 (1977).
3. S. M. Stanley, *Macroevolution: Pattern and Process* (Freeman, San Francisco, 1979); S. J. Gould, *Science* **219**, 439 (1983).

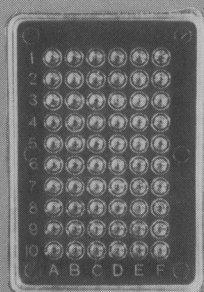
Intellectually it seems to me to be quite unnecessary to point out that arguments about modes of evolution are "philosophically intractable," but the contention that they are "pseudoquestions" is a "personal preference." One of my most memorable undergraduate experiences occurred when a curator at the British Museum of Natural History stopped by the library desk where I was researching a particularly erudite issue in coelenterate phylogeny, a topic to which he had made several contributions. In my youthful naïveté, I expressed frustration that we would never know the answer. Firmly but gently he pointed out that the significance and usefulness of debate in evolutionary matters lies, not in "getting the answer," but in the continual reevaluation of old data, the questioning of old ideas and assumptions, and the incorporation of new data. I happen to disagree with the punctuation model but, in confirmation of the sage advice I received a quarter of a century ago, I have gained a great deal from considering the arguments that have been posed pro and con. One should not miss the opportunity to explore and appreciate the latest blooming in the desert of dogma.

PAUL F. A. MADERSON

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Brooklyn College of the City  
University of New York,  
Brooklyn, New York 11210*

**Erratum:** In the report "Cloud droplet deposition in subalpine balsam fir forests: Hydrological and chemical inputs" by G. M. Lovett *et al.* (24 Dec., p. 1303), two errors appeared in Table 2 on page 1304. The cloud deposition of  $\text{SO}_4^{2-}$ , incorrectly reported as  $275.8 \text{ kg ha}^{-1} \text{ year}^{-1}$ , should have been  $137.9 \text{ kg ha}^{-1} \text{ year}^{-1}$ . The percentage of the sum contributed by clouds, reported as 81 for  $\text{SO}_4^{2-}$ , should have been 68.

Fig. 1 Photometrically determined charts of lymphocytotoxicity test.

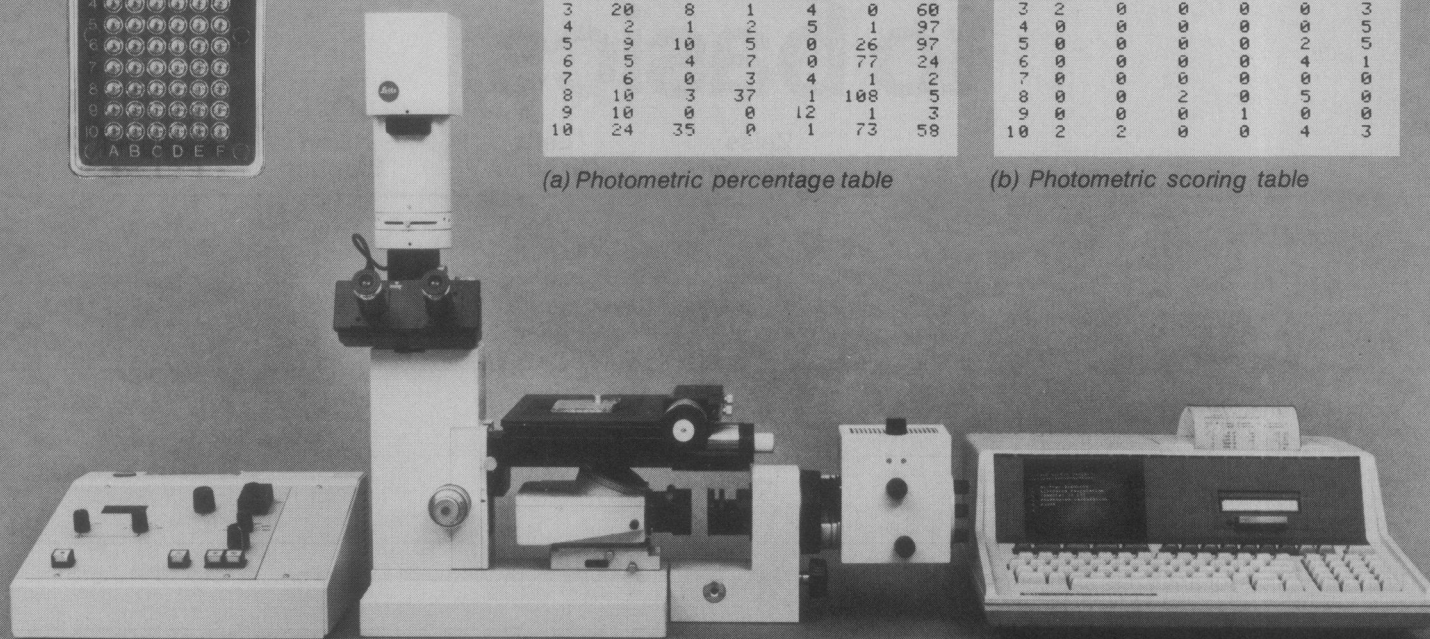


|    | A  | B   | C   | D  | E   | F  |
|----|----|-----|-----|----|-----|----|
| 1  | 47 | 101 | 103 | 3  | 0   | 85 |
| 2  | 57 | 67  | 106 | 1  | 0   | 97 |
| 3  | 20 | 8   | 1   | 4  | 0   | 60 |
| 4  | 2  | 1   | 2   | 5  | 1   | 97 |
| 5  | 9  | 10  | 5   | 0  | 26  | 97 |
| 6  | 5  | 4   | 7   | 0  | 77  | 24 |
| 7  | 6  | 0   | 3   | 4  | 1   | 2  |
| 8  | 10 | 3   | 37  | 1  | 108 | 5  |
| 9  | 10 | 0   | 0   | 12 | 1   | 3  |
| 10 | 24 | 35  | 0   | 1  | 73  | 58 |

(a) Photometric percentage table

|    | A | B | C | D | E | F |
|----|---|---|---|---|---|---|
| 1  | 3 | 5 | 5 | 0 | 0 | 5 |
| 2  | 3 | 4 | 5 | 0 | 0 | 5 |
| 3  | 2 | 0 | 0 | 0 | 0 | 3 |
| 4  | 0 | 0 | 0 | 0 | 0 | 5 |
| 5  | 0 | 0 | 0 | 0 | 2 | 5 |
| 6  | 0 | 0 | 0 | 0 | 4 | 1 |
| 7  | 0 | 0 | 0 | 0 | 0 | 0 |
| 8  | 0 | 0 | 2 | 0 | 5 | 0 |
| 9  | 0 | 0 | 0 | 1 | 0 | 0 |
| 10 | 2 | 2 | 0 | 0 | 4 | 3 |

(b) Photometric scoring table



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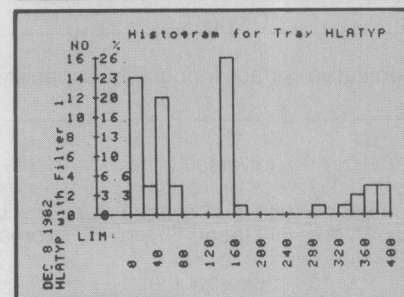
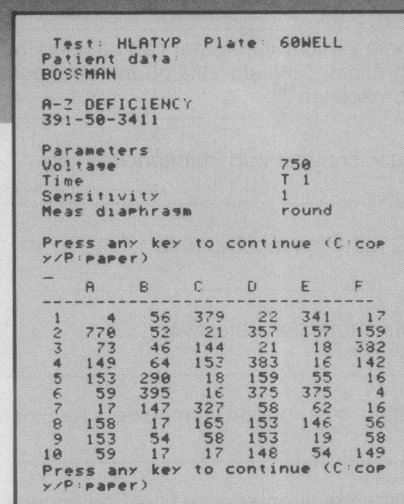


Fig. 2 Statistical analysis of data via a histogram.

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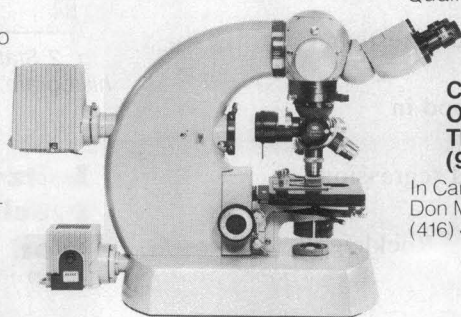
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## Industry's Other Contribution to Education

There has been much discussion of the quality of precollege science and mathematics education in the United States and of its relation to the nation's economy and security and to the quality of life. The general consensus is that substantial immediate improvement is necessary and that all sectors should become involved in this effort. Industry itself, as well as government and the nonprofit sectors, might do well to view industry as a major partner in problem definition and resolution, rather than primarily as a potential funding source. A valuable asset of industry is the technical capabilities of its current and retired scientists and engineers.

Recently, the American Chemical Society (ACS) sponsored a conference on Using Industrial Chemists for the Enrichment of High School Chemistry and Science Education. One point that became apparent at the conference is that a number of companies already have in place local programs to supplement secondary education.

Phillips Petroleum Company, in Bartlesville, Oklahoma, and the local school system sponsor a Science Teacher's Workshop for precollege science teachers from more than 100 school districts in Oklahoma and southern Kansas. The program is designed to rekindle the teachers' interest in science and to assist them in developing new classroom techniques for making science interesting for students. A day-long workshop is held, including a "science circus" of experiments for the general community. The last such show drew larger crowds than any recent local athletic event.

The Science Consultants Program, sponsored by Xerox Corporation, brings scientists and engineers into elementary schools twice a month to give demonstrations and provide students with hands-on experience in such areas as chemistry, optics, and probability. In 12 years the program has reached more than 10,000 fourth through sixth graders.

The Chemical Industry Council of New Jersey has developed programs that draw on the intellectual resources of the chemical industry. Each year the Chemical Caravan brings 200 students to a local university, where faculty members and industrial personnel present programs on the applications of chemistry and on activities in industry. Chemical Pilgrimage, a week-long teachers' workshop, mixes classroom instruction with field trips to industrial plants and laboratories.

The PRISM Program, developed by the Industrial Management Council (IMC) of Rochester, is aimed at increasing the number and quality of students who enter science and engineering. The program involves curriculum development, teacher training programs and parent awareness sessions, and extensive use of role models from industry to motivate students. It begins in the seventh grade and continues through the twelfth. The IMC is an association of 150 manufacturing firms that have made a 10-year financial commitment for a permanent staff which includes professionals in curriculum development and community relations.

A second point made at the ACS meeting is the importance of summer employment in industry for high school science teachers. These positions acquaint teachers with applications of chemistry and the many activities of industry, as well as giving those in industry closer contact with and a better understanding of the educational community. The financial support to teachers is also important. The ACS Corporation Associates have taken some steps to encourage more such opportunities for teachers. As the economy improves, it is hoped that more positions will become available.

Joint efforts of the industrial and educational communities are capable of enriching secondary education in science and mathematics. They are to be encouraged.—F. BASOLO, *President, American Chemical Society*, and Morrison Professor of Chemistry, Northwestern University, Evanston, Illinois 60201, and E. WASSERMAN, *Chairman, ACS Committee on Corporation Associates, American Chemical Society, Washington, D.C. 20036*

# Boehringer Ingelheim Research Awards

Boehringer Ingelheim International GmbH, Ingelheim am Rhein, is offering 3 awards for the advancement of research. These awards will be granted for previously unpublished results of research on the **subclassification of muscarinic acetylcholine receptors and their functional mechanism in the autonomic nervous system.**

The awards will be as follows:

1st prize: DM 30,000.–  
2nd prize: DM 20,000.–  
3rd prize: DM 10,000.–

Only previously unpublished, original studies may be submitted. The final date for submission is 15.02.84.

The competition is open to scientists working in this field who are not employed by Boehringer Ingelheim or any of its affiliated or associated companies.

The decision whether an award shall be granted shall be made by an international jury of scientists:

Sir Arnold Burgen, Cambridge  
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Basil Hirschowitz, Birmingham/Alabama  
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